The 'explorer': Gerhard's work on magnetic tape

El 'explorador': Gerhard y su trabajo con cintas magnéticas

Monty Adkins•

Resumen

Roberto Gerhard fue un pionero de la música electrónica en Inglaterra, autor de más de veinte obras significativas, entre las que se encuentran conciertos, obras de teatro y piezas para radio desde 1954. Sin embargo, por diversas razones políticas, culturales y personales, su música electrónica no ha sido, ni publicada, ni apenas divulgada hasta el momento. La música electrónica de Gerhard es uno de los repositorios más ricos para comprender el desarrollo de la técnica compositiva tardía del compositor y el desarrollo temprano de la música electrónica en Reino Unido. El presente escrito presenta el resumen de una década de trabajo dirigida por el autor del artículo y realizada por los investigadores Carlos Duque y Gregorio Karman en el archivo Roberto Gerhard de la Biblioteca de la Universidad de Cambridge (CUL) de Inglaterra. Este archivo alberga libros, manuscritos, cuadernos de notas y, lo más importante para el presente artículo, más de 600 cintas magnéticas del compositor. Aunque algunas de estas cintas contienen grabaciones de obras compuestas por otros autores, la mayoría pertenecen a composiciones instrumentales y electrónicas de Gerhard. El artículo abarca aspectos relacionados con sus métodos compositivos, su estudio o su relación con el Taller Radiofónico de la BBC. El escrito se basa en publicaciones previas del autor del artículo, concretamente *In Search of a Third Way*[1] y *Claustrophilia: A Musical Gift from Gerhard to John Cage*[2]. Por otra parte, el artículo proporciona

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[1] Monty Adkins, 'In Search of a 'Third Way", in *The Roberto Gerhard Companion*, ed. by Monty Adkins and Michael Russ (Aldershot: Ashgate, 2013).

[2] Carlos Duque and Monty Adkins, 'Claustrophilia: A Musical Gift from Roberto Gerhard to John Cage', in *Essays on Roberto Gerhard*, ed. by Monty Adkins and Michael Russ (Cambridge Scholars Press, 2017), 261-278.

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una lista revisada y actualizada de las obras electrónicas del compositor existentes, basada en la investigación realizada en el archivo de cintas.

Palabras clave: Gerhard; música de cinta; música electrónica; composición de sonido; vanguardia; catálogo de música electrónica.

Abstract

Roberto Gerhard was a pioneer of electronic music in England creating over twenty substantial concert, theatre and radio works from 1954. However, for various political, cultural and personal reasons Gerhard's electronic music has not been published or widely disseminated. Gerhard's electronic music is one of the richest repositories for understanding the development of the composer's late compositional technique as well as the early development of electronic music in the UK. This article presents the summation of a decade of work produced alongside researchers Dr Carlos Duque and Dr Gregorio Karman on the Roberto Gerhard archive held at the Cambridge University Library (CUL), England. Gerhard's archive at the CUL contains his books, letters, manuscripts, notebooks and most pertinent to this article, over 600 magnetic tapes. Whilst some of these tapes contain recordings of works by other composers, most pertain to Gerhard's instrumental and electronic compositions. The article covers Gerhard's working methods, his studio, his relationship to the BBC Radiophonic Workshop. The article draws on previous publications by the author, notably: *In Search of a 'Third Way'* and *Claustrophilia: A Musical Gift from Gerhard to John Cage*. In addition, the article provides a newly revised list of the composer's extant electronic works based on research in the tape archive.

Keywords: Gerhard; tape music; electronic music; sound composition; avant-garde; electronic music catalogue.

I. Gerhard in context

"This is really the music of the age of the hydrogen bomb"[3], so wrote Nicole Hirsch in *France-Soir* on 4 December 1954, following the premiere of Edgard Varèse's *Déserts*. Varèse's work, one of the first large-scale works for ensemble with tape interpolations, was seen as the apotheosis of the composer's experiments with organized sound. Howard Taubman wrote that the listeners heard, "rumbles and buzzing, beeps and blurps, metallic growls and a kind of mechanical keening. There were combinations of noise like dentists' drills, riveting, trains going over a rusty bridge, a monstrous bowling alley or rush-hour traffic gone wild"[4]. In the dawning era of the technological sublime, Varèse and other composers working with electronics became emblematic of the musician in the atomic age. It was against this backdrop that Roberto Gerhard made his own first steps into what he came to term *sound composition*. Although figures such as Pierre

[3] Nicole Hirsch, Review of *Déserts*, *France-Soir* (4 December 1954): 8.

[4] Harold Taubman, 'Music: No Sound Like a New Sound', *The New York Times*, 1 December 1954, 45.

Schaeffer, Pierre Henry, Karlheinz Stockhausen, Iannis Xenakis, Luciano Berio and Bruno Maderna are, along with Varèse, the most often cited figures of post-war electronic music, the resurgence of interest in this period has seen other important figures such as Daphne Oram, Else Marie Pade and Roberto Gerhard being more widely recognized for their pioneering work. Hugh Davies writes that:

> It is, however, Varèse, with only two major and one minor electronic works, who most comes to mind in comparison with Gerhard. Although their musical personalities were very different (Gerhard refined, urbane, and sophisticated, Varèse rough-hewn, uncompromising, and primordial), they had a strong common feature: their music during the 1950's and 1960's, doubtless enriched in part by their experiences in the new tape medium, grew more powerful and filled with energy as they grew older in years.[5]

Unlike Varèse and other early leading figures, Gerhard's exposure to the new technology was not via a state-sponsored studio and composing concert works, but rather through the creation of incidental music in his own private studio for theatre. In 1946–7 Gerhard wrote the incidental music for the Shakespeare Memorial Theatre's production of *Romeo and Juliet*. The instrumental cues were recorded on to disk and played back during the performance on a Panatrope, a piece of equipment commonly used in theatres at the time, often comprising two turntables side by side. It was this experience and the potential it offered for a more imaginative use of sound, coupled with Gerhard's burgeoning interest in electronic music, that led him to create a series of sound scores for theatre and later radio and film productions.

Gerhard's pioneering achievements in the mid-1950s can be understood when put in the context of nascent European electronic music. The first *musique concrète* work, the *Étude aux chemins de fer*, was produced by Pierre Schaeffer in 1948 at the Club d'Essai, RTF (later INA-GRM). In 1950 Schaeffer and his then assistant Pierre Henry produced their first substantial work in the genre, the collaborative *Symphonie pour un homme seul*. The WDR studio opened in 1953, where Stockhausen produced his first experiments with Elektronische Musik, the *Studie I* & *II* (1953 and 1954). The first acknowledged work that combined instruments and electronic sounds was Maderna's *Musica su due dimensioni* produced in Bonn, in 1952 for flute, cymbal and electronic tape. One of the most famous larger early works incorporating electronics was Varèse's *Déserts* (1954) for ensemble and tape. Varèse's work alternates rather than integrates the instruments and electronics, having three tape 'interpolations'. It was in the same year, 1954, that Gerhard completed his first ensemble and tape work, the incidental music for Bridget Boland's play, *The Prisoner*.

By the time Gerhard came to compose music for George Devine's 1955 production of *King Lear*, with designs by Isamu Noguchi and John Gielgud in the title role, the instrumental cues for previous productions had been predominantly replaced by electronic ones. Like *Déserts*, Gerhard's

[5] Hugh Davies, 'The Electronic Music', *Tempo*, n. s., 139 (1981): 36.

music provoked strong responses. The sound score for the storm scene (*King Lear*, Act III, Scene 2) was likened to, "London Airport in full flight"[6], while another reviewer claimed that, "storms in this Never-Never Land sound exactly like jet-engines"[7]. Such was the critical furore surrounding the production that when it reached London all the performances sold out. Despite the similarity of the critical response to their work, and those noted by Hugh Davies, Gerhard and Varèse differed in their aesthetic approach to magnetic tape sound composition. Whereas Varèse's vision of electronic sound was utopian, offering a, "liberation from the arbitrary, paralyzing tempered system" and, "new harmonic splendours obtainable from the use of sub-harmonic combinations now impossible"[8], Gerhard viewed the new medium as offering an extension to, rather than usurping, the sound palette of the orchestra. In addition, unlike his European counterparts who were continuing to produce works primarily within the concert music tradition, Gerhard was concerned with the potential of the medium for commercial music for radio, theatre, and film. This was a characteristic shared by other pioneers in Britain at the time including Tristram Cary, who produced experimental works for radio and Ernest Berk who created an extensive oeuvre of over 200 electronic works for dance. Gerhard's work with sound on magnetic tape as well as his other compositional innovations led him to consider himself an explorer of sound rather than someone who merely experimented with it. In his writings from 1930, Gerhard is as prophetic regarding the future of music as Cage and Varèse's were to be later in the decade. Gerhard wrote that:

> Adding 'noises' to music, on the other hand opens doors to a distinctive cinephonic genre […] we should accept that there is all the immense repertoire of acoustic impressions of an 'extra-musical' order that attack our ears all the time, and constitutes an almost unexplored territory, untested as to its aesthetic value to the musician.[9]

Although Gerhard writes in *Concrete Music and Electronic Sound Composition* that he approached "the electronic medium strictly as a sideline"[10], the importance of this work and its impact on his instrumental composition has thus far received scant academic interest with much of the focus continuing to be on Gerhard's personal application of serial technique in the works from the last decade of his life. Gerhard himself maintained that working in the electronic medium had resulted in a "[…] number of far-reaching morphological changes in the manner of organizing sound and it

[6] Northern Daily Echo, 28 July 1955.

[7] Robert Wraight, Review of *King Lear*, *Star* (27 July 1955).

[8] Edgard Varèse, 'Music as an Art-Science', in *Contemporary Composers on Contemporary Music*, ed. by Elliot Schwartz and Barney Childs (New York, 1967).

[9] Roberto Gerhard, 'Music and Film (1930)' in *Gerhard on music: selected writings*, ed. by Meirion Bowen (Aldershot: Ashgate, 2000), 79-80.

[10] Roberto Gerhard, 'Concrete music and electronic sound composition (1959)', *Gerhard on music. Selected writings*, ed. by Meirion Bowen (Aldershot: Ashgate, 2000), 180.

seems to me that these changes are bound to affect methods of composition in the traditional field of instrumental composition as well"[11].

It is evident in examining Gerhard's notebooks that his thinking developed from pitch organisation to include textural morphology, spatial thinking, as well as the development and perceptual relationships between 'families' of sound-types. These ideas were applicable to both his electronic and later instrumental works.[12]

II. Gerhard sources

Whilst Schaeffer, Stockhausen and their respective colleagues at the Groupe de Recherches Musicales (GRM) and Westdeutscher Rundfunk (WDR) studios propagated concert electronic music and produced significant theoretical texts on their work and the new medium, Gerhard was a more practical composer. Gerhard's experiments were carried out in the public glare initially through composing incidental music such as *The Prisoner* (1954), *King Lear* (1955) and *Pericles* (1958), and his thinking explained in radio talks such as *Audiomobiles* for the BBC Third Programme (1960).

One of the disadvantages of not working permanently in a major radio or state-funded studio meant that there was no archival administrative structure to preserve Gerhard's electronic works. Apart from the electronic component of the Symphony No.3, *'Collages'* neither of the publishers of Gerhard's instrumental music (Boosey & Hawkes and Oxford University Press) hold copies of his electronic works, or his incidental works incorporating electronics. The major repository of Gerhard's unpublished electronic music is the archive held in the Cambridge University Library.[13] A small number of recordings and cues of theatrical productions are held at the British Sound Archive and the Archive of the Royal Shakespeare Company.

During the 1950s and 1960s, Gerhard amassed a significant magnetic tape collection in his studio. This collection comprises a major repository of historical sound recordings of Gerhard's own work in which all areas of his compositional activity are represented. Following Gerhard's death in 1970, Poldi Gerhard continued to play back the recordings, helping to identify their contents with her own annotations and comments. After her own death in February 1994, the studio was dismantled and the tapes were deposited at the Cambridge University Library with the rest of Gerhard's archive. In

[11] *Ibid.* 9, 180.

[12] A rare example is Carlos Duque, 'The Influence of Electronic Music on Roberto Gerhard's Symphony No.4 'New York", *The Roberto Gerhard Companion*, ed. by Monty Adkins and Michael Russ (Aldershot: Ashgate, 2013).

[13] The cataloguing of the tape collection was part of Adkins' Arts and Humanities Research Council funded 'The Electronic Music of Roberto Gerhard'. The format of the catalogue is: CUL (Cambridge University Library) OR01 (open reel collection no. 1) 0254 (item no. 254) 01 (first spool – there are boxes with up to four small spools in, and one spike with ten reels on it.).

2008 the inventory of the tape collection took place, and later that year, Gerhard's archive was donated to the Cambridge University Library. This archive is tantalizingly incomplete. Four boxes, containing an undisclosed number of tapes were borrowed by David Drew, a close colleague of Gerhard's, in 1990 from Dr. Rosemary Summers, the executor of the Gerhard estate. At present their whereabouts and contents are unknown. Additional tapes surfaced in 2017 after Hilary Tann donated a chest of materials pertaining to Gerhard to Rachel Mann, including scores, typed analyses (by Tann and Susan Bradshaw) as well as further tapes.[14]

A preliminary assessment of Gerhard's Tape Archive was compiled by Gregorio Karman in 2007-2008.[15] It provided an overview of the collection, and examined the state of some of the tapes some of which are over sixty years old. In 2012, an Arts and Humanities Research Council Project[16] enabled all of the tapes in the Cambridge University Library archive to be digitized and a complete catalogue of the archive was produced.[17] During this stage, the annotations on boxes and other materials found on the tape containers were documented and the general state of the collection was assessed. Different issues and problems with playing the tapes were identified including on-going chemical and other degradation processes (see figure 1). In addition, a number of tapes were found to be incorrectly labeled or misplaced, as well as many boxes being empty.[18]

[14] These twenty tapes were digitised by the author and Rachel E. Mitchell in July 2018. They contain both early works by Tann as well as recordings of Gerhard's compositions. They do not contain previously unknown electronic works or working materials.

[15] See Gregorio Karman, 'Roberto Gerhard's Tape Collection', http://info.ggkarman.de/sites/default/files/pdf/Karman_Report_2008_Cambridge%20University%20Library.pdf.

[16] Monty Adkins, 'The Electronic Music of Roberto Gerhard', funded by the Art and Humanities Research Council 2012 with co-researchers Carlos Duque and Gregorio Karman.

[17] See Gregorio Karman, 'Annotated Catalogue of the of Roberto Gerhard Tape Collection', .

[18] All tapes have a single gauge of ¼ inch, and comprise a variety of track formats including: full-track mono, half-track mono, half-track stereo, or quarter-track stereo. Digital transfer of the tapes involves taking care of irregular or loose winds, mechanical deterioration of tape headers, or dry splices. However, the majority of the tapes in the collection remain in good playing condition.

Figure 1. A tape affected by severe deformation

For Gerhard's electronic works, the magnetic tape collection at the Cambridge University Library therefore remains the primary source. Over half of the tapes in the collection are directly related to Gerhard's sound compositions, the rest comprising a considerable number of recordings of his own instrumental works and a library of music by his contemporaries (including Schoenberg, Webern, Berg, Bartok, Stockhausen and Nono). The tape archive contains 610 entries. This includes individual tapes in boxes, multiple tapes in boxes (such as the individual cues for Symphony No. 3 '*Collages*'), as well as some empty tape containers. The tapes pertaining to Gerhard's electronic music contain all different stages of his production methods, from initial source recordings to what the composer termed 'multilevel compound mixes', and completed compositions. This in itself offers a unique perspective on Gerhard's working methods and is distinctly different with regard to his instrumental works for which he left very few sketches, preferring to destroy them and leave only the fair copy of the autograph score.

III. Gerhard's studio & the BBC radiophonic workshop

According to the International Electronic Music Catalogue (1968) compiled by Hugh Davies, the first informal activities in Gerhard's private permanent studio are listed as having been initiated in 1954. The official foundation of what Gerhard termed his 'Home Office' can be dated to 1958, coinciding with the composer's moving in to 14 Madingley Road, Cambridge on 1 October 1958.

Gerhard's close friend, Joaquim Homs, visited Cambridge in September 1959 and provides a first-hand impression of the studio one year after the Gerhard's move to Madingley Road:

> The study was ample and, at the back, near the window that lead to the garden, there was a grand piano […] By now Gerhard had constructed an electronic laboratory in his study with the aid of the Radiophonic Workshop, and it was full of tape-loops of concrete music.[19]

This passage, and a further extract from this recollection from the 1954-1959 section of Homs' book is not unproblematic. Homs writes:

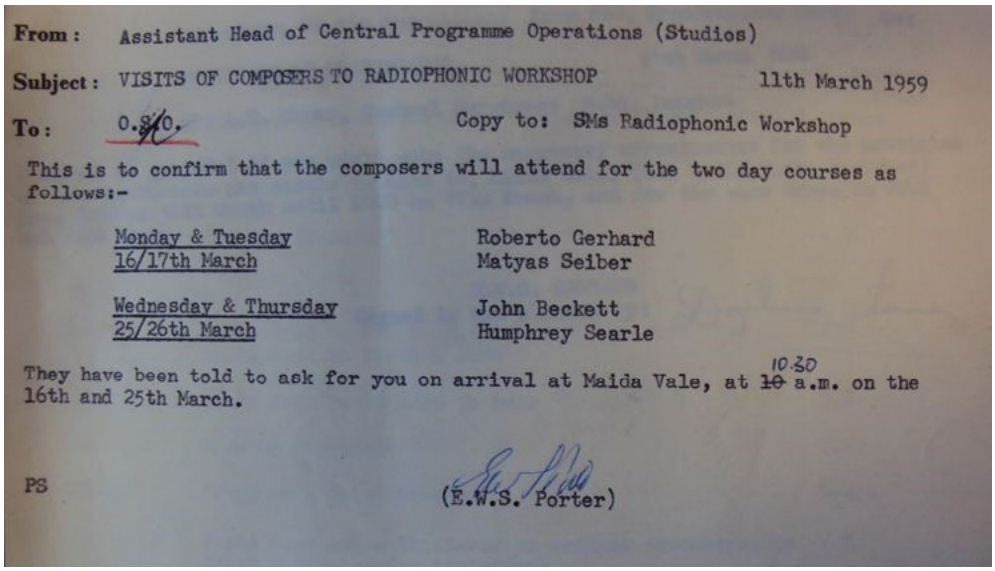
> It was a memorable trip, so much that we extended it for a few more days than we had planned. We managed in addition to attend two film documentaries with concrete music by Gerhard: *Four Audiomobiles* (the second one about DNA being especially interesting).[20]

Whilst the description of the studio may be accurate there are other discrepancies that are harder to resolve. There is no evidence that Gerhard received any support in establishing his studio from the BBC Radiophonic Workshop, itself only established in April 1958.[21] In fact, a recording of Poldi Gerhard contained in the tape archive at the Cambridge University Library indicates that much of the additional equipment in the new 'Home Office' was acquired on hire-purchase and stretched the Gerhard's personal finances. Furthermore, though Gerhard's studio was already established, it was not until 11 March 1959 that he received notification that he was one of four composers selected to be invited to the Radiophonic Workshop for their first two-day course at Maida Vale (see figure 2) introducing composers to the facilities there. In fact, it was only Gerhard who regularly returned to the Workshop from 1959-1964 to work on BBC Radio commissions. He seems to have occupied a unique position in this regard.

[19] Joaquim Homs, *Robert Gerhard and his Music*, ed. by Meirion Bowen (The Anglo-Catalan Society, 2000), 60-61.

[20] Homs, *Roberto Gerhard*…, 60.

[21] The Radiophonic Workshop was agreed on paper in 1957 and established and opened on 1 April 1958 by Daphne Oram with Desmond Briscoe as Senior Studio Manager and Dick Mills as Technical Assistant.



From: Assistant Head of Central Programme Operations (Studios)

Subject: VISITS OF COMPOSERS TO RADIOPHONIC WORKSHOP 11th March 1959

To: O.S.O. Copy to: SMs Radiophonic Workshop

This is to confirm that the composers will attend for the two day courses as follows:-

Monday & Tuesday 16/17th March	Roberto Gerhard Matyas Seiber
Wednesday & Thursday 25/26th March	John Beckett Humphrey Searle

They have been told to ask for you on arrival at Maida Vale, at ~~10~~ 10.30 a.m. on the 16th and 25th March.

PS

(E.W.S. Porter)

Figure 2. Letter confirming Gerhard's place on the 1959 two-day course at the BBC Radiophonic Workshop

Further issues raised by Homs' recollections pertain to the two film documentaries and *Four Audiomobiles*. Whilst the two film documentaries can be accounted for, presumably *All Aboard* and the second, a commission from Unilever entitled *Your Skin* both created in 1958, the reference to the *Four Audiomobiles* are more problematic. Although these will be discussed later in relation to Gerhard's completed sound compositions, it is worth noting that the parenthetical reference to 'the second one about DNA being especially interesting' is most likely a mis-remembering on Homs part, or a conflation of memories from a later visit, as all other evidence, including letters, performance dates, reminiscences by Hans Boye and Gerhard's own notebooks all point to the 'DNA' piece as being *Audiomobiles 2: 'DNA in Reflection'* completed in 1963, some four years later. Although Gerhard produced a short work included in his 1959 Third Programme talk *Audiomobiles*, the *Audiomobile 'in the manner of Goya'*, there is no evidence either in the tape archive that he completed four autonomous tape works entitled *Four Audiomobiles* in 1958-59.

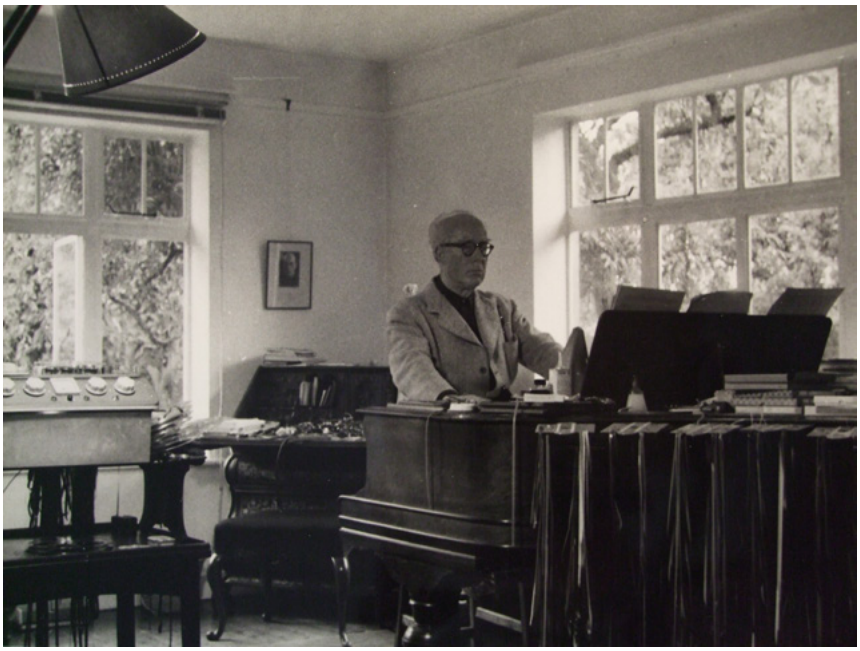
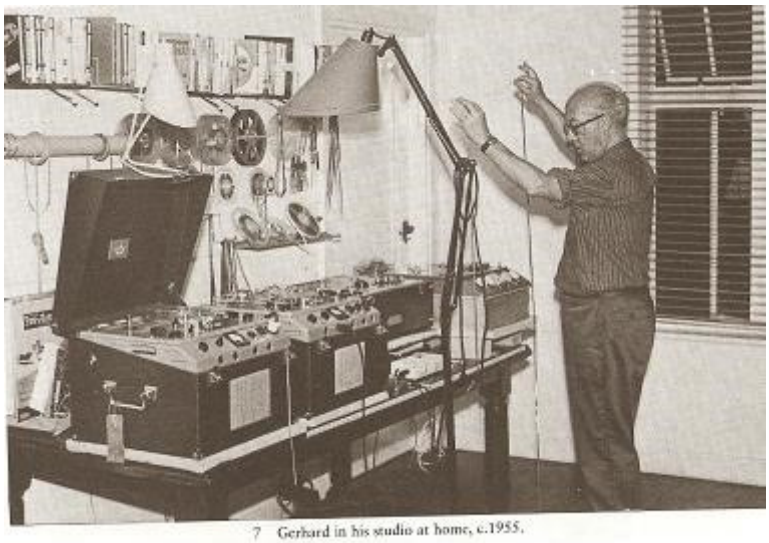


Figure 3. Tape loops attached to Gerhard's piano

A series of undated black and white portraits of Gerhard in his study[22], perhaps simultaneous to Homs' visit with his wife, present varied perspectives of four open-reel tape recorders, together with numerous reels on shelves and an unusual image of hundreds of tape splices fixed on hooks to the lid of the grand piano (see figure 3). Gerhard maintained that:

> I've always been working with shoe-string equipment in electronics. It comprises: one microphone, five tape recorders, a track mixer of five channels, and that is all. I've never used oscillators or white noise generators. I'm allergic to sine tones. When I needed certain types of white noise, the BBC Radiophonic Workshop has kindly provided lengths of tape. I would have been happy to have been able to install envelope control. I could not afford it. But I have been able to develop some measure of envelope modification by a manual means. I have no visual or audio monitoring. I wish I could have had some modulators. No automatic switching devices. On occasion their absence has been very trying.[23]

[22] Envelope 1. Prints Fl & B946 + Negs. Roberto Gerhard Collection. Cambridge University Library.
[23] Gerhard quoted in Irena Cholij, 'Electronic Music and King Lear', *Tempo*, n. s., 198 (1996): 30.



7 Gerhard in his studio at home, c.1955.

Figure 4. Gerhard working in his 'Home Office', c. 1959

A closer investigation of these photographs (see figures 3 and 4) supplies further information about the recording equipment in Gerhard's studio (1958-59). There were two EMI TR50[24] mono recorders, an early Vortexion WVA[25] mono recorder and a Ferrograph Series 66 mono recorder.[26] In the early 1960s, Gerhard incorporated a new Ferrograph Series 4[27] mono recorder and a five-channel mixer[28]

[24] A robust machine employed in many professional studios in the early days of tape music. It was advertised by EMI as being "Used by the experts in the world's leading recording and broadcasting organizations. A transportable high fidelity tape recorder designed for professional use". It recorded full-track format (i.e. recording only in one direction), was capable of tape speeds of 15 ips and 7.5 ips (a model with 7.5 ips and 3 ¾ ips was also available), and provided separate microphone and line inputs. The take-up reel rotated clockwise, resulting in a tape wound with the oxide coating facing out rather than inwards, in order to reduce print-through. Few other machines employed this method. It was introduced in 1951.

[25] Mono recorder with Wearite (Ferrograph) deck. There were full and half-track versions. The WVA model had two heads (no off-tape monitoring). The model was introduced c.1951-1952.

[26] The Ferrograph series 66 chassis model is a mono half-track recorder with two selectable speeds (15 / 7.5 i.p.s. or 7.5 i.p.s. / 3.75 i.p.s.), based on the standard Ferrograph series 3-deck mechanism. It did not include a power output stage, so it had to be connected to an external amplifier. Aimed at Hi-Fi enthusiasts, it was designed to be incorporated into a cabinet alongside the Hi-Fi system: an amplifier, turntable and radio tuner. First introduced in 1957.

[27] Ferrograph Series 4, mono, half-track with two selectable speeds (15 / 7.5 i.p.s. or 7.5 i.p.s. / 3.75 i.p.s.). Introduced in 1959 as a successor of Series 3. The main changes were a more ergonomically designed control knob and a new head cover design.

[28] Probably a Vortexion valve mixer, which were produced with between three and twelve channels.

into his studio. It would not have been uncommon to find a similar set of open-reel tape recorders in the facilities of the BBC.[29] With this in mind, and though Gerhard was eager to underline the modest equipment with which he worked in the 'Home Office', it would be better to characterize his studio as one that contained some of the best commercially available equipment of its type at the time.

For Gerhard, his contact with the BBC Radiophonic Workshop, came to be vital in terms of commissions and external support for his work. It opened on 1 April 1958 some four years after Gerhard had started work in the medium; the technicians working in Room 13 at Maida Vale (Radiophonic Workshop headquarters) included, among others: Daphne Oram (who resigned in January 1959, after 15 years with the BBC, to follow a career as a composer); Delia Derbyshire (who joined the BBC in 1960 and collaborated with Gerhard on his Prix Italia winning *Anger of Achilles*) and Dick Mills (who assisted with performances of Gerhard's work (particularly the Symphony No.3 *'Collages'*) at the Royal Albert Hall and the Royal Festival Hall). When the Radiophonic Workshop opened, Gerhard's work with electronic sound was already well-known. Peter Manning writes that:

> The 'closed door' policy of the BBC Radiophonic Workshop, and the continuing lack of support from other quarters, severely retarded developments in Britain during the 1960s. Indeed, Roberto Gerhard was the only established composer from the broader community to be granted reasonable access to the BBC facilities during the decade. This permitted him to produce a number of pieces, primarily for radio, working both at the BBC and at his own private studio in Cambridge.[30]

The years 1958-1965 were the most productive regarding Gerhard's electronic music output. It is perhaps because of the regular commissions (*Asylum Diary* (1959), *The Overcoat* (1961) and *The Anger of Achilles* (1963-64)) that Gerhard received from the BBC for music for radio plays and William Glock's admiration of Gerhard's work that afforded him to work in his home studio and in the BBC Studio with such great flexibility.

IV. Gerhard's works

Attempting to arrive at a definitive list of Gerhard's extant electronic works is problematic when consulting existing texts. Often, one text has been copied by another and as a result inter-referencing reinforces initial mistakes. In Homs' *Robert Gerhard and His Music* we find the following listings:

[29] See Desmond Briscoe & Roy Curtis-Bramwell, *The BBC Radiophonic Workshop* (London: BBC, 1983), 20; for a pre-Radiophonic Workshop photograph of Daphne Oram working with Ferrograph Series 2 tape recorders at the BBC.

[30] Peter Manning, *Electronic and Computer Music* (New York: Oxford University Press, 2004), 14.

Table 1. List of Gerhard's electronic works as listed by Homs

Audiomobiles I-IV	electronic music on tape (1958-59); no2, DNA in reflection, used for film soundtrack (1963)
Ten Pieces	for tape (1961)
Sculptures, I-IV	for tape (1963)
Claustrophobia: a page for John Cage,	for harps and radios (1966)

Thom Holmes in his book, 'Electronic and Experimental Music: Technology, Music, and Culture' similarly refers to Gerhard's *Ten Pieces for tape* (c. 1961)[31] and this date is replicated in many online sources.

In the revised and expanded list of works published by Hugh Davies in the International Electronic Music Catalog in 1968 references to the *Audiomobiles* from 1958-59 are removed, the only reference being to *Audiomobile 2 'DNA'* (originally for film *DNA in Reflection*). For this work, the title *DNA in Reflection* refers to the version with the film by Hans Boye and Anand Sarabhai. Gerhard subsequently presented and broadcast the work as a standalone concert piece as *Audiomobile 2 'DNA'*. The reference to the *Sculptures I-IV (or V)*[32] are replaced with a single reference to *Sculpture I* (1963). The *Ten Pieces* are now correctly assigned as extracts from *Audiomobile 2 'DNA'*, and no reference is made to *Claustrophobia* (see figure 5). In Davies' list of works, as well as those mentioned above, *Caligula* also warrants further discussion as the connection between the BBC work based on Camus is not as clear cut as it at first seems.

The radio music for Caligula was commissioned by the BBC and broadcast in 1961. The final score in the Cambridge University Library and the listing with the Performing Rights Society indicates an incidental music score for only instruments. Although Gerhard may have worked on an intended electronic part initially, no electronic part was included in the final broadcast version of the incidental music. The tape work entitled *Caligula* may have grown out of the same initial musical ideas but is actually a separate work. The work was premiered at the ONCE Festival in the USA on 18 February 1962, an important series of concerts organized by composers at the University of Michigan, Ann Arbor, (including Roger Reynolds, Gordon Mumma, Robert Ashley and George Cacioppo), where Gerhard had been a Visiting Professor the previous year.

[31] Thom Holmes, *Electronic and Experimental Music: Technology, Music, and Culture*, 5th ed. (New York: Routledge, 2016), 94.

[32] 'Roberto Gerhard', in Wikipedia, https://en.wikipedia.org/wiki/Robert_Gerhard.

In his *Tempo* article on Gerhard's electronic music, Hugh Davies writes that following Symphony No.3 *'Collages'* that:

> Gerhard's electronic music was once again largely background music. Only one short work was specifically composed for concert use: *Sculpture I* based on sounds produced by a small sculpture of brass rods made by John Youngman. Material for four further works with the same title was assembled (early 1967: 'as yet unedited') but like other projects appears never to have been completed.[33]

Roberto Gerhard—list of electronic compositions

revised and expanded from the entry in the *International Electronic Music Catalog* (MIT Press, 1968)
compiled by Hugh Davies

TITLE	FUNCTION	YEAR	DURATION	NOTES
The Prisoner (chamber ensemble and tape; play by Bridget Boland)	theatre	1954	40′?*	
King Lear (chamber ensemble and tape; play by Shakespeare, Stratford production)	theatre	1955	40′?*	
A Leak in the Universe (chamber ensemble and tape; play by I. A. Richards, BBC)	radio	1955	c.10′	
The Unexpected Country (play by Olwen Wymark, BBC)	radio	1957	28′30″**	
Pericles, Prince of Tyre (chamber ensemble and tape; play by Shakespeare, Stratford production)	theatre	1958	40′?*	
All Aboard (for Bowater)	film	1958	c.5′	
Your Skin (for Unilever)	film	1958	c.5′	
Asylum Diary (play by Christine Lavant, BBC)	radio	1959	75′**	BBC ***
Coriolanus (play by Shakespeare, Stratford production)	theatre	1959	40′?*	
Lament for the Death of a Bullfighter (poem by Lorca, BBC)	radio	1959	12′58″	BBC ***
Collages, for orchestra and tape (rev. 1967 as *Symphony No.3 (Collages)*)	concert	1960	19′	BBC *** disc: HMV ASD 2427/ publ. OUP
The Overcoat (chamber ensemble and tape; play based on Gogol, BBC)	radio	1961	c.15′	
The Cherry Orchard (chamber ensemble and tape; play by Chekhov, Stratford production)	theatre	1961	40′?*	
Caligula (chamber ensemble and tape; play by Camus, BBC)	radio	1961	c.15′	

[33] Hugh Davies, 'The Electronic Music', *Tempo*, n. s., 139 (1981): 35.

Caligula (based on the above)	concert	1961	c.6′	
Macbeth (chamber ensemble and tape; play by Shakespeare, Stratford production)	theatre	1962	40′?*	
Sculpture I (sound from a small-scale model of sculpture of brass rods by John Youngman)	concert	1963	4′18″	
Audiomobile 2 DNA (originally for film *DNA in Reflection*)	concert/ film	1963	8′57″	
10 excerpts from *DNA in Reflection* (*Asyndeton, Bubblecade, Campanolog, Dripsonic, Meteoroids, Speculum, Stridor, Suspension, Telergic, Uncle Ned*)	disc	1963	5′12″	disc: Southern Library of Recorded Music MQ 760 (45 rpm)
The Anger of Achilles (orchestra and tape; play by Robert Graves, BBC)	radio	1963	110′**	BBC***
Macbeth (excerpts from earlier theatre score, for BBC TV anthology)	TV	1964	c.3′	

all works monophonic, apart from later (1967) *stereophonic revisions of* Symphony No.3 (Collages) *and* Audiomobile 2 DNA.

Figure 5. List of Gerhard's Electronic works compiled by Hugh Davies

In private letters to Davies, Gerhard indicates that he has, "[…] an accumulation of work in a state of near-readiness, I mean ready for com-po-si-tion, namely ca 25 to 30 7" reels of multilevel compounds classified as 'good'"[34]. One such example is tape CUL_OR01_011601 on the box of which Gerhard has written, "very good bits of electronic music" and contains twenty-four minutes of highly developed (almost) continuous electronic music derived from the Youngman sculpture.

Although neither the *Audiomobiles* or *Sculptures* series of works were completed it is clear from the amount of working material in the tape archive that Gerhard was not dissatisfied with the results he obtained from working and processing sounds for the works. It was merely that his time for the final editing and montage of the works was limited. As none of Gerhard's electronic concert works were commissioned, one scenario is that the pressure of increasingly prominent commissions such as the *Concerto for Orchestra* (1965), *Epithalamium* (1966), Symphony No.4 '*New York*' (1967), *Leo* (1969) and the unfinished Symphony No.5 (1969) meant that there was little time to complete time-consuming works for tape that carried little financial reward.

In the catalogue of works listed as Appendix II in 'Gerhard on Music' compiled by Meirion Bowen, reference is made to, "*Sculpture I* (1963): Electronic composition based on sound from a small-

[34] *Ibid.* 80, 35.

scale model of sculpture of brass rods by John Youngman"[35]. Hugh Davies himself acknowledges the confusion around these works, writing in the programme accompanying the London Sinfonietta's Schoenberg/Gerhard Series in 1973 that the catalogue,

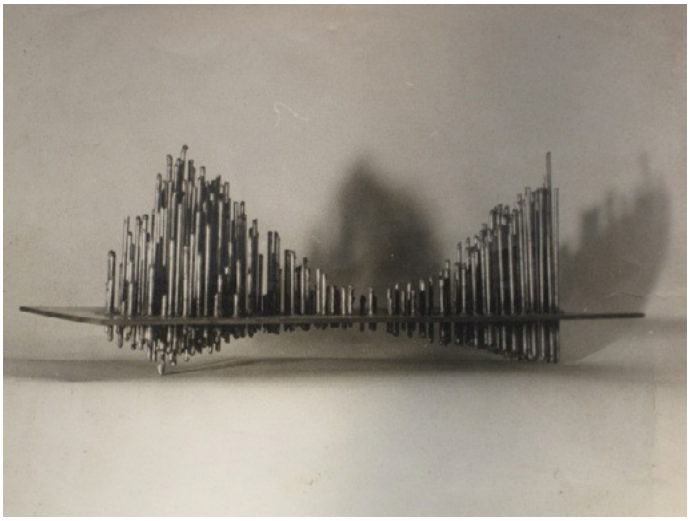


Figure 6. John Youngman 'Sculpture'

> […] gives dates and titles for some of the electronic works that conflict with the list assembled by Gerhard and the present author… four *Audiomobiles* are dated c.1958-9, and *Sculptures I-V* are listed as if all had been completed in 1963… Indeed, there were other Audiomobiles, including 'a capriccio in the manner of Goya', but they were 'just a series of illustration-examples for a lecture' given in 1959; *Audiomobile 2* became the title of the concert version of the soundtrack for the DNA film (did it incorporate the second of the original Audiomobiles, or was the original set considered as No.1?). No subsequent ones were mentioned by Gerhard in compiling the 1967 list.[36]

In order to obtain some further clarity on Gerhard's completed works in the *Audiomobiles/ Sculptures* series below is a list of references to either the term 'Audiomobile' or 'Sculpture' in the Gerhard Tape Archive at the Cambridge University Library (see figure 7).

[35] Meirion Bowen, ed., *Gerhard on Music: Selected Writings* (Aldershot and Burlington VT: Routledge, 2000), 261.
[36] Hugh Davies, 'The Electronic Music', *Tempo*, n. s., 139 (1981): 36.

CATALOGUE	REEL ANNOTATIONS	BOX
0015		**Inside**: *Green for SCULPTURE (middle)* **Side**: *4/Green: Calligula Assembly/from Sculpture/ Pink Empty*
0016		**Side**: *SCULPTURE (LAST TAKE) / ~~HIGH~~ WIND (WHISTLING)*
0045		**Front**: ~~Audiomobile No 2~~ "DNA" Concerto ~~7 ½~~ P.s. F.O. 3.III.67
0048		**Side**: *(DNA) Audiomobile 2* **Back**: *Roberto Gerhard Audiomobile 2 (DNA) (1963) 15" p.s. full track*
0049		**Back**: *1) Horn 2) Horn + Sculpture*
0077		**Side**: *Audiomobiles: Examples*
0114	DNA / MIXTUR on reel side 1	
0115		**Back**: Red/Sound Observed + D.N.A.
0144	DNA [crossed out in Yellow crayon]	
0146		**Back**: GREEN: Duo concertante DNA (part) W.O.
0165	Sculpt 3 [but Plague from RFH is on it so 1964]	
0186		DNA Assembly
0187		**Back**: DNA – MIXTUR Stock [Probably goes with CUL 0114]
0231		**Front**: Version II. Audiomobile 3 "Sculpture" Starts 7 ½ then 15 ips STEREO **Side**: Audiomobiles 3 [Poldi]
0235		**Front**: "Collages" Bands 1 + 10 / Audiomobile 1 15" Sculpture full track Roberto Gerhard
0239		**Front**: Audiomobile 3 "Sculpture" **Side**: Audiomobile 3 "Sculpture" [Poldi]
0269		**Front**: DNA 7 ½ with BBC Announcer [Poldi]
0271		**Front**: Roberto Gerhard AUDIOMOBILE 3 "Sculpture" 15"i.p.s. full track - stereo
0291	SCULPT A8 (Excerpt from Asylum Diary)	
0361	Audiomobile 1 (Sculpture) full track 15"	**Bag**: Sculptures (electronic) has been [Poldi]
0405	AUDIOMOBILE 2 DNA 1) Two-track copy (no joins) of 2) Original half-track 15 i.p.s.	
0414	DNA [red crayon] ERASE [yellow crayon]	
0434	DNA [yellow crayon]	
0437		**Paper**: Preparing for sculpter – Roberto & P with several shouts of stop by Roberto
0532		Sound Variations by Roberto Gerhard on a Music Construction by J. Youngman (stamp University of Cambridge School of Architecture)
0540		~~6~~ 5 bands for Sculpture R.G.
0542		**Side**: For End of SCULPTURE **Front**: for End of SCULTURE 2 alternatives
0543		**Side**: for Sculpture 4 bckwrd
0561-06	Reel annotation: DNA [red crayon]	
0563-10	Reel annotation: 24 DNA 1	
0563-11	Reel annotation: DNA	
0564-01	DNA 3 / TIMP GLI	
0564-07	SCULPT	
0564-09	DNA 2	
0596	DNA	

Figure 7. Listings for *Audiomobile* and *Sculpture* in the Gerhard tape archive, CUL

The catalogue clearly refers to *Audiomobile 1 'Sculpture'* and *Audiomobile 3 'Sculpture'* (including a 'Version 2' of this work). Although there has been conjecture that these were revisions and a renaming of the same work, the archive itself suggests these are individual works and contain quite different sonic material. Reference to *Audiomobile 1* only appears once in the tape collection.[37] On the spool is written, "*Audiombile 1 (Sculpture)* full track 15ips". However, the materials on the tape are multilevel compounds, a term Gerhard used to indicate the final materials that he would use for a work but before the final assembly, and appear to be recorded at 7.5ips. Although an edited version of this was released[38] it cannot be considered in the catalogue of Gerhard's completed works.

The naming of pieces relating to the Audiomobiles/Sculptures series in the tape archive is confusing and is perhaps something that Gerhard only settled on after he had worked on a number of sound constructions. For example, the work based on John Youngman's sculpture appears first as *Sound Variations by Roberto Gerhard on a Music Construction by J. Youngman* then as *Sculpture I* in various catalogues and finally in the tape archive as *Audiomobile 3 'Sculpture'*.

Gerhard recorded the sculpture with Youngman most likely in 1959–1960. In order to create a more amplified resonant sound, Gerhard recorded the sculpture on top of his piano, using the natural resonance created as an acoustic 'aura' in lieu of his lack of reverb, as such the work occupies predominantly one auditory space. Gerhard was clearly fascinated by the recordings he made. The sounds of the sculpture occur in a number of compositions, including the aforementioned tape work entitled *Caligula* (1961). In his catalogue of works, Hugh Davies lists *Sculpture I* work as being complete in 1963, though Youngman himself claims that (a version of) the work was completed before this and that he played it during his final practical exam in Cambridge in 1961:

> An indicator of its date is that my oral professional practice exam took place in 1961. Professor Martin arranged that my turn should come when the external examiners were taking tea and that to entertain them I should play them a tape (borrowed from Roberto, I think) of the sculpture. I passed the exam with Roberto's help.[39]

A further indicator of the original version of the work being prior to 1963 comes from Hans Boye, one of the collaborators on the film *DNA in Reflection*, for which Gerhard wrote the electronic score for in 1963. Anand Sarabhai, Boye's collaborator, was a close friend of Youngman. Boye writes:

[37] See tape CUL_OR_0361.

[38] See Roberto Gerhard, *Electronic Explorations from his Studio + The BBC Radiophonic Workshop* (Sub Rosa, Belgium, SR378), 2014.

[39] Interview with the author 25 April 2012, during the 2nd International Roberto Gerhard Conference, Barcelona.

> At that time Anand came to think of a local composer, Roberto Gerhard, who had once 'made music' with a sculpture consisting of a metal plate studded with metal rods of different lengths. The artwork thus appeared as a 3D-landscape of metal rods, and if one tapped the individual rods, they would give off different tones. Roberto Gerhard borrowed the sculpture from the artist and shortly after he could present a musical composition created by recording the sounds from the sculpture, manipulating them and mixing them into a new recording.[40]

From this, it is clear that Gerhard's composition based on Youngman's sculpture, or at least its reputation, was well known enough in private circles in Cambridge at the time for Sarabhai and Boye to approach Gerhard for a new sound composition to accompany their film. The definitive version of *Audiomobile 3 'Sculpture'* in the Gerhard Tape Collection is labelled 'Version II' and suggests that the composer revisited the work and made changes to it. The first version of this revision incorporates stereo piano gestures, later removed in the final version, suggests that this revision took place in 1967 when Gerhard also produced stereo versions of parts of his Symphony No. 3 '*Collages*' and *Audiomobile 2 'DNA'*. The evidence suggests that Gerhard worked on a series of works alternatively titled Audiomobiles/Sculptures between 1958 and 1967 producing extensive well-worked materials but never completing the projected series that are erroneously listed in his completed works.

Claustrophilia (not *Claustrophobia* as listed in Homs) is a real outlier in Gerhard's oeuvre.[41] Following John Cage's letter to Gerhard on 24 January, 1966, requesting, "a manuscript or page, rough or finished, pencil or ink"[42] for his publication *Notations* Gerhard chose to create an original work, *Claustrophilia*, for multiple harps, radio and loudspeakers, rather than supply an existing page of manuscript (which he did inadvertently). The result was an unusual piece, not merely because of its scoring, which has a strong kinship to the Cageian experimental tradition but also due to it being Gerhard's only text score (see figure 8).

Gerhard met Cage in the summer of 1961, as a result of Gerhard's visit to the USA as a teacher on a composition course at the Berkshire Center, in Tanglewood.[43] Gerhard sent the score on the 22 December, 1966, eleven months after Cage's letter asking for the piece. However, Gerhard sent two notation examples to Cage. On one side of the page Gerhard wrote *Claustrophilia* for harps, radios and loudspeakers, and on reverse side was page 129 from his *Concerto for Orchestra*. Ironically, only the page from *Concerto for Orchestra* was published in the book *Notations*[44]. *Claustrophilia*,

[40] Hans Boye, 'How Roberto Gerhard was persuaded to make the soundtrack for the 16mm firm DNA in Relection', *Proceedings of the 1st International Roberto Gerhard Conference* (Huddersfield, 2010), 105.

[41] See Carlos Duque & Monty Adkins, 'Claustrophilia: A Musical Gift from Roberto Gerhard to John Cage', in *Essays on Roberto Gerhard*, ed. by Monty Adkins and Michael Russ (Cambridge Scholars Press, 2017), 261-278.

[42] John Cage to Roberto Gerhard, January 24, 1966. Roberto Gerhard Archive, Cambridge University Library.

[43] Joaquim Homs, *Robert Gerhard and his music*, ed. by Meirion Bowen (Trowbridge: Cromwell Press, 2000), 65.

[44] John Cage, *Notations* (New York: Something Else Press, 1969), 292.

the work that Gerhard wrote for the collection was unpublished and the original is still part of the John Cage archive.[45] In the letter to Cage, alongside the score Gerhard wrote that, "I wish you'd perform it! I'm certain with you and David Tudor as Monitors you'd make a stunning composition of it" [46]. The work is scored for eight harps (or as many multiples of four as possible) who each select a study piece or score from the orchestral repertoire; four offstage radios which require four players to 'tune' them as well as two Monitors (Gerhard's term for those mixing the sound and determining the compositions overall duration).

[45] The premiere of the work was organised by Gregorio Karman at the 2nd International Roberto Gerhard Conference and given on 1 April 2012, Conservatori del Liceu, Barcelona. Documentation can be found at: http://info.ggkarman.de/node/160.

[46] Roberto Gerhard to John Cage, December 22, 1966. Roberto Gerhard Archive, Cambridge University Library.

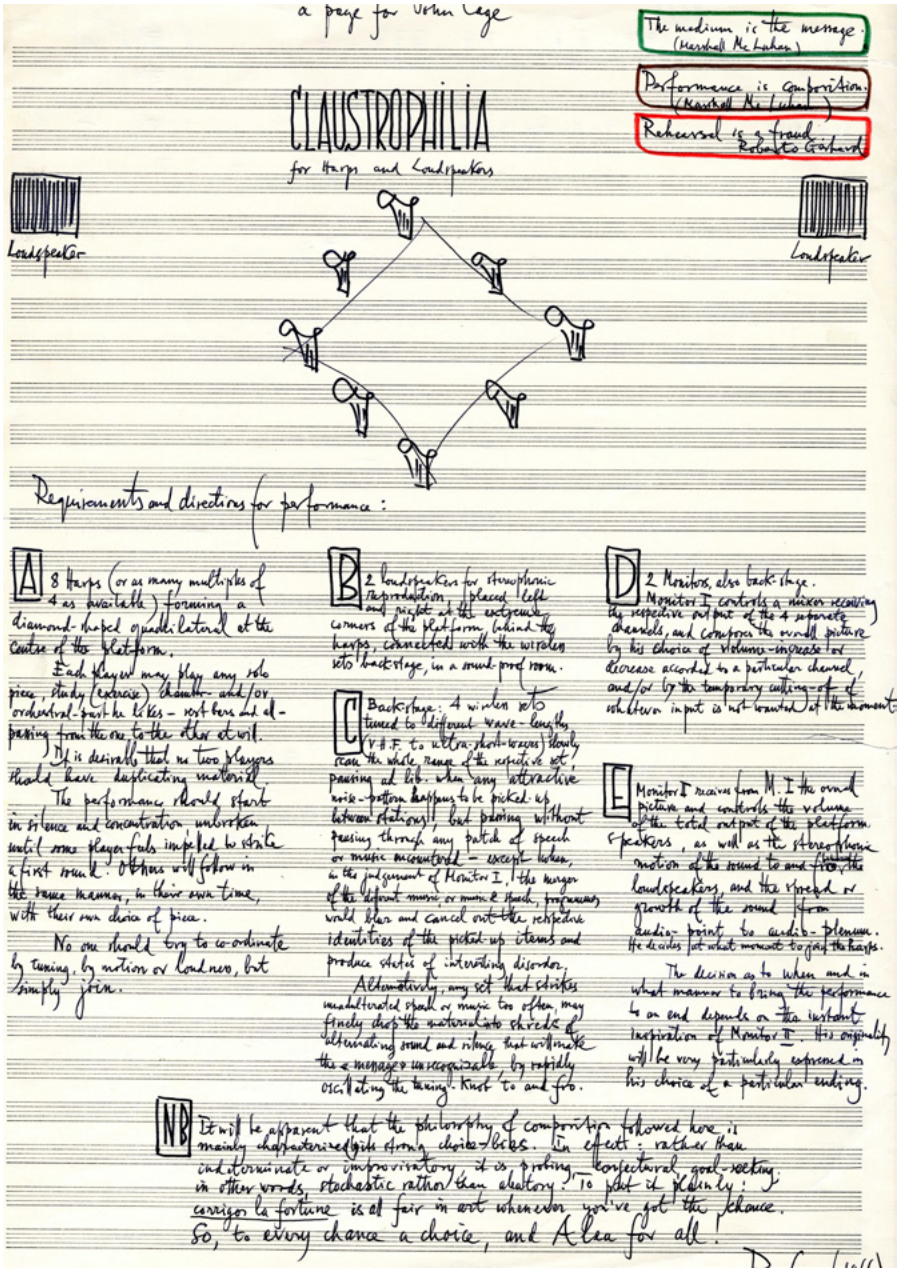


Figure 8. Gerhard *Claustrophilia* (1966)

Having worked on the Gerhard tape archive for a decade now, it is possible to provide a revised and definitive list of the composer's electronic works as evidenced from the materials contained within it. This is provided at the end of this article.

V. Gerhard's aesthetic approach to sound composition

All the writings in Gerhard's notebooks suggest that the late 1950s was a time in which the composer was undergoing a significant rethinking of his approach to composition – one informed by his serial structuring of time and pitch and the intuitive freedom that working in the electronic medium gave him. Unlike Schaeffer, who wrote extensively about *musique concrète* in his two major treatises, *À la recherche d'une musique concrète* (1952) and the *Traité des objets musicaux* (1966), or other early pioneers such as Stockhausen or Xenakis, Gerhard did not set out to develop new models for listening and composing with sound. Notwithstanding the importance of the *Audiomobiles* (1960) and the later *Sound Observed* (1965) radio documentaries Gerhard created for the BBC Third Programme, Gerhard was, as a freelance composer, more interested in composing the next work rather than theorizing about them. This is not to suggest that Gerhard was not an active thinker. In fact, the composer's notebooks document his ongoing engagement with electronic music, the discourse surrounding it extends over more than a decade. These notes, quotations and short writings consider, among other things, the nature of sound, time, texture, and how working in the studio offered a working practice that was fundamentally different to composing with instruments. These notebook entries were never intended as contributing to a theory of *musique concrète*, rather they are a document of the composer's ongoing exploration and questioning of the new medium and its ramifications for all aspects of his creative work. Nevertheless, when these distributed passages are drawn together, a coherent and cohesive body of thought emerges.

One of the first things that Gerhard considered was the medium itself, and how the unchanging nature of the sound material on tape nevertheless resulted in the listener experiencing the work differently each time. The composer writes that,

> […] a Velazquez, a Henry Moore are as immutably fixed in their being as a piece of sound-composition on tape. They do not change at different viewings. They do not change, be we do, and in more ways than one, both psychologically and sociologically.[47]

The immediate tactility of working with, and transforming, sound with magnetic tape and the subsequent montage process opened up new possibilities for thinking about music as sound – as a temporal flow rather than discrete bars and units.

[47] Roberto Gerhard, Notebook, CUL, Gerhard 9.102, fol. 10v.

Gerhard was well aware of the techniques of electronic music on the continent: transposition, looping and layering of sounds, cutting and splicing to create rhythms or dynamic envelopes, feedback, filters and ring modulators, were thoroughly described in a special number of the technical magazine of the Nordwestdeutschen Runfunk devoted to the Cologne Studio for Electronic Music[48], part of the composer's book collection along with other seminal texts relating to the early days of electronic music by composers such as Pierre Schaeffer, Karlheinz Stockhausen and Milton Babbitt. While always suspicious of studios operated by sound technicians, Gerhard, on occasion regretted his lack of more sophisticated devices, envelope controllers and modulators. It is therefore not surprising that one of his favourite resources was the use of transposition.

Gerhard's approach to electronic music traversed the aesthetic paradigms that polarized early *musique concrète* and *Elektronische Musik*, often using instrumental, concrete and, on occasion, electronic sound materials. Working very much on his own initially from 1954, he was critical of the dogmatic approach of his European contemporaries, writing that,

> […] most of us had already noticed for some time that, whether German, Italian, Dutch or Belgian, electronic music sounds curiously alike in its timbral aspect. If the possibilities were really unlimited, one couldn't help feeling that these composers were strangely coincident and repetitive in the use they made of them.[49]

Gerhard goes on to write that the sine tone has a "rigid, cold, dead-signal quality. It is utterly unsuited to convey anything warm, tender, vivid, alive in human experience"[50]. From a compositional perspective, Gerhard was always more interested in the metamorphosis of acoustic source materials and the potential they offered for abstract sound composition, stating that, "the microphone captures the living spark of the natural acoustic source"[51]. Gerhard was, however, more circumspect than Varèse, Schaeffer or John Cage in his use of acoustic sources often using (extended) instrumental sounds. In his unpublished notebook from 1957, Gerhard writes that he considers that, "the term "musique concrète" is ridiculous twice over, first, on its own account: it doesn't even pretend to name the thing directly; second, it takes for granted that, what is condescendingly called 'the other music', is *abstract*. Why?"[52] Later in a script for a radio programme for the BBC Third Programme entitled *Audiomobiles*, first broadcast in 1960, he wrote that:

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[48] 'Sonderheft über Elektronische Musik' Technische Hausmitteilungen des Nordwestdeutschen Rundfunks. Jahrgang 6 Nr.1-2 (1954).

[49] Roberto Gerhard, 'Concrete Music and Electronic Sound Composition', in *Gerhard on Music: Selected Writings*, ed. by Meirion Bowen (Aldershot and Burlington VT: Routledge, 2000), 181.

[50] *Ibid*., 183.

[51] *Ibid*., 183.

[52] Roberto Gerhard, Notebook, CUL, Gerhard 7.115, fol. 20.

> […] in principle, anything that comes from an acoustic source is possible material for *musique concrète*. This, of course, throws the gates wide open – too wide, perhaps – to material of all sorts, musical and not so musical. The French themselves, for instance, are not above using pots and pans for their *exercices aux casseroles* as they describe them.[53]

Gerhard script of this radio programme was developed as 'Concrete Music and Electronic Sound Composition', presented at the Joint Congress of the International Association of Music Libraries and the Galpin Society in Cambridge in 1959. Deletions in his notebooks reveal an interesting statement left out of the broadcast and the published version:

> Instead I'd rather try to briefly characterise ~~in general lines~~ the two schools of thought – musique concrète and electronic music – ~~in order to~~ which have been responsible for the main developments so far – in order to ~~see what room is there left if any, for a third approach whether there is room and justification for a third approach and if so, how this would be related to/and how it would differ from …~~[54]

Gerhard's 'third' approach to electronic music, with its emphasis on the abstract 'musical' quality of concrete sounds rather than their associative meaning, and the sampling and transformation of his own instrumental compositions, is akin both to the work of Iannis Xenakis[55] and Bruno Maderna, two composers for whom electronic music and its techniques were to play an important part in informing their compositional aesthetic, and also to the later writings of Schaeffer. Gerhard's use of concrete, instrumental and electronic sound sources in *Audiomobile 2 'DNA in Reflection'* (1963) has a kinship in approach with Maderna's *La Rire* (1962) which incorporates the sounds of voices, footsteps in rain, white noise and sine-tone generators, as well as transformed timpani, flute and piccolo, one that demonstrates an openness to all possibilities inherent in the medium rather than the strictures of the early Paris or Cologne schools of thought. Although Gerhard possessed a copy of Schaeffer's 1952 treatise *À la recherche d'une musique concrète* and critiques it in his notebooks,[56] it is Schaeffer's phenomenologically reductionist notion of *l'écoute réduite*, proposed in his later *Traité des objets musicaux* (1966) – in which the sound as 'sign' is ignored in favour of listening to the abstract contours and dynamic qualities of the sound, that is most akin to Gerhard's thinking.[57] Schaeffer wrote, "it is the sound itself that I aim at, that I identify"[58]; two years previous to this on his radio

[53] Roberto Gerhard, 'Concrete Music…', 184.

[54] Roberto Gerhard, Notebook, CUL, Gerhard 10.152, fol. 35v.

[55] Xenakis used recordings of his own compositions in *Polytope de Montréal* (1967), *Kraanerg* (1969) and *Hibiki-Hana-Ma* (1970), and created a highly abstract sound world from a Loatian mouth organ and Asian jewellery in *Bohor* (1962).

[56] Roberto Gerhard, Notebook, CUL, Gerhard 7.115, fol. 20a.

[57] Pierre Schaeffer, *Traité des objets musicaux* (Paris: Seuil, 1966).

[58] *Ibid*., 266.

programme *Sound Observed*, Gerhard himself said that, "sound does not remind me of something else, it reminds me only of *other* sounds"[59]. In this respect Gerhard's approach can be termed proto-acousmatic (Schaeffer defines acousmatic as "referring to a sound that one hears without seeing the causes behind it"[60]).

Such an acousmatic approach enabled Gerhard to focus on the abstract musical potential of the processed sounds and their dynamic shaping over time, a technique not dissimilar from his handling of instrumental material. However, the electronic medium offered a more intuitive approach to music making than Gerhard's increasingly complex pre-compositional structuring for his instrumental works. At the same time that the composer was finishing one of his most highly structured works, Symphony No. 2 (1957–9), a work in which the serial set determines not only the pitch content but also the temporal structure of the work, he was also embarking on a series of works in which sound composition played an increasingly important and liberating part. These include the *Audiomobiles* series, *Lament for the Death of a Bullfighter*, *Caligula*, the taped sections of Symphony No. 3 '*Collages*', as well as the radio and theatre productions *The Overcoat*, *Pericles*, *Macbeth* and the Prix-Italia-winning *The Anger of Achilles*.

VI. THE CREATION OF A REPERTOIRE OF SOUNDS

In working with magnetic tape Gerhard was aware that he was adopting different working methods from those he normally employed when working in the instrumental realm, and was gaining fresh insights into the nature of sound itself. In his notebooks he writes:

> The composer at the tape machine is like a commander in the field, he is in the very thick of events. This is a tremendously exhilarating situation. Direct action with actual sound stimulates aural alertness to an unsuspected degree. And – what is even more important – it also stimulates thought as applied to tactics and strategy in quite new ways.[61]

And also: "After a full day's work by the tape-recorder one suddenly discovers that one's ears have become […] atuned [sic] to all manner of sounds, indoors and outdoor-sounds to which, one realizes, one had been completely deaf before"[62].

The strategy that Gerhard refers to is one in which empirical rather than a priori methods came to dominate his practice when working with magnetic tape and as such marks

[59] Roberto Gerhard, 'Sound Observed', in *Gerhard on Music*, ed. by Meirion Bowen, 193.
[60] Schaeffer, *Traité des objets*…, 91.
[61] Roberto Gerhard, Notebook, CUL, Gerhard 9.115, fols 13v–14a.
[62] Roberto Gerhard, Notebook, CUL, Gerhard 9.115, fol. 15a.

a different methodological approach in his 'sound compositions' than in his notated works of the same period. In his notebooks there are long lists of sounds that form the numerous mixes or 'compounds' that he produced before the final montage of a work. There are, however, no sketches, notes, or diagrams referring to the sound compositions themselves. In his instrumental compositions of the late 1950s onwards Gerhard used the serial set to govern large-scale pitch and temporal structure, but within this framework he was able to work out much of the local detail of a work intuitively. In his sound compositions Gerhard took this intuitive process much further, writing that:

> The basic resorts brought into play are the same as in ordinary composition on paper – only more so, as it were, which is to say that intuitive and imaginative approach rule supreme. There is no system, no computation, there are no blue-prints. Sound firing the imagination, sound for the love of sound is the prime mover.[63]

This seeming dichotomy between the rigour of Gerhard's own interpretation of serial time and pitch structures and the freedom offered by tape composition is reflected in an isolated statement in one of his notebooks from 1957, in which he writes, "pre-compositional hurdles (parameter organization) = paralysis of the reflexes"[64]. This seems to suggest that Gerhard was aware that extreme parametric organization could only take him so far and that tape music offered him an additional means of structuring material through more textural and gestural means. As Gerhard continued to work with magnetic tape it is clear that he began to adopt a coherent personal aesthetic towards tape composition. His notebooks become increasingly filled with ideas about the temporal nature of composition, about timbre and texture. While his radio and theatre productions continued to use Foley sound, such as "taps on a cardboard tube" for some of the sounds for the incidental music for *Macbeth*,[65] Gerhard's more autonomous sound compositions utilized more abstract or processed sound materials, often instrumental sounds, which in some cases underwent considerable metamorphosis to form hybrid 'sound families'. Gerhard's thinking at this time is best summed up in 'The Composer and His Audience', in which he writes:

> One of the hardest discoveries for the musician to make, it seems, is that music, contrary to a generally held belief, is not made with notes. The eye leads the ear astray; it easily persuades it that the notes are really there – and nothing but the notes, as far as one can see. The ear, therefore, misguidedly concentrates on locating notes, or disentangling their clusters, on tracing the patterns they form. Yet the basic stuff of music is sonic motion, not notes or sounds. Manoeuvre is the

[63] Roberto Gerhard, Notebook, CUL, Gerhard 9.102, fol. 8a.
[64] Roberto Gerhard, Notebook, CUL, Gerhard 7.115, fol. 11a.
[65] Roberto Gerhard, Notebook, CUL, Gerhard 10.127, fol. 1.

> raison d'etre of the formations […]. The true business of the composer is to release the flow and shape, and steer the stream of sonic events in time.[66]

Gerhard's notebooks contain numerous annotations of source materials and comments on these. For Gerhard, the first step toward creating a sound composition was to gather a repertoire of raw materials on tape. This process is described in ff. 1-10 of the sound score for the incidental music to *King Lear* (1955)[67], which contains detailed instructions for recording a catalogue of instrumental sounds using different dynamics and modes of attack, including: maracas, cymbals, xylophone, turkish cymbal, tam-tam, piano, chromatic timpani, bass drum, gong and mbira. In his studio, Gerhard had a microphone available for making recordings of piano effects[68], or smaller percussion instruments. But the sound materials he utilized were by no means limited to instrumental sources. Production notes reveal the regular use of daily objects for making sounds (packing paper, paper tissue, combs, ashtray), as well a wide range of incidental noises (birds, dogs, axe strokes, cracking tree, thunder, wind, rain and storm, whipping gusts, crowds, chatter, laughter, screams), which could be home-made[69] or taken from the everyday environment. In his notebooks, Gerhard writes,

> […] we all have got to start in the same way: by building up a repertoire of sounds which are stored on tape. […] The sounds selected may either be appropriate in their original form to the sound-picture one has in mind or else require further treatment before being used. Most of my stored sounds are of instrumental origin, recorded on tape through microphone. The next step - what I called my second stage - is directed towards a certain transformation of that original sound, ideally towards a metamorphosis of the sound [in] which [its] origins are blurred, and a far-reaching change of identity might be achieved.[70]

Gerhard's methods for obtaining such source materials for his compositions are documented by Lindsay Anderson and Dick Mills. Anderson writes that, "I remember visiting Roberto in Cambridge, talking about the score, and even assisting him in throwing various objects down the stairs, in an effort to product the right kind of abstract sounds which he felt he needed"[71].

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[66] Roberto Gerhard, 'The Composer and His Audience', in *Twentieth-century Music: A Symposium*, ed. by Rollo Myers (London, 1960).

[67] GERHARD.7.102, ff. 1-10, Cambridge University Library.

[68] For example, the tape labelled 'Roberto working on piano strings for incidental music' [CUL_OR01_005501] would be a document of those experiments, with similar recordings to those described in *King Lear*'s sound score (low piano strings: pluck, rub with wire brushes, comb, roll with timpani sticks). [Gerhard.7.102].

[69] For example, the labelling 'Rain and storm home produced by Roberto' [CUL_OR01_039101].

[70] GERHARD 9.116 f26-27v. Cambridge University Library.

[71] Lindsay Anderson, 'This Sporting Life' in *Tempo*, n. s., 139 (1981).

Dick Mills, who worked at the BBC Radiophonic Workshop describes recording sessions in which Poldi Gerhard was fond of participating too, writing that:

> Roberto had a rather difficult problem to overcome when attempting to record his basic sounds, as he lived on a busy trunk road in Cambridgeshire and the only quiet period was around 3.30 in the morning. One can imagine the scene as Roberto twanged and banged and bonked metallic objects as his wife Poldi acted as recording engineer. Both of them were in their sixties at that time.[72]

VII. The application of sound sources in Gerhard's works

Aside from sound sources recorded in his own studio, Gerhard also recycled fragments of recordings of his own instrumental works. Where the materials he needed could not be easily recorded or created in his own studio Gerhard would resort to commercial sound catalogues or to outsourcing the recordings to a professional facility when a wider palette of instrumental sounds was needed. One such example is the music for the Royal Shakespeare Company's performance of *Pericles* (1958) for which Gerhard produced the incidental music for ensemble and electronics. The box of tape CUL_OR01_025401 credits 'Studio Black, Queens Way' for the recording of percussion and exotic instruments. The multiplicity of sources from which Gerhard would obtain sounds included his close friend Joaquim Homs who provided the recordings of castanets which were required for the tape part of Symphony No. 3, *'Collages'*. Although Gerhard had a preference for sounds of acoustic origin, this did not rule out the occasional use of synthetic sounds, such as white noise or sine tones obtained from test and demonstration records or from sessions in the BBC Radiophonic Workshop. In the instances in which Gerhard required variable speed playback, the transformation would again be organised in an external facility, most often the BBC Radiophonic Workshop. In his notebooks, Gerhard used capital letters to identify the sound patterns that resulted from the combination of multiple sources as he developed his compositional materials. Such processes enabled Gerhard to mix sources at fixed or variable loudness to obtain more articulated sound images, and successively build up several strands up to 'multilevel compounds' ready for editing in the final composition. In his notebook Gerhard writes lists of the elements that make up these strands (see figure 9).

[72] Desmond Briscoe and Roy Curtis-Bramwell, *The BBC Radiophonic Workshop* (London: BBC, 1983), 38-40.

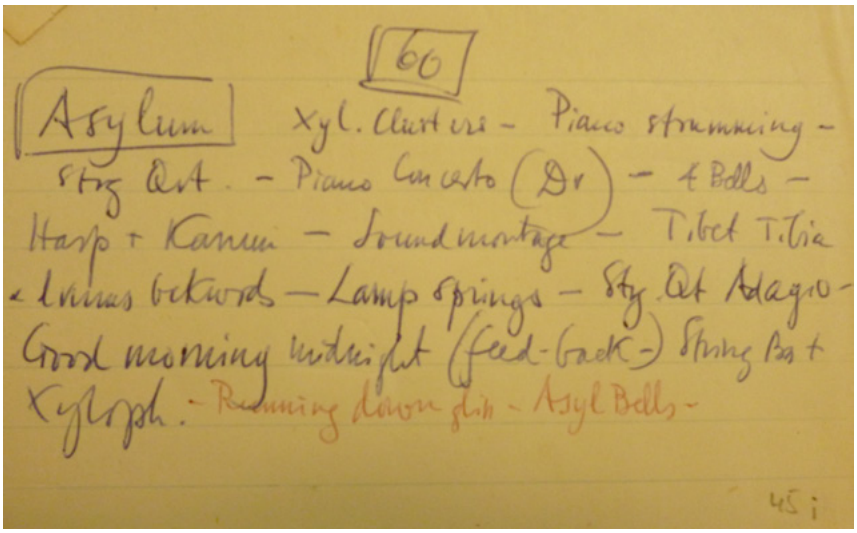

Figure 9. Gerhard 7.115 f.45i

In the second stage of the production process, Gerhard listened intently to the internal characteristics of his material, abstracting the sounds from their physical sources through various means of processing. During this stage of processing the primacy of the original sound as a means of grouping material developed from it became redundant as a means of classification. As Gerhard processed his material he regrouped it so that the timbral or gestural relationship between the sounds now assumed the most important means of classification. This processing stage allowed Gerhard to re-classify the transformed sounds into sound-families, what Gerhard referred to as his, "theory of change of family through sound mutation"[73] in which material is grouped together because of its similar sound behavior or timbre. Gerhard came to develop the idea of a genealogy of sound, stating that:

> I have come more and more to believe that the overall sonic domain is perhaps not as vast and as diverse as one is a first inclined to assume. Rather does it seem a finite and bounded domain, and that in more aspects than that of frequency range alone. And I suspect that when acousticians take these matters up, it will probably be found that the number of existing 'distinctive families' of sound is not so inordinately large. What makes one think that this might indeed be so, is suggested by the fact that sound of a given family can be modified, by suitable operations, and made to resemble less and less the original sound from which we started. Gradually, it will adopt

[73] Roberto Gerhard, 'Sound Observed', in *Gerhard on music: selected writings*, ed. by Meirion Bowen (Aldershot: Ashgate, 2000), 190-195.

> a novel character, but the degree of novelty that can be obtained is not unlimited. After a certain amount of change, there comes a moment when the sound simply begins to show characters of another, different, but already well-known family. In other words, it would seem that it is possible to develop new varieties, but now new families. The number of basic sound-families seems to be comparatively small. Most of them are probably already represented in the modern orchestra. If a section of tuning-forks were added – standing for spectrumless sine tone – the representation might be considered to be fairly complete.[74]

From these sound-families Gerhard developed a series of clear compositional stages and his own terminology for each:

- small mixes Gerhard termed *sound images* or *sound aggregates*;
- these *aggregates* were mixed to form *compounds*;
- numerous *compounds* were mixed to form *multilevel compounds*;
- from these *multilevel compounds* the final *assembly* or *sound montage* would be mixed through editing.

The origins of this terminology can be found in his notebooks. Gerhard writes:

> To compose and compound. To compose, in the sense of *putting* things *together*, in mere linear consecutiveness, or even in *placing* and *spatlising* [*sic*] a plurality o[f] events in more complex synchronicity is *not all*, it is indispensible, at the same time, to *compound*, i.e. to potentiate factors by settling differences and contradictions – by which is not meant that they should be 'de-fused' in the ballistic sense – but that their continuing struggle should be harnessed to the form-generating process, building up a manner of chain-reaction.[75]

Here a further comparison with Maderna may be drawn. About electronic music, Maderna once said, "we no longer listen in linear time - our consciousness casts various projections of time that can no longer be represented with the logic of one dimension"[76]. Working with electronic music made Maderna trust in his compositional intuition. The influence of electronic music in Maderna's instrumental composition can be found in works such as the *Serenata per un satellite*. Gerhard himself wrote that, "the way time is felt in electronic music differs entirely from the way time is experienced in traditional music." Gerhard was adamant that there is a fundamental difference between working

[74] Roberto Gerhard, 'Sound Observed…', 193-194.
[75] Roberto Gerhard, Notebook, CUL, Gerhard 10.140, fol. 20v.
[76] From a transcription of Maderna's 1957 presentation at Darmstadt (made by Horst Weber, 1984).

with electronics and instruments. He uses the term sound-behaviour to characterize this difference. Gerhard writes,

> […] the operative word is *behaviour*, it will be noticed, not colour; colour is never of decisive importance. Instead of 'behaviour' I might have used the term *sound-activity*. The electronic medium, in effect, makes possible new modes of action with sound which have greater freedom of tonal movement, of configuration and of textural weaving than those which our traditional instruments permit.[77]

Gerhard's notion of sound-behaviour bears a close conceptual resemblance to what Denis Smalley would later term spectromorphology[78], literally the shaping of sound through time, an extension of Schaeffer's typo-morphologie proposed in the *Traité des objets musicaux* (1966). Interestingly, these sound behaviours are never codified to the extent that they were by Schaeffer and later Smalley. Again, there is no abstract schema being formulated, merely the observations and thoughts of a practicing composer. What is clear, however, is that Gerhard considered these sound behaviours as directly contributing to the form and structuring of a work, writing that, "wave-shape = prototype of form"[79]. These new modes of action and of composing with sound contribute to what the composer termed the "temporal shaping" of a work, one that provided the listener with an aural blueprint, which could be enhanced by repeated listenings. Gerhard writes:

> I care enormously about shape, a telling shape, an apprehensible shape, a shape you could almost *remember as shape*, not the first time, to be sure, but after a time, after a number of times of listening to the piece, almost as you can remember a spatial sky-line, of town or hill – or mountain – range once you've become familiar with it; there is such a thing as a temporal sky-line, I believe, that's what I mean when I say shape, only a temporal shape has got to be *per-formed* [*sic*].[80]

In certain works, such as Symphony No. 3 '*Collages*', the temporal shaping is extremely dynamic and highly profiled. In other works, such as *Audiomobile 3 'Sculpture'*, the temporal shaping is far less differentiated, but because the work is built on essentially one sound type (recordings of a sculpture made from brass rods created by John Youngman), the subtle differences are at once further metamorphoses of the sonic materials as well as a means of forwarding the musical argument.

In line with thinking in fields of sound-activity the electronic works are driven by gesture and texture led sections. Although Gerhard did not care for Schaeffer's term for the basic perceptual unit in *musique concrète*, the *objet sonore*, it is clear that in his electronic works and increasingly in his

[77] Roberto Gerhard, 'Concrete music …', 194.
[78] Denis Smalley, 'Spectromorphology: Explaining Sound Shapes', *Organised Sound* 2, no. 2 (1997): 107-126.
[79] Roberto Gerhard, Notebook, CUL, Gerhard 7.103, fol. 18a.
[80] Roberto Gerhard, Notebook, CUL, Gerhard 10.102, fol. 2a.

later instrumental works, he nevertheless moved away from the 'note' as the essential unit, to his own notion of the sound object or sound-field as building blocks for his works.

Gerhard most prized intuition and imagination when working with magnetic tape, and, like Xenakis, he worked quickly and drew material from any source at his disposal when it suited his needs. As a result, there are sections of the Symphony No. 2 metamorphosed in *Lament for the Death of a Bullfighter*, and the same sonic materials shared between works: *Audiomobile 3 'Sculpture'* and the final section of Symphony No. 3 '*Collages*' use the same piano sounds; a keening vocal loop originally designated as "for the end of SCULPTURE"[81] was used in both *Asylum Diary* (1959) and in a variant form in *Caligula* (1961). For a composer known to destroy his sketches upon completion of the final score, this practice suggests a very different working philosophy. Part of this has to do with Gerhard's notion of the metamorphosis of sound materials and their grouping into sound families. He wrote, "nothing that instruments or the orchestra can do as well or better can be justified in the electronic medium. To be justified, both the sound-stuff and the way it is organized must be original growths of the medium"[82]. Following the initial recording of sound materials for use in a composition, Gerhard listened intently to the internal characteristics of his material, abstracting the sounds from their physical sources through various means of processing. The piano, percussion and the accordion were particularly favoured as source materials, as is evident in the number of tapes in the Gerhard Tape Collection in the Cambridge University Library that contain recordings of Gerhard and his wife Poldi making source sounds with these instruments for processing at a later date. Gerhard once said that there are more sounds in the piano than one can imagine, and utilized this instrument and sounds derived from it in his earliest sound composition, the *Audiomobile 'in the manner of Goya'* recorded for his *Audiomobiles* radio programme on the BBC Radio Third Programme in 1960. Gerhard was also aware that all instruments were not equally useful. In a notebook the composer observes that the processing of long wind notes, such as those of the flute and oboe, may result in awkward vibrato effects.[83] This is one reason perhaps that he favoured the accordion (which Gerhard also considered a wind instrument) so much. Percussion and pedal glissandi on timpani also feature often in Gerhard's sound compositions.

The process of sonic metamorphosis was important to Gerhard. In his *Audiomobiles* BBC broadcast he was critical of Schaeffer and Pierre Henry's *Symphonie pour un homme seul* (1951) for not achieving significant metamorphosis of their initial sonic material, thus leaving the associative connotations of the sounds or an unimplied narrative too near the surface of the work. Gerhard states that, "there is in fact, no striking metamorphosis of basic materials in it. The identity of the so-called *objets sonores* remains pretty obvious throughout. Their line up too, is more in the nature of

[81] Roberto Gerhard, RGTC, CUL_OR01_Gerhard_0542.
[82] Roberto Gerhard, 'Sound Observed…', 195.
[83] Roberto Gerhard, Notebook, CUL, Gerhard 7.107, fol. 44v.

a loose sequence than of an imaginative sound montage"[84]. In contrast, Gerhard's working method is almost identical to the later notion of the acousmatic that developed at the Groupe de Recherches Musicales (GRM) in the late 1960s, proposed by François Bayle. Gerhard considered that when sonic materials were not sufficiently abstracted from their sonic origins, that the ramifications are not merely that the sounds appear like scenes from a film but because of their lack of metamorphosis they never transcend their concrete origins and become essentially musical:

> If the result of sound montage, which is here of course the crucial operation, is not a new and compelling overall structure in which the component parts, as if under a magic spell, are made to play new roles, musical roles I mean, to which their original identity could never have given us any clue, then sound montage remains something of a game; something like a jigsaw puzzle with pieces upside-down or the wrong way around, bumping into one another and thus emphasizing their isolation, rather than giving them a common purpose which would lift them onto a plane of poetic imagery.[85]

The importance given to this temporal shaping or morphology of sound is demonstrated by another entry in Gerhard's notebook, where the composer gives a whole page over to the various definitions of the term 'morphology' and related terms:

> Morphology: science of form. Branch of biology, deals with the form of living organisms, the structures, homologies, metamorphoses which govern or influence that form.
> morphography: description of form (descriptive morphology)
> morphosis: shaping
> morphon: to shape
> morphé: the shape (Gestalt), form, figure, configuration
> morphotic: formative[86]

In the *Audiomobiles* radio programme Gerhard stated that often when working with concrete sound sources the composer is working towards a true metamorphosis of source materials. However, he also considered that the result of sound manipulation of musical materials is nearly always an impoverishment due to a loss of high or low frequencies in the original, what Gerhard referred to as a loss of the vitality of the original. The opposite is true of more noise-based sounds, which Gerhard considered ripe for manipulation, as sound manipulation brings the noise element under more control and hence gives it more focus. It is clear from this why Gerhard combined the extensive manipulation of percussive sounds with more simple, though no less sonically sophisticated, treatments of piano,

[84] Roberto Gerhard, *Audiomobiles*, BBC Third Programme, first broadcast 23 July 1960, and re-broadcast on 21 August 1960.

[85] Gerhard, 'Concrete Music…', 184.

[86] Roberto Gerhard, Notebook, CUL, Gerhard 7.107, fol. 1v.

celesta and recordings of his own instrumental works. It also demonstrates why Gerhard was so drawn to John Youngman's sculpture, since the variety of different timbres and sonic gestures, both pitch-based and noise-based – that could be extracted from it was considerable. In *Audiomobile 3 'Sculpture'* the sounds from the sculpture itself are supplemented in the final work by piano sounds that Gerhard had already recorded and processed.

Gerhard's notebooks contain numerous entries that discuss the relationship between form and the arrangement of materials in electronic music, and also the notion of bounded openness within controlled large-scale structures (an aleatory technique). *Audiomobile 2 'DNA in Reflection'* (1963) was subtitled by Gerhard 'an aleatory soundtrack' for Hans Boye's and Anand Sarabhai's abstract film based on the DNA model by James Watson and Francis Crick. As is evident from the final composition, *Audiomobile 2 'DNA in Reflection'* may contain a disparate collection of sounds, but they are brought together in a tightly structured, dynamic and vital work where all sounds have "a common purpose" projecting a clear "poetic imagery"[87]. Yet, despite the unofficial subtitle for *Audiomobile 2 'DNA in Reflection'* as "An Aleatory Soundtrack", Gerhard was against too much openness and considered the indeterminate approach that John Cage adopted a step too far, that:

> The notion of an 'open' work – in the sense of the poetics of *ale'a* [*sic*] – (in contradistinction to the poetics of *necessity*) is open to the charge that it issues in a 'teleology without,' (*adaptation* without *design*), a teleology in which the final cause becomes little more than a process of mechanism.[88]

In *Audiomobile 3 'Sculpture'* Gerhard utilizes a sectional structure that demonstrates the use of a variety of more improvisatory sounds, using the sculpture by John Youngman itself as a sound generator, as well as very carefully crafted pitch structures. On a larger scale there is also a balance between intuitively structured and highly organized sections.

When it came to the actual composition of a piece, Gerhard again had strong ideas regarding the dynamic character of a work. In the *Audiomobiles* radio talk of 1960 Gerhard critiques Luciano Berio's *Mutazioni* (1955). Although he admires the colouristic nature of the electronic sound materials, he nevertheless considers the work to have a 'structural impoverishment', despite the novelty of what Gerhard calls Berio's 'patterning technique'. In the broadcast he states that,

> […] the incidence of sound impact, single or in clusters, popping up all over the auditory space all the time in a quicksilver perpetuum mobile seems to succeed in filling it up evenly and with the satisfactory illusion of broad surface play effect […] and Berio is not quite as successful [as Bach's solo works for solo strings] in hiding the fact that his piece is but a one part – a single part

[87] Gerhard, 'Concrete Music…', 184.
[88] Roberto Gerhard, Notebook, CUL, Gerhard 9.109, fol. 5a.

> composition with one solitary strand. Berio misses the polyphonic depth – the structural richness of the interlocking simultaneous pseudo strands which Bach achieves.[89]

The polyphonic quality that Gerhard is talking about here is immediately evident in the *Audiomobile 'in the manner of Goya'* (1959), which he played after the Berio example. In its short duration (1'54") this work succeeds in conveying a restless polyphonic dynamic energy somewhat akin to the 'Tam Tam II' movement from Henry's *Le microphone bien tempéré* (1951). Utilizing low percussive sounds recorded from hitting the inside of his piano as his source material, Gerhard counterpoints this with other more pitch-based and gestural material, again predominantly derived from the piano but using sounds that have undergone more of a sonic metamorphosis. The sheer relentlessness and physicality of the work aptly conveys the intensity and psychological darkness that pervades Goya's late paintings. In line with thinking in fields of sound activity, Gerhard's sound compositions are driven by gesture and texture-led sections, the latter of which Gerhard further subdivided into lattice and grid-based. It is this interplay of gesturally differentiated sonic materials and the metamorphosis of textural materials that generates both local level and structural richness in Gerhard's sound compositions.

What all of Gerhard's autonomous sound compositions share, as well as many of Gerhard's post-1960 instrumental works, is a one-movement form. While earlier twentieth-century composers, such as Schoenberg in his *Chamber Symphony*, Op. 9, and Sibelius in his Symphony No. 7, had drawn all the formal elements of a classical symphony into a single musical span, Gerhard's one-movement works are often made of a number of clearly defined sections that do not adhere to a classical precedent. Gerhard wrote: "*One* movement form; preferable because breaks act as mechanical interruptions – their blank temporal duration is unrelated, non-integrated in the total form, breaks are like wedges fragmenting a whole"[90]. This technique can be seen in both large and small-scale works. The Symphonies Nos. 3 and 4 comprise seven and thirteen sections respectively, while the five-minute *Audiomobile 3 'Sculpture'* is made up of ten sections. What this one movement form enables Gerhard to achieve is not a synthesis of musical elements in the classical sense but rather to draw attention to the constant metamorphosis of materials and the temporal shapes that result. In another notebook Gerhard outlines various structural types that permeate and drive these works:

> Structural Types (Trains of events)
> I Statement (a) Main (b) Subsidiary
> II Introduction. Prelude
> III Digression
> IV Steady State events (slowing down of progress)
> V Transient, goal-aiming, leading events. Building up (speeding up)

[89] Roberto Gerhard, *Audiomobiles*, BBC Radio Third Programme (1960).
[90] Roberto Gerhard, Notebook, CUL, Gerhard 7.104, fol. 10a.

> VI Corollaries, consequences, expanding or overflow, liquidating, ~~building~~ down, terminating
> VII Closing, cadential events (also appendixes, after thoughts).[91]

The terminology here is interesting in so much that terms pertaining more to instrumental works, such as 'statement' and 'introduction', give way to sound behaviours more suggestive of Gerhard's notions of modes of action, configuration and textural weaving. Here again, the language of goal-aiming or liquidating musical behaviours is akin to the terms later employed by Smalley in his description of spectromorphology. The correspondence between Gerhard and Smalley, although unintentional, is again highlighted in Gerhard's discussion of timbre and musical space. The discussion of these topics in the later notebooks is not specific to instrumental or sound composition, but to the composer's approach to composition in general. Although Gerhard considered instrumental and tape composition to involve different methods of working, it becomes clear as his writings progress that his compositional thinking and aesthetic approach to approaching sound, be it instrumental or on tape, is increasingly unified. Therefore, the quotations below illustrate an approach to musical parameters equally applicable to instrumental writing and sound composition. Gerhard outlines various timbre types and considers timbre to be the:

> Interplay of all parameters
> Sound
> Silence (variable limits of tension before it becomes a hole in the fabric)
> Cluster
> Close-meshed
> Wide-meshed
> Pitched
> Non-pitched sound.[92]

In *Audiomobile 3 'Sculpture'* timbre becomes a key element in defining the metamorphosis of sonic material. Clusters, silence, pitched and non-pitched sounds are used to define the temporal shaping of the work. The last element to be considered is the auditory space of a work. Gerhard writes:

> Music has its being in a 3 dimensional medium.
> *Auditory space* strictly one dimensional, high-low location of sonic events. Quantitative expression in c/s [cycles per second]. Timbre is a special parameter in this dimension. Interaction of spatial and temporary dimensions result, through space [*sic*: time?] – ~~metaphorically~~ – impingin[g] on space and space on time. In real or actual span of the notes life: build-up-corpus-decay, and, on a larger scale: anticipation, actual perception (sense datum) + expectancy of things to follow.

[91] Roberto Gerhard, Notebook, CUL, Gerhard 7.105, fol. 32a.
[92] Roberto Gerhard, Notebook, CUL, Gerhard 10.175, fol. 8a.

Temporal extension: variability of durations + density of events = motion or speed (constituting 2 parameters in the *t* dimension).[93]

The passages cited above are just some of the numerous entries that can be found in Gerhard's notebooks on the subjects of form, structure, time and timbre demonstrating his increasingly sophisticated thinking about *com-position*, the putting together of sound, as a malleable physical medium. What they demonstrate is Gerhard's working though of these ideas through the practice of composition itself, as well as the composer's unwillingness to accept European writings on electronic music at face value. They document Gerhard's own thoughts about, and exploration of the new magnetic tape medium and its wider ramifications.

VIII. Conclusion

This article demonstrates Gerhard's unique position in post-war electronic music in Britain and further afield. Working in his own private studio and later in the BBC Radiophonic Workshop he created a series of works for radio, film, theatre and concert hall that exemplify his highly individual thinking about unique approaches that the magnetic tape medium offered. Although the magnetic tape collection at the Cambridge University Library is incomplete, it nevertheless remains the most significant and unique resource by far of Gerhard's electronic music. Research using the archive has led to Gerhard's autonomous works being published on CD.[94] However, much of the music for film, radio and theatre remains unpublished. This will become available via a website created in association with the Cambridge University Library as part of the 'Gerhard Revealed' project (2020) funded by the Arts and Humanities Research Council. Below is a revised worklist of pieces that include electronics as evidenced by the materials in the Gerhard tape archive:

Theatre

The Prisoner	1954
King Lear	1955[95]
Pericles	1958
Coriolanus	1959
The Cherry Orchard	1961

[93] Roberto Gerhard, Notebook, CUL, Gerhard 10.115, fol. 10a.

[94] Roberto Gerhard, *Electronic Explorations from his Studio + The BBC Radiophonic Workshop* (Sub Rosa, Belgium, SR378), 2014. The versions of the pieces on the CD have been re-edited and re-mastered by the author and Dr Alex Harker at the Centre for Research in New Music at the University of Huddersfield. Processes employed include reducing tape hiss and broadband noise, clicks, crackle, mains hum, tape splices and low frequency thuds using automated algorithms to a more painstaking manual clean-up of the audio spectrum.

[95] The original Panatrope disks in RSC Stratford archive.

Radio

A Leak in the Universe	1955
The Unexpected Country	1957
Ayslum Diary	1959
The Overcoat	1961
Macbeth	1962
The Anger of Achilles	1963

Radiophonic

Lament for the Death of a Bullfighter	1959[96]

Film

All Aboard	1958
Your Skin	1958[97]

Concert

Audiomobile 'in the manner of Goya'	1958-59
Symphony No. 3 'Collages'	1960 (orchestral + tape)
Caligula	1961[98]
Audiomobile 3 'Sculpture'	1960-61[99]
Audiomobile 2 'DNA'	1963[100]

Live Electronic

Claustrophilia – a page for John Cage	1966

[96] The work was not conceived of as incidental music but as a fully integrated text/sound work, hence listed as radiophonic.

[97] *Film is in the* UniLever *archive*, Port Sunlight, duration is 15 minutes with instrumental introduction and outro sections with electronic effects underpinning the narration.

[98] A tape only work, premiered at the ONCE Festival, 1962, not to be confused with incidental music of the same name.

[99] The final Version II may be later (c. 1967) as Gerhard continued to work intermittently on the series.

[100] This is the name of the work without the film. With the film it is called *DNA in Reflection.*

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