Finding Visual Music in its 20th Century History

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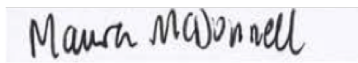Supervisor: Professor Matthew Causey

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Signed,

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Abstract

Visual fine art and music are typically considered to be separate disciplines and separate art forms. This, however, is not the case for visual music. Visual music straddles both visual art and music. Visual music has come to prominence in both contemporary arts practice activity and research, but it evolved out of a series of historical developments by artists, theorists and commentators who explored forms of an integrated art of music and visual art through the invention, application and/ or use of science, theories of colour, technology, painting, cinema, video, music technology and early digital computers. This thesis examines visual music in its 20th century history, taking into consideration important precursors to visual music in the 'colour-tone' analogies and experiments in natural science of the eighteenth century, the ensuing birth of the 'colour organ' and 'colour music' tradition of the eighteenth and nineteenth centuries and that continues on in the twentieth century to today, as one vein of visual music, in the real-time performance of colour, light and video in music performance works. The development of abstract art and absolute film of the late nineteenth and early twentieth centuries also played a significant role in the evolution of visual music, so much so that certain trends within visual music today are not entirely understandable without reference to this particular historical period of art and film. Development in music in the twentieth century likewise had a major impact on the shape of the content of much visual music, not only in terms of atonal music compositions but also in the particular efforts in creating *musique concrète* (Pierre Schaeffer *et al.*), for the purpose of television broadcasting. In a very important yet much overlooked respect, this thesis argues that visual music *concrète* is one way in which many composers (including the author of this thesis) has generated visual music.

The author has engaged in arts practice in the field of visual music and has contributed to the field since 1997. Her entry into visual music came from the perspective of music and music technology. The motivation for this research was to place the author's early visual music arts practice work in an art-historical context of the evolution of a visual music art in the twentieth century. The thesis has found that artworks described as visual music have two main characteristics that denotes its visual music status. The content of an art work can be a form of visible music in terms of the mathematical basis of vibratory phenomenon and its resultant visual patterns. Or, the visual music is a form of artistic expression that comprises an artist's desire to work with a relation between visual and music in the gathering together of the means, forms, conceptions of both visual art and music and related technologies and creating art works. The research relates some exciting discoveries, such as the experimental television work of the *musique concrète* composers and the television studios in France in the 1960s and their collaborative films and the innovative data approaches to a shared expression of visual and music in the Global Visual Music Project at the end of the twentieth century.

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Chapter 1   INTRODUCTION

Today, the term 'visual music' has become a well-known expression associated with a variety of artistic approaches that integrate a visual art and music expression into a single artwork. Such an artwork typically comprises some form of combined media from the visual art and music domains, but as history shows us, there are also instances of a visual music where there is no audible music part present, but the visual takes on the form of a silent visual music. What is of main interest in this thesis are those works in which the visual art and music are both present. The processes that facilitate the combination and integration of media and art domains come from a wide range of artistic, mechanical, and/or computational-technological means. The term 'visual music' itself, nonetheless, does not provide us with any specific meaning regarding either the visual or the music elements of the integrated artwork, nor does it prescribe or predict a certain style, medium or genre for the visual art and music produced. The term, rather, is used more like an umbrella term that captures an overarching practice and theme for several kinds of particular visual art and music practices wherein music ideas and visual ideas are fused together in the making and presenting of an artwork.

1.1   FINDING VISUAL MUSIC IN ITS TWENTIETH CENTURY HISTORY

Contemporary visual music is an arts practice that has evolved in time and over time. This research thesis revisits and examines closely the precursor artistic activities, events and artworks of the twentieth century and events leading up to the twentieth century that are of most relevance to the identification and understanding of the emergence of a visual music art. The purpose of this examination is to draw out the significances of the insights and discoveries made by such precursors in their articulations of a visual music to understand what visual music is in its capacity as an arts practice. The historical enquiry in this thesis ends near the end of the 1990s, culminating in 1998, at a point in time when the author had just already embarked upon her own visual music arts practice and research journey into visual music and had one of her visual music works presented in a music concert setting. The author's first combined visual art and music works were created between 1996-1998 and, at that time, were inspired by the technology of the electronic music studio. There was also at this time an increasing awareness that what was being done was quite new in the greater scheme of visual art and music practice. The author completed a Masters research project on the crafting of what she subsequently calls a visual music work (McDonnell, 'Towards One', 1998). The task set for this experimental work was to apply the concept of harmony taken from the mathematical basis of harmony in music both to the visual elements and

the crafting of synthetic sound in an electroacoustic music composition. The premise for the study was that the concept of harmony could be the basis for explaining the fundamental unifying principle of this new artistic integration of images and music. Disappointingly, it could not be concluded that this was the *sole* principle for such artistic integration. The main finding, rather, was that harmony as a concept did not fully explain all the dimensions of the imagery that were created for the artwork; nor could it fully explain the music composition she crafted. It only explained a very small part of the work. Harmony, as a concept, was only one of many thousands of possibilities for crafting visual music relations. This was the main conclusion of the Masters' project. A period of research commenced after this study in 1998. It was soon discovered that this search for a fundamental principle that explains the relation between visual art and music for visual music was not at all new, but in fact had been sought by many artists and inventors throughout history and in many possible forms of visual music relations. The author's twenty-year research journey has culminated in this PhD thesis document.

It was in the twentieth century that much of the groundwork for the emergence of a visual music art in the twenty first century took place. The sheer variety of approaches from artistic ideas to technological innovations in visual music that were part of the cultural contexts for each approach taken to create a visual music, makes it hard to generalise what was for each practice a particular project. However, it became apparent, time and time again in this research, that the term 'visual music' is a most useful and general category by which to describe these diverse twentieth century developments. This thesis, then, makes the argument that the designated term of 'visual music' is a very helpful term by which to describe the general overarching characteristics of these practices in the twentieth century. These visual music practices are part of a contemporary visual music history and thus provide a rich means for insight, understanding and future possibilities for the art going forward in the twenty-first century.

In the early twenty-first century the term 'visual music' began to be used extensively by a range of artists, filmmaker, and composers as well as by curators, commentators and academic researchers involved in exhibitions, academic studies, film screenings and music concert performances. Part of the particular interest in conducting this research, therefore, was to investigate to what extent artists and commentators were aware of the significance of the term 'visual music' at the time during the twentieth century as a descriptor, among others, for a new art in which a music and visual art expression are intertwined. This thesis will uncover the main commentators that used the term up to the late 1990s.

During the twentieth century, the term 'visual music' was used to describe a range of different art practices across a range of mediums. Initially, it described an observation of a new type of content arising from new approaches to the visual elements in a painting. It was used, for instance, by a range of authors in their discussions of cubist, symbolist and abstract painting (D.

Imgardt, 1909 quoted in Fry, 1912). Subsequently, the term was deployed to explain innovations in film for a new art within filmmaking (Diebold, 1916. Ruttmann, 1925) — indeed, it is in film practice that most histories of visual music are located. Later, nevertheless, the term 'visual music' was used to refer to a variety of forms of integrated electronic media art practices, though at the time artists themselves rarely described their work as 'visual music', such terminology being more often used by critics and commentators. In the mid-to-late twentieth century, other terms used by artists to name their endeavours to integrate visual and music elements in their practices were: 'musical light film'; 'video art'; 'audio-visual art'; and 'kinetic art'. Near the end of the twentieth century, nonetheless, the term was increasingly deployed by artists themselves to describe the overall intention in their integrated media art works comprising both the means and content in which a unity of visual images and music is sought and in which, for many artworks, both visuals and music were present in the final artwork. The author's own art and music practice which she started in 1996, and in which she used the term 'visual music' to describe the overarching art category for her work, is a case in point. One observation that the author discovered in the research for this thesis, is that what started out at the beginning of the twentieth century as in the domain of the critic to designate the term visual music to a work of art became a term increasingly used by *artists themselves*. This is an important development for art and music, for, over the course of the twentieth century not only did artists themselves comment on their own work but they also contributed to a commentary and analysis of the general context to which their artwork belonged. The starting point for this thesis, then, is the author's own current visual music art practice and her own curiosity as to how a visual music work operates and what it artistically attempts to achieve. It is from this specific standing point that the author engages in an analysis of the general art context of visual music to which her artwork belongs.

This finding of visual music in its twentieth century history, therefore, serves two purposes: it provides a rich historical context for examining and placing a contemporary visual music practice in an art-historical context and it identifies the relevant art-historical context for the author to integrate her own visual music practice in the context of an art-historical continuum. What is considered of significance in finding visual music in its twentieth-century history, then, is grounded in the author's own visual music practice. As the initial entry into visual-music for the author was via an influence of electronic music and in particular the efforts and pioneering work of *music concrète* of Pierre Schaeffer, the sub-title of this work identifies a much overlooked view on visual music in the twentieth century 'as a form of cinema one could call *concrète*'.

1.2   RESEARCH ROOTED IN THE ARTIST'S STANDPOINT

The research for this study into visual music is grounded in the arts practice perspective which having an active arts practice affords the author. As such, this study is not grounded *per se* in the

arts practice works of the author. By grounding the research in a particular arts practice perspective, rather, as the author has done here, it is envisaged that this will facilitate new ways of interpreting historical events and drawing out the key artistic motivations and questions behind historical activities. In this regard, each of the solutions found and identified in historical, art works resonate with the problem-solving nature of the author's own art-making activity and the fundamental question that she seeks to address in all her works which is what type of visual music relation is being sought.

In the author's own arts practice, visual music is at the core of the practice and is named as such. The author operates with three distinct but related perspectives in her work. Firstly, the visual art image can represent a music dimension; secondly, the music performance can be an extended visual composition that follows similar compositional and aesthetic processes to the music. Thirdly, a visual music piece both presupposes and entails some sort of music conceptual intent towards the creation of a visual art image. In the case of the author's visual music art practice, that intent is explicitly and deliberately sought in the creation of the visual aspect of the visual music work. Allied to this visual music concept intent is the crucial point that the visual is played or performed concurrently with the very music composition that informs and informed the visual. Here, the two parts of visual and music are unified in the visual music experience and in the result. In this respect, the visual music is an 'explicit' visual music expression that is informed by a subjective and considered visual music concept that went into the making of the visual part of the visual music work itself.

1.3   DISCOVERING NEW AREAS OF STUDY IN TWENTIETH CENTURY VISUAL MUSIC

The volume of artistic activity in the twentieth century across a variety of mediums and means of production provides the researcher with a rich field of study. Many contemporary authors on visual music are beginning to examine the field and, as a result, more artists are becoming aware of a vibrant historical context for their practice. There are many strands in the twentieth century history of visual music. These strands of activity might seem unrelated to each other, as one strand, for example, consists in identifying the experiments with the electronic video signal and another on the conceptual ideas for the content of a painting, or on the measure and duration of the transformation of a shape in the film frame. Much of the focus of historical visual music research to date has been on the visual dimensions in film-works as the archetype precursor of contemporary visual music work and on the musical themes of the content of early abstract painting. This study includes such research in its analysis and the contribution that this study makes is to tease out the extent to which critics and commentators at the time designated a visual music description to a work or commented upon the extent of the musical aspect of images. Several discoveries were made as a result of the research conducted in this thesis and these will

be summarised here. Each of the chapters, however, will go into more detail of the research conducted that brought the author cumulatively to such discoveries.

This study will also show that historical works also arose as a result of collaborations and considerations of a visual accompaniment to music from music studio technology-led experiments in the mid twentieth century which is also the domain of the author's point of entry into a visual music art practice. The history in relation to the role of the music studio in facilitating collaborative (and what the author would designate) early visual music works has been rather overlooked to date and is a rich field for further study. The author discovered the significance of these activities mainly because she is and has been curious about how music composers and artists collaborate and was on the lookout, as it were, for when such collaboration started, and the author's own background lies in music, art and media technology. Furthermore, the author was aware that the main area of influence for her own visual music practice came from knowledge of the science and technology of music as well as audio in the electronic music studio. The author is also aware of a vibrant community of contemporary music composers who use the electronic music studio to compose their music and who also craft a visual accompaniment, for example, Joseph Hyde, Diego Garro, Bret Battey, Dennis H. Miller, Vibeke Sorensen, Jean Piché and many more. The music technology-led approaches to creating an accompanying visual to a music soundtrack is an important direct precursor to a strand of visual music practice today that comprises electronic and electroacoustic music composers and musicians crafting their own visual accompaniment, as well as to electroacoustic composers who collaborate with visual artists to create hybrid performance works. This strand of practice is related to other sub strands of practice with images generated with a technological link to the audio data of the electronic music as represented in various processes and functions of machines and computers. Such activity is not necessarily conducted by composers but by electronic musicians and artists who create performances of closely related music and visual material. There is an increasing and prevalent trend in electronic and electroacoustic music circles today to employ a visual element in the presentation of a music concert.

In the course of enquiry for this thesis, the author discovered that several experimental films made from research collaborations between the *musique concrète* composers of the *Groupe de Recherche Musicale[s]* (GRM) studio, led by Pierre Schaeffer, and the *Radiodiffusion-Télévision Française* (RTF) (later renamed the *Office de Radiodiffusion-Télévision Française* (ORTF) in 1964) in Paris from 1960s onwards, has as much, if not more relevance to the author's own visual music practice as the canon of historical visual music works referred to and discussed in contemporary histories of visual music. A question that emerged after discovering this historical activity that relates closely to the author's own activity is can these divergent and historical precursors to visual music be accounted for and artistically reconciled in current

flavours of visual music practice? Can these music composer cum studio-led practices be brought into and accommodated within the visual music canon?

Another discovery made in the research of this thesis is the special significance of events arising out of an art technology research project that took place near the end of the twentieth century. The art technology research project instigated by the principal investigator Vibeke Sorensen was titled 'The Global Visual Music Project' (see 5.6.8). In this project the computational and technological tools related to the computer were investigated for their potential to create several music performance-works. Sorensen captured something of the essence of the change that took place over the course of the twentieth century which witnessed the development of global tools and technologies that facilitated not only a new type of access to music and visual as material but also a new type of music and image-making, as well as the potential for more people across all cultures to create and output visual music art.

At the beginning of the century, accounts of visual music themes in art was focused on geographical areas, for example, Roger Fry (1866-1934) wrote of a visual music referring to a French School of painting and William Moritz (1941-2004) referred to a Californian Visual Music School. Indeed, it is of course the case that there are pockets of activity in local geographical areas, yet, this arts practice Global Visual Music research project captured the shift that became the starting point for the twenty-first century visual music art as well as art in general. Here, the means for art and music making were accessible at the point of their data representations. Furthermore, the tools for working with such data were not nation, nor school specific, but available to owners of the increasingly common individual home computer devices that many people in the West had in their ownership.

Another rich area for historical research of precursors to visual music is to investigate the early experiments with television technology. The contemporary practice of video synthesis approaches to creating visual music works has already identified the main pioneers and precursors for its history in the video works activities of Nam June Paik (1932-2006), Steina Vasulka and Woody Vasulka (1937-2019), Steve Beck, Tom DeWitt and many more. This strand of artistic activity, like film, is well accounted for in visual music discussions. Of particular interest to the author is the role of television in the instigating of the experiments that took place by filmmakers using *musique concrète* music compositions as their soundtracks. The initial reason for the creation of images with *musique concrète* music was in order to output the results of that combination for television broadcast. This thesis considers this to be of considerable significance for visual music as it sets the seeds for the collaborative nature and potential of combining an image with electroacoustic and electronic music for a combined media presentation, and this resonated with the author's very first visual music work, created in 1997, which was conceived as being a television broadcast artwork. Of course, the developing television technology

facilitated a technical means for presenting visual music works as well as providing for others the technology as a means for making the art. What came out of a consideration of television as a form of dissemination for these images and *musique concrète* music pieces was that such integrated film works could be presented in new types of setting such as in a music concert setting.

Another discovery made was the significance of symbolism in painting and conceptions of the absolute and higher realities that were explored as themes and content for painting. Some of the themes that the symbolist painters explored were based on the exploration of musical ideas and structures and applying these to the form and content of painting. In such paintings (by Mikalojus Konstantinas Ciurlionis (1875-1911) and Pavel Kiznetsov (1878-1968), for example), the emergence of a steady stream of artistic activity that explored sonic themes for visual art emerged to such an extent that one could identify the sonic theme as being a general and common characteristic across all the variety of the mediums and variety of approaches to crafting a visual content for an artwork.

Other more commonly known origins for a visual music are the continuation in the twentieth century of a tradition from the late eighteenth and ninetieth centuries of building instruments to play and perform colour. These inventions in their basis explored the possibility of a scientifically demonstrable analogy between colour and sound. Yet, there are cross overs with other art mediums as the analogy between colour and sound was also explored in painting and film. The impact of electronic visual and audio technologies and the subsequent digital video and audio technologies near the end of the twentieth century meant that novel ways and means could be used to create both images and music and to put together images and music. The author has uncovered some already known practices in the area of film and painting (such as the paintings of Paul Klee (1879-1940), Wassily Kandinsky (1866-1944) and the film works of Viking Eggeling (1880-1925) and Oskar Fischinger (1990-1967)) and some relatively unknown practices for the visual music community in the area of music technology (such as the film work arising out of the music *musique concrète* music studio and the conversations between Kinetic artist Frank Malina (1912-1981) and Pierre Schaeffer (1910-1995)) and its influence on the evolution of utilising visual projections for music performance settings, such as in ballet performances (such as the collaborations between *musique concrete* composer Pierre Henry (1927-2017) and kinetic light sculptor Nicolas Schöffer (1912-1992)) and culminating in the music concert performances in late twentieth century (such as the authors own visual music work performed in a music concert in 1998).

The desire of this study is to find the visual music across all these ranges of practices and to bring them together into one place so that one can compare the various conceptions and practices of visual music in the selected art works examined. The title 'finding visual music in its twentieth century history' captures the journey through the twentieth century of the various

artistic and technological developments that contribute to the context from which visual music today takes place. The study draws out to what extent was there a conception of visual music during this period. The subtitle, 'a form of cinema one could call *concrète*' reflects the author's own particular entry into visual music in the 1990s, as being a visual form of *musique concrète* and that such an approach has its historical roots in the collaborative research film works made between filmmakers in the (RTF) and the *musique concrète* compositions of the GRM, led by Pierre Schaeffer. Indeed, Schaeffer used a similar phrase in an interview in 1959 (see 5.3.5). There have been some omissions in this examination of the twentieth century history (see 1.6) and the author would like to acknowledge that in the late 1990s that many new forms of art and music making and many new modes of performing art and music were emerging, just at the cusp of the twentieth first century. The scope of the study ends just before those developments took root. The twentieth century is when visual music was born, and the twenty-first century is where visual music became a recognisable art practice and a term for describing a range of combined art practices that utilise a visual music expression. This thesis aims to find out what that visual music expression is to be found in its twentieth century history.

1.4   RESEARCH QUESTIONS

In light of both the historical studies of visual music and the author's own experience of creating visual music works of art, this thesis raises the following questions: to what extent is visual music, as it is currently practiced, a continuation or a radical new departure within the history and evolution of visual music? Is visual music in contemporary practice the fruition of the earliest attempts at a visual music art? Or, is it a unique new type of art activity that is a product of mid- to late twentieth and twenty-first century music, art and technological innovations? What are the similarities and differences between the usage of the term 'visual music' to describe art works and art practices in history in relation to the understanding of the term 'visual music' in the author's art practice? Can finding out the different contexts for the usage of the phrase tell us about the main characteristics of the term visual music as it was applied in history? Can we arrive at a definition of the concept of visual music from the consideration of the various general conceptions of the term visual music identified in this research?

As well as addressing the above questions about finding visual music in its twentieth century history, the research into the evolution and development of visual music in the twentieth century will be guided by three main research questions. For each question, a short overview is provided.

Research question 1- conceptions of visual music: What conceptions of visual music are there in the historical arts practices of the twentieth century? Was the term visual music applied by artists and commentators at the time and, if so, to what did it refer? Can other arts practices

also be understood as belonging to a history of visual music, and if so, what kind of visual music relationship is sought therein?

1. The study of the concept and historical evolution of visual music is in its infancy mostly involves a process of identification and description, pointing out the significant works and artists who worked with visual images related to musical ideas in some way through various technologies, but mainly through film. In these histories, rarely is the evidence for the actual usage of the phrase presented, works, instead, being claimed to be visual music works. This thesis is interested in finding out whether there is evidence in history for the deployment of the term 'visual music' and was it used as a term at the time to demarcate and describe works that have become the typical historical works to be named and claimed as historical visual music works? Are there any new discoveries of works from the past to be made that are of relevance to the history and concept of visual music and that need to be included as precursors of art activity characteristic of visual music? While examining the historical works, the thesis is interested in finding out what conception of 'visual music' that a commentator or artist had in the art work so described, and whether this conception of visual music can contribute to today's understanding and evaluation of visual music? Research question one, then, is about conceptions of visual music.

Research question 2 – the means, methods and technologies of visual music: Are there common and general characteristics of arts practices across different mediums, technologies and techniques?

2. Many authors and artists today know of many other precedents to contemporary visual music that have taken place in recent history across a wide-range of art works, art forms and mediums that make use of a wide variety of technologies. The differing technological aspects of the practices can make it seem that these are unrelated and unconnected arts practices, and that the visual music meaning is determined mainly from its technology. This thesis is interested in identifying the common visual to music aspects from these diverse technological practices and to ascertain can this too contribute to today's understanding and evaluation of visual music? This is research question two and it concerns the means, methods and technologies of visual music.

Research question 3 – the visual music expression: What is the main type of expression taking place in a visual music work in the visual part of the work? Can it be identified and defined? Is there a language of visual music and a concept of visual music? Where does that language come from, and what are its main influences?

3. In visual music, there are two parts at work, the visual part and the music part. When a visual music work is experienced, it is quite difficult to decipher the means of making that work, whether the work is fixed or generated live, or to determine whether the music is composed first and the visuals second, or *vice versa*. The visuals and music unify in the experience of the work.

Is this, therefore, a common principle of visual music that a unity is achieved and is experienced? Is the unity of visual and music the ultimate goal of a visual music? If so, how is this unity achieved in the craft of the work? It is the belief of the author that the unity is perceived through the visual part, regardless of whether the visual is set to music, or the music is scored to the visual, or has been generated through technological means. This thesis is interested in examining how the visual part develops its own visual language of expression that is related to the music part in some way and then deploys it in a visual music work. This is the third research question: it concerns the visual music expression.

1.5 RESEARCH APPROACH

The approach to visual music taken in this research seeks to uncover and identify evidence of relevance to the evaluation of the emergence of a visual music conception of an integrated visual art and music in the twentieth century. The starting assumption is that visual music is not art domain, medium or technology specific, but an artistic activity that has a broader art base from which it operates; that is to say, it is an activity encompassing several art disciplines, mediums and technologies. The study did start with some prior knowledge by the author about the field. The author had a particular interest as an advocate for the field of visual music and considered herself as being one of its first practitioners to designate her own work as visual music in her earliest work at the end of the twentieth century and at the beginning of the twenty first century. Thus this research was informed by the artist's own conception and visual music arts practice.

Visual music in the twentieth century clearly arose from an interaction between science, music, visual art, cinema and technology and it developed into an active practice through the new mediums of video and computational techniques arising from the development of the computer as a new tool to make music, and from film and video work. Working through the fields of influence and the various disciplinary contributions, nonetheless, was a challenge. The author wanted to present the findings of her research by organising the thesis and its writing according to the main themes identified as of importance for an understanding of the emergence of visual music in the twentieth century. The approach, therefore, was both to identify these key themes and to select accordingly the commentators, artists, and artists' works that helped to shed light on the theme.

Finding the evidence for a visual music approach to art required examining in the first instance those authors and artists who used the term 'visual music' for their works and to analyse why and for what purpose did they used the term. The research also examines important developments and artists who did not call their work 'visual music' but who explored approaches to an integrated visual art and music, for example, the development of the colour organ tradition and the development of abstraction in painting. A little background context for each author, artist

or work is also provided to help locate the visual music and integrated art practice in its contemporary setting. By presenting such evidence, the background context and organising the analysis into themes, it is intended, therefore, that this approach will thread together what, at first, might seem like being very separate and disparate developments. Attempts at unifying or connecting disparate and different practices can be made in relation to the emergence of visual music in the twentieth century.

What is of interest in all texts is the key characteristics of expressiveness that an artist or commentator identifies in their work as visual music, their conception of music and its role in the elaboration of a visual language in their work, how they view their art works as a whole, such as a new art comprising an integrated visual and music art, and their conceptions of the visual composition in relation to the music part. The integrity of the research requires the author to not read back into historical texts and works and revise an author's own views on their art and their intentions and approaches, as much as possible, in favour of seeking, instead, to present the author's, artist's or commentator's views themselves. The author, however, did weave together the individual artists' approaches into a narrative that helps to make sense of the complexity that is inherent in the examination of visual music.

The main difficulty in the examination of visual music is that it does not have a disciplinary home. It is not cinema, nor visual art, nor music; it is, rather, an amalgamation of all these forms of art, and yet it incorporates a significant input from science and scientific knowledge. Nor is this amalgamation the same for every work that employs a visual music approach. Each artist brings to bear their own starting points in terms of knowledge about an artform, their own means by which to realize their art work and their own curiosity and experimental mind that interacts with their previous knowledge and means. The innovations of the abstraction painters in this regard are key in their promotion of a new type of image content for visual art.

The aim of this study, therefore, is to show how by the end of the twentieth century visual music practices evolved and developed into a more consistent and established type of artistic activity that became conscious of itself as a visual music activity.

Having commenced her visual music practice in the twentieth century, the author considers herself well placed to ascertain the key influences on her own development as a visual music artist and is confident about starting her enquiry into visual music from an art practitioner's standpoint. Her knowledge and areas of influence have come from music, mathematics, music technology and visual art. It is in relation to these areas of influence that the author first started to examine the evolution of a visual music.

1.6 Scope of study

The research scope of this study has been to focus on twentieth century developments in visual music. At times, however, it was necessary to provide some earlier context prior to the twentieth century, in order to explain a particular practice or technique that was inspired by that approach (e.g., ancient Greek Pythagorean reflections on music and mathematics). It had been hoped to include a discussion of the practices of the twenty-first century of which the author is very familiar, having followed the contemporary field since 2002. Although this is of great value to the author, it was felt that, for this first study, this was not necessary in order to do justice to the practices and techniques of visual music in the twentieth century. Furthermore, including the practices and research of the twenty first century would have made the study too long for the purpose of a dissertation. A future study could examine the twenty-first century practices and research into visual music. Moreover, in the writing phase for this research, it was also found that there was a natural break in the topic on two fronts. One, the author's own practice can be distinguished into two phases – the first phase in the twentieth century and the second phase in the twenty-first century. Initially, the author's created practices in the final years of the twentieth century was heavily influenced by music technology processes and developing a content for television broadcast. The technology used here comprised a mix of analogue video and computer video techniques in the crafting of the visual part. The author then embarked on independent study into visual music for ten years, and took up her arts practice again in 2010, after a ten-year gap. This second phase of her art practice in the twentieth first century was based on a lot more knowledge about the field and was geared towards a different type of output and dissemination, that of the music concert and the short-film screening genre. The practice was also wholly digital and often computational as data from audio files was used to interact with parameters pertaining to image and video files in the computer. Indeed, the end of the twentieth century saw the beginnings of various forms of digital technologies, techniques and methods for creating images and sounds. Up until this development, there were a variety of mediums, arts, technologies and techniques used to explore a visual music.

Another limit in this study has been to narrow down the examination of visual music to focus on the visual forms of expression and content in a visual music work and the manner in which a visual language has been utilised by an artist taking influence from some aspect of music and its musicianship, its physical nature, and its technological interventions. This does not mean that the musical aspect is of lesser importance, on the contrary, the music part is an extremely important part of visual music. The author, nonetheless, was interested in finding out in what way the *visual part* took on board its musical counterpart and how did that musical aspect influence the choices made in creating the visual part of the work. It has been of interest to the author for some time to examine the visual language of expression in visual music and to elaborate

that visual language from the art-historical continuum. This thesis, then, limited its analysis to the visual part of the visual music work.

Although this study declares that it is finding visual music in its twentieth century history, not all artistic activity has been examined and some fields that have not been examined in great depth, such as, video synthesis and the emergence of various forms of audio-visual performance across a range of genres, from Disc Jockey (DJ) and Video Jockey (VJ) music gigs, to new music audiovisual concerts. There has been some discussion of these approaches where an artist's work is examined, and so, they have not been totally left out. The area of the evolution of graphic notation and graphic scores has also been omitted, in particular the pioneering work of Iannis Xenakis (1922-2001). Composers who were influenced by painting ideas such as Morgan Feldman have also been omitted in this study. Such omissions, however, do not mean that they are not of importance or significance for a visual music history. Rather, the focus in this thesis was to provide some contribution to the many varied approaches of conceiving a visual music, from either a visual art, musical or technological perspective. Artists and the works examined in the thesis, therefore, are representative of some aspect of the visual music field that the author wished to highlight. It is hoped that the sample artists' works examined will contribute to giving us a picture of visual music as it emerged and developed over the twentieth century from a practitioner and researcher's perspective. There are many important contemporary artists, filmmakers, composers who are active today and were active in the late twentieth century also, but the author has been unable to include in this study, due to limits of the thesis' length. There has also been a deliberate choice to include, as much as possible, the works and ideas of female artists and inventors.

1.7 STATE OF THE ART OF VISUAL MUSIC

1.7.1 HISTORICAL BACKGROUND ACCOUNTS OF RELEVANCE TO VISUAL MUSIC

The main historical precursors to our present audio-visual culture and contemporary visual music practice have been described in various short articles and essays (Moritz, 1985, 1996; Zilczer, 2005; Strick, 2005; Naumann, 2009; Daniels, 2009a; Shaw-Miller, 2009; McDonnell, 2007, 2009, 2014a); on websites and in festival and exhibition catalogues (Brougher *et al*, 2005; Riccò, D. and de Cordoba, M.J., eds., 2007, 2009, 2012, 2015, 2018; Schobert, ed., 1993; Visual Music Marathon, 2007, 2009); in dissertations (Levin, 2000; Holsopple, 2003; Mollaghan, 2011; Cope, 2012, Payling, 2014); and in recent book publications (Mollagan, 2016,; Abbado, 2018). There are several monographs on historical authors, for example, on Oskar Fischinger (Moritz, 2004; Keefer & Guldemond eds., 2013) and Viking Eggeling (O'Konor, 1971). Rogers (2013) has also conducted a theoretical analysis of the contribution of the first decade of video art and technology

in the art gallery and its cross-media and cross-disciplinary underpinnings. There has been some theoretical work examining the wider field of the boundaries between music and art in the context of nineteenth to twentieth century modernist cultural activity where cross-fertilization occurs between the two arts (Shaw-Miller, 2004). Under the framework of developments in film and *avant-garde* art movements of the twentieth century, R. Bruce Elder (2008) provides an in-depth account of practices in this historical field that is of relevance to a visual music history. Extensive historical research has been conducted by Peter Vergo on the connections between visual art and music, covering 'two thousand years of history from the time of Confucius to the heyday of the European Enlightenment' (Vergo, 2005) and from the mid-nineteenth century to 1950 (Vergo, 2010). Historical research on the colour-tone analogy and its applications has been conducted by Olivier Darrigol (2010a, 2010b), Maarten Franssen (1991) and by the musicologist Jörg Jewanski (2010). Jewanski's doctoral thesis was on the history of the musical light film. The historian and filmmaker William Moritz (1941–2004) authored and published widely on visual music, animation, and film topics for over a thirty-five year period. He also published monograph articles on several filmmakers, such as: Oskar Fischinger, Mary Ellen Bute and Harry Smith. One of his early writings on visual music 'Towards an Aesthetics of Visual Music' was written in 1986. Here he refers to a visual music composition's experimental nature:

> Are there 'rules' for the composition of Visual Music? Perhaps so, but not any easy, exact values — no one colour or shape or motion is always equivalent to a certain tone or chord or rhythm. And the secrets of constructing a satisfying overall structure must be learned from a great deal of comparative study of successful and unsuccessful Visual Music compositions — and a lot of trial-and-error practice! (Moritz, 1986)

Moritz was also a member of the Visual Music Alliance (VMA), Los Angeles, U.S.A. It was a group that changed its name over the course of its existence and it ceased operating in 1992. The VMA group sought to promote works that integrated visual and audio media as an art form. One of the Center for Visual Music's (CVM) collection and archives pages is devoted to providing texts, dates and source documents in relation to this group (Centerforvisualmusic.org, 2011). According to CVM, the VMA was originally named the 'Music and the Arts Technological Center, Inc.', and it was founded in 1971, but sometime after this, there was a name change to 'Visual Music Alliance' in 1980.

> The Visual Music Alliance (VMA) was founded in 1980 by a group of professional film and video artists and musicians to promote the visual/audio media as an art form and to fill the information void on the cutting-edge technological developments that were altering the face of the moving-image arts. (ibid.)

Documents show that the name was in use in a periodical in 1982. CVM provide a quote in a paragraph in the periodical titled 'What is Visual Music' in the October 1982 periodical *The Relay*.

> Visual Music is a dynamic art form combining visuals and music, which interact to achieve a unique effect that would be impossible with either discipline alone. In its ideal form, Visual Music is an exciting combination of disciplines that is repeatedly viewable, wherein the music and visuals complement each other. This creative combination of form, colour, motion and music promises unlimited prospects for artistic expression. (ibid.)

In 1994, the United States based arts organisation, the Iota Center was founded by Larry Cuba to foster an international community of artists grounded in the dissemination of works both contemporary and historical experimental works and in academic enquiry. The Iota Center draws our attention to the teleology of terms to describe what is effectively similar approaches to crafting images and music in film and video technology, noting that its name has changed but that at present, visual music is the term most in use and states:

> Historically, the artistic exploration of abstraction in the moving image has taken on many forms with a wide variety of names: Lumia … Visual Music … Mobilcolor … Absolute Film … Video Synthesis … Rhythmic Light … Abstract Animation. Today the medium is commonly referred to as "Visual Music". We believe that there is a vast amount of interconnectedness between these varied techniques and titles, and that their common artistic goals can unite them into a single art of light and movement. As the first arts organization to dedicate its mission to visual music, we continue to expand our resources and collections in this area. (IotaCenter (n.d.b.)

The Iota Center is an active organisation today and focuses on the building of collections and in the curation and dissemination of works, and states:

> Although Iota's interests span many interconnected areas of historical experimentation, the medium for which we have the richest collections and resources is experimental film and video work with a special emphasis on abstract film, animation, and films from West Coast artists. (ibid.)

In 2003, Moritz, along with Barbara Fischinger, Jules Engel, John Whitney, Jr, and Cindy Keefer, founded the Center for Visual Music (CVM) in Los Angeles. Today, CVM is an active organisation today, under the directorship of Cindy Keefer, with an international membership of contemporary visual music artists, theorists and curators interested in the field of visual music (and for which the author is also a member). The CVM is involved in the archival preservation and promotion of visual music and abstract cinema, and in the curation of historical film screenings and contemporary screenings and exhibitions. On its website it states that it is:

> A non-profit film archive dedicated to visual music, experimental animation and abstract media. CVM is committed to preservation, curation, education, scholarship, and dissemination of the film, performances and other media of this tradition, together with related historical documentation and artwork. (ibid.)

There has been an increase in artists engaged in the visual music field who are also writing about their practice, this has grown considerably in the past ten years from academic based arts-practice research across a range of publications and journals. Such literature, however, is beyond the scope of this thesis (see 1.2.3). This growth of artist-led research knowledge dissemination

and networking opportunities, nonetheless, has been greatly aided by an important development that took place in mid-twentieth century. In 1967, Frank Malina launched the *Leonardo* Journal, published by The MIT Press, with the aim of providing a platform for artists to contribute to intellectual life in a systematic and clear manner, similar to the way that scientists share their research and build knowledge based on each other's findings. He had noted that artists had no platform from which to write about their own work and processes but, instead, had to rely on a tradition of critics to disseminate the knowledge about their artworks. In 1996–1998, his son Roger Malina explains that:

> These ideas led Malina to found the new art journal 'Leonardo' in 1967. This was to be a journal for contemporary artists where the artists themselves would write about their own work. It would be a journal of ideas where artists could exchange information and obtain information. There would be articles by researchers in all other disciplines which had bearings on the arts and the journal would have an international scope. (Malina, in Olats.org, 2011)

Frank Malina was a kinetic artist and astronautical engineer. He acknowledges the differences between how artists and scientists share the knowledge which they have generated but remarks that work 'in the fields of the engineering sciences and visual arts leads me [him] to support the view that in both these fields the "creative" process is basically similar, even though their objectives are so different' (Malina, 1968a). Since the establishment of *Leonardo*, this type of model for disseminating the work of artists who engage also with the research part of their practice has been continued in several other peer-reviewed academic journals. For example, the *Computer Music Journal*, founded in 1977 and published by The MIT Press, publishes research on computer music, digital sound technology and musical applications of the computer. The peer-reviewed journal *Organised Sound, An International Journal of Music and Technology*, founded in 1996 and published by the Cambridge University Press, presents research on how the application of technology on music has an impact on music and other art fields. Landy explains the rationale of this journal, noting that it:

> focuses on the rapidly developing methods and issues arising from the use of technology in music today. It concentrates upon the impact which the application of technology is having upon music in a variety of genres, including multimedia, performance art, sound sculpture and music ranging from popular idioms to experimental electroacoustic composition (Landy, n.d.)

1.7.2   BACKGROUND CONTEXT - AN EMERGING ACADEMIC COMMUNITY

In the academic publishing, practice and research community, leading publishing houses, such as Oxford University Press and Routledge, have recently published several *compendia* and edited collections. They have also started to scope the wider field of music and visual culture and to bring together disciplines for the purposes of analysing and examining similar research questions, but from the separate perspectives of their disciplinary expertise (Richardson *et al*., 2013;

Shephard *et al.*, 2014; Kaduri, 2016). These developments demonstrate that the wider academic community is taking notice of the audio-visual cultural trends and is giving it some attention. In recent years, there have been several artist-led academic research *symposia* on visual music and related areas that have enabled such practitioner-theorists to share their research and artworks. For example, three international 'Understanding Visual Music' *symposia* (UVM) were held in Montreal (2011), Buenos Aires (2013) and Brasilia (2015). These focused on 'research-creation processes and multiple relations between art, science and new technologies that are key factors in obtaining creative results, when working with a universe composed of moving images and organized sound' (Ceiarteuntref.edu.ar, 2013). In 2012, the International Symposium on 'Visual Music', organized by the School of Art, Design & Media (ADM), Nanyang Technological University, Singapore had the theme of 'Visual Music and Visual Music Research & Studies' (Adm.ntu.edu.sg, 2012). Recently, a symposium presented by CVM in association with Sonoma State University, the Center for Visual Music (CVM) Symposium 2018, with the subtitle 'Exploring and Preserving Visual Music', (Centerforvisualmusic.org, 2018), explored the theories, histories and practices of visual music.

In 2012, *Organised Sound* devoted Volume 17, Number 2 issue to the topic of 'Composing Motion: A Visual Music Retrospective' (Fox-Gieg *et al*, 2012), co-ordinated by Margaret Schedel and Nick Fox-Gleg. In its call for submissions, it draws upon the scholarship of experimental electroacoustic composition to encourage scholarship in the visual music field, noting an equivalent language between visual music and electroacoustic music in particular: 'The language of electroacoustic music is particularly suited for the abstract imagery of visual music. If music is organised sound then visual music is organised image' (Composing Motion, 2010). Articles on visual music related topics were contributed by Diego Garro, Bill Alves, Anton Fuxjäger , Lindsey Vickery, Peter Manning, Ryo Ikeshiro, Ewa Trębacz, Andrew V. Uroskie, and Brian Kane.

The open source international journal *eContact!*, an online journal for electroacoustic music practices founded in 1998 and published by the Canadian Electroacoustic Community (CEC), is 'dedicated to the exploration and promotion of the richly diverse discipline of electroacoustic practices' (About eContact, 2017). In 2014, it devoted its 15.4, April 2014 issue to the topic of videomusic and visual music (coordinated and edited by Jef Chippewa). Several articles in this issue are on the topic of visual music (McDonnell, 2014; Saint-Denis, 2014; Garro, 2014b; Weinel & Cunningham, 2014). In the editorial for this edition, Joseph Hyde explains that videomusic is a subset of visual music:

> Videomusic is a field of practice that could be seen as a subset of visual music, a term which can be considered today to be familiar enough to speak for itself. This broader area of artistic activity includes digital work, cinema, painting and visual 'instruments', and dates back at least to the 18th century. (Hyde, 2014)

These two publications mark the continued recognition of visual music as a field of research and arts practice in both the fields of sonic arts and electroacoustic music. Other rich sources of information and dissemination of knowledge in the field of visual music are through the talks, presentations, articles and essays that are commissioned for symposiums, exhibitions, screenings and festival catalogues.

1.7.3   2005 AND 2007 – VISUAL MUSIC ON THE WORLD STAGE

In 2005, two distinct and unrelated major events took place in the art and music communities that demarcate the starting point of a wider awareness of visual music as comprising more than a historical literary or methodological correspondence between visual art and music but as denoting a new type of art music work and practice on its way to becoming a global practice. The first of these events was a major art exhibition entitled 'Visual Music' in the formal art institution setting of the Hirschhorn Museum and Sculpture Garden, Smithsonian Institution, Washington D.C., and The Museum of Contemporary Art, Los Angeles, U.S.A.. The exhibition displayed and installed works from historical and contemporary bodies of works that related to its main theme. A book *Visual Music: Synaesthesia in Art and Music Since 1900* (Brougher et al, 2005) was published by Thames and Hudson in the same year 2005, and edited by the organisers of the exhibition. It accompanied and documented the exhibition, and it included additional scholarly essays on topics related to the visual music theme of the exhibition. This exhibition indicated that many practitioners were creating works from either a visual art or music perspective which shared common features, such as, the close integration of the music and visual art expression and the use of audio and video media to present the art simultaneously. Visual music, however, was not defined as a formalised movement for this exhibition; it was acknowledged rather as being a little known but alternative tradition in the history of abstract art since 1900 that had 'evolved into a significant current within modern and contemporary art' (Brougher et al, 2005, 10). In his essay 'Expanding the Synesthetic Paradigm', however, Ari Wiseman does present a general definition of visual music and observes:

> Visual music comprises a diverse range of art practices that assimilate abstract qualities found in music — including movements, rhythm, tempo, mood, counterpoint, intensity, harmony, and compositional structure — within visual phenomena. (Wiseman, 2005, 181)

Later, in the same year, the *Computer Music* Journal published its Winter 2005 issue, Vol. 29, No. 4 on the topic of visual music, and here in the academic music field the editors defined visual music as entailing,

> audiovisual creations in which the artist strives to endow the video component with formal and abstract qualities that mimic those of musical composition. This emulation often, but not necessarily, derives from a more or less direct mapping between sonic elements in the soundtrack, on the one hand, and time-varying visual parameters in

the video track, on the other. The more direct mappings bring to mind the rare perceptual phenomenon of synaesthesia, as noted by several of this issue's authors. Visual music can be solely graphical, but the present authors are computer music practitioners who also work in the visual domain. (Terry, 2005, 4)

In 2005, then, both the visual art community and the computer music community made a concerted statement, albeit from each of their separate disciplinary perspectives, noting that visual music had arrived. The former event emphasized the visual art that explores the qualities of music in its work and the latter emphasizes the computer music practitioners' mappings of abstract sonic elements in the soundtrack to formal and abstract qualities in a video component. This demonstrated that music composers also worked in the visual domain in their music compositions. At this time, these two publications represented the two major modes upon which a visual music work is often crafted: the visual art perspective and the music composer's perspective. For the visual artist's point of view, the art is assimilating music into its own art language, and from the music composer's perspective, the composer is extending the music language to a visual expression.

In 2007, Dennis H. Miller, a music composer, academic, and visual music artist, curated a monumental international event in North Eastern University, Boston, U.S.A., as part of the Boston Cyberarts Festival 2007, entitled the 'Visual Music Marathon'. This event consisted of twelve hours of non-stop visual music, historical films and video screenings. It was repeated in New York at the Chelsea Visual Arts Theatre, and hosted by the School of Visual Arts, New York in 2009. This event was unique for visual music practice in that it was based on an open call for works, and Miller was able to present twelve hours of back-to-back screenings of the highest quality pieces, containing both historical films in the abstract film genre and many contemporary works. It was this event that really marked the world-wide phenomenon demonstrating the extent of the practice in which artists, musicians and composers were working with moving images and sound in a close expression — a visual music. An essay was commissioned for the catalogue (McDonnell, 2007, 2009), and reviews of the event were positive. McMurray wrote a review of the event for the *Computer Music* Journal (McMurray, 2007). One of the contributors, the studio-artist turned visual music artist, Jean Detheux, wrote an extensive article for the Animation Network, entitled 'Visual Music Marathon: Musical Fine Art Animation Benchmark' (Detheux, 2007). He interviewed some of the participants and documented their views as well as his own about this practice-based event on visual music.

These two events contributed to a statement about visual music that put visual music as a term and art practice on the world stage. Of course, they are specifically events that refer to a world stage that was happening in western culture. However, there is another world stage that was also happening for visual music at the cusp of the twenty first century as a result of the proliferation of world-wide media and technology, in which visual music was developing in non-

western cultures such as Indonesia and India and where an evolution of their own living traditions into visual music work took place as well exchanges between western and eastern music cultures. In Bali, musicians began to work with public video mapping projection and music in performances, building on their own traditions of musicians performing with shadows and music simultaneously. Similarly, in India associations are made between visual art images and music. The emergence of a rich multicultural exchange between western and non-western art traditions is having some considerable influence on many later western artists of the twentieth century such as Len Lye. The contemporary animation film director Ishu Patel, who was an animator at the National Film Board of Canada (NFB) for twenty five years, produced a number of visual music works that was influenced by associations between visual art and music of the Ragamala (see his film 'Bead Game', 1977). The investigation of such developments is beyond the scope of this thesis, but it is of importance to note that such global developments are also at work on the world stage of the evolution of a visual music art.

1.7.4   THE AUTHOR'S CONTRIBUTION TO VISUAL MUSIC

The author has been active in contributing to the international visual music field as a distinct area of practice and field of study, and has been involved in networking, sharing, promoting, teaching and disseminating knowledge about visual music since 1999. She has met many like-minded individuals and groups who are engaged in similar activities in relation to visual music and its related fields. This thesis is conceived of as both an enquiry into visual music and as a field of study. It is thus a consolidation and gathering together of the findings that the author has accumulated over twenty years of research culminating in the formal research that has been carried out in this thesis. The author also has an arts practice that she names as visual music too. It is this visual music arts practice that she started in 1997 that has been the main motivation for the author to enquire more into the art of visual music. Her own education consisted of keeping the arts separate. This was not at all satisfactory as a knowledge basis for being able to work with two means of expression, such as abstract visual art and music, which the author was keen to explore. Increasingly, the intermingling of the visual arts and music and the use of technology to explore relationships and combinations of visual art and music, has enabled practitioners and theorists to address the inter-art and inter-disciplinary nature of today's visual music practice. Indeed, even still now, she hears of experts saying that artists should not engage in theory and should let the researchers get on with the formulation of theory, or that music composers are a special breed of which those not trained in music composition need not consider doing. This also is not satisfactory for the author. Her passion for understanding the nuts and bolts of this combined arts practice as well as creating art is what drives her desire to theorize on the kind of arts practice to which her art belongs. This thesis, then, addresses the art-historical continuum in

which her own arts practice resides. The author designates this to be a visual music arts practice. Visual music is not a new concept; nor is it a new art when one examines the history of artistic efforts to combine the two arts of visual art and music. Visual music and such approaches to a combined artistic expression, however, are a relatively unknown history in music or visual art. Visual music approaches are not considered in film theory or in the history of cinema. These main domains of enquiry touch on visual music sometimes, but not consistently. This thesis, therefore, seeks to bring together those domains, practices and approaches in the twentieth century that sought an integrated visual art and music expression.

Today, visual music is a much more common term used by commentators and practicing artists. One commentator, for instance, has even remarked that 'visual music, [is] a term which can be considered today to be familiar enough to speak for itself' (Hyde, 2014). Hyde is an example of an artist who has followed on some similar paths to the author. He was influenced by *musique concrète* techniques in his initial work with visual compositions for his music compositions and he is also involved in academic research (5.6.7.2.) Hyde has also been a key player in the gathering together of arts practice research and academic researchers and practitioners in the broader field of sound and image in his role as director of the biannual Seeing Sound Symposiums that have taken place since 2009. Yet despite this recent recognition of the term itself among practitioners and theorists of visual music, there is little agreement about what 'visual music' is in itself and, more often than not, the term is left undefined or unexplained in its particular usage. Furthermore, there has been relatively little examination of the variety of conceptions of visual music that are at work in individual works, or how the visual music connection that is sought in integrated art works is crafted in the visual part of the work.

1.8   THESIS STRUCTURE

Chapter two, titled 'Making Music Visible', identifies and discusses the early uses and contexts of uses for the term 'visual music' in the twentieth century and also includes an examination of the previous eighteenth and nineteenth century developments in the art of colour music, colour organ and mobile colour inventions. During this earlier period, the desire and interest in the integration of arts through the Romantic and Modern art periods is reflected in several aspirational writings for forms of integrated arts involving painting, music, as well as with other arts such as poetry. This is contrasted with a parallel development of a more explicitly scientifically informed endeavour and interest in finding physical connections between the phenomenon of sound and colour, and which resulted in what has been called the 'colour organ' tradition. The art practices and works that are examined in this chapter, therefore, are those that aspired to a visual music, those that used the term 'visual music', and those that attempted to physically integrate a visual and a music for the purposes of exploring a form of integrated art. This chapter aims to find out

what conceptions of visual music existed in this early period that stems from the late eighteenth century, through the nineteenth century, and to the early twentieth century.

Chapter three, titled 'The "Visual Music" of Form and Content', examines the development of new types of content in the visual art of painting that arose in relation to artists exploring new ways of conceiving of form and content in the early to mid-twentieth century. In painting, relations between music and painting were sought based on devising forms from the mathematical basis of music's tonality, artists choosing their own colours and devising their own forms, the exploration of sonic themes in symbolic form, and the emergence and development of abstraction in painting. The key figures examined in the field of abstract painting who looked to music as a model for artistic expression in painting are Kandinsky, Klee, Malevich and Kupka. Their ideas on the new reality and the concrete in painting brought forward a new type of non-objective content that the artist could create through their own choice of means and their own choice of form. It was to the new content in painting that the term 'visual music' was explicitly employed. The formal structures of music were translated into visual forms and into a pictorial language by several painters who are examined in this chapter. The approach to colour was also linked to music concepts in several painters' works.

Chapter four, 'The Visual Music of Film', examines the development in the medium of film of an exploration of non-objective and abstract imagery. This advances the exploration of abstract content in film form. Early filmmakers engaged in creating non-objective films were influenced by both developments in abstraction in painting and in a continued development of exploring musical ideas in visual forms. Many of the experimental filmmakers, however, who were interested in the language of music were also interested in working with camera recording images. In this regard, their images were composed not to elicit the classic narrative or storyline of literature but as objects themselves in the art form, the image was a formal element. Several of the early filmmakers collaborated with composers and other artists bringing together the arts through a joint effort. The early experiments in film consisted of artists devising their own methods, techniques and ways to work with the medium of film to explore close relationships between a visual and a music. With the addition of music in the soundtrack of the film, this relationship between a visual and a music was explored in a more in-depth way and was capable of being explored in this way. With film, the means to synchronise and combine images and music provided a new tool by which to explore a visual music expression. So much so, indeed, that 'visual music' became a more frequently used term to describe these works by critics and commentators and increasingly by the artists themselves. Several filmmakers, right through the twentieth century, devised their own unique take on a relationship between a visual and music in their works, some of whose works will be examined in this chapter.

Chapter five, 'The Electric Audiovisual *Arts*-relais', examines the mid-to-late half of the twentieth century and considers the impact of the electronic arts and their contribution to a visual music. The advent and rapid advancement of electronic technologies used to transmit sound and images as radio and television signals brought a whole new set of tools to be explored by music composers and filmmakers. Experiments with radiophonic art and the use of radio frequencies to make some kind of change to an electronic image, was also explored in kinetic art forms. Many art forms emerged as a result of artists using these technologies for artistic purposes, such as, for instance: video art, kinetic art, light play performances, and video synthesis experiments. Many of these experiments comprised an artist or group of artists exploring close relationships between the electronic representation of sound with the electronic representation of images. Many saw the potential for a new art comprising moving images and music. Many of the activities of the innovators in this regard held fringe type events in order to perform their work as their work would not have fitted into the conventional art settings of the time. Others did utilise the conventional art spaces, such as, art installation and music performance, and experimented with visual presentations with music presentations in these spaces. A lesser known area in visual music history is the collaborative research and experiment work that included involvement by Pierre Schaeffer and his team of *musique concrète* composers in Paris from 1950 to 1975 in the GRM and the [O]RTF, where, for the initial purposes of creating an art content for television broadcast, films were created in a collaboration with the music of the *musique concrète* composers. What this research has found is that this push towards generating a content for an experimental television is something not noted much in visual music histories and, to a certain extent, is not widely known about. It is interesting, nonetheless, that it was a music-led research effort that saw the potential for the combining of images and music, following a similar compositional trajectory. It was Schaeffer's *musique concrète* techniques with which the author experimented, in both images and sound, which formed the basis of the author's own initial foray into exploring a visual music expression between video images and music in her first works created at the end of the twentieth century. The end of the twentieth century sees the emergence of the music composer cum visual composer artist as well as the exploration of visual images for an electroacoustic music presentation. It also sees the emergence of more computational methods in the creation of images and sound and in the exploration of relationships between images and sound based on the computational interactions between the datasets for images and sound. The Global Visual Music Project, a research project that took place at the end of the twentieth century, represents one of the most significant examples of the turn towards digital methods and computation in the creation of relationships between images and sounds. Many artists, nevertheless, choose their own means to create relationships between music and images, and may use a mix of electronic, recorded sounds and images, generative processes from computational techniques, as well as appropriating and devising systems and devices to create the results desired. In this way, the legacy of the

abstract painters and their innovations in allowing the artist to choose and create the forms of their work according to their need to do so, is as of relevance to the artist of the twenty-first century as it was in the early decades of the twentieth century. What the artist imagines is possible with the means chosen and available, is the crux of a great work of art.

Chapter six concludes the study by presenting and discussing the main issues and findings arising from study of visual music in its twentieth century history, with specific focus on both the sonic themes for visual music and the visual music expression.

Chapter 2   MAKING MUSIC VISIBLE

2.1   INTRODUCTION

Imaginings of a future art of integrated or synthesized arts by some artists and theorists from the eighteenth century onwards, show an uncanny accuracy in the prediction of a new future art that would combine visual art and music presentation. Although the phrase 'visual music' was not used in these early imaginings, the phrase 'visible music' was by Novalis (1772-1801) in one instance). This phrase, nonetheless, captures precisely the tone and task of those who sought to not only explore but also bring about an integrated relationship and affinity between music and painting. This, in turn, led to the creation of an extended and augmented music performance through the invention of a projection of mobile visual forms, a 'colour organ'.

This chapter begins by drawing attention to some of the early examples of authors and artists from the eighteenth and nineteenth centuries who either imagined a future scenario or made plans for an art that could make music visible with a play of visible forms. The chapter then examines the highly influential colour-tone analogy that Sir Isaac Newton (1642-1727) elaborated in the latter half of the seventeenth and early eighteenth century to explain the relationships between hues of colour in early colour science. This analogy became the cornerstone of various systems of colour and colour harmony that were devised in the late nineteenth century. It was also appealed to in the designing and production of several colour scales that were ordered into circles and segments, emulating the geometric proportions of music tones to music scale. Mapping colour to particular keys, pitches, or notes of a music instrument keyboard was also attempted. This paved the way for the plans of a colour harpsichord that sought to explore the colour-tone analogy through a practical experiment, whilst also recognising that colour had its own expressive qualities for artistic presentations.

There were several colour organs invented. Each inventor, however, used their own system of correspondences between colour and tone and devised their own colour-tone scales. Thus this endeavour to make colour available in instrumental form opened up possibilities other than to play colour scales, so much so, that a new art of 'colour music' was announced by several of these inventors. In this development, several individuals investigated the possibilities of building instruments to play colour akin to how a musician might play music on a piano. Throughout the eighteenth and nineteenth centuries, inventors, scientists, painters, musicians and composers became actively involved in either making plans for, or building custom instruments to investigate further the possibilities of such colour instrumentation. All of these efforts brought to fruition the idea of a future music with the play of visible forms.

The authors presented in this chapter are noteworthy in their aspirations and conceptions of a close connection between the visual arts and music. Some of these authors use the phrase 'visual music' to describe this connection, others pre-empt the pre-figured possibilities of a future art that could combine visuals and music, imagining what did come to pass in the twentieth century through light projection and cinematic means. In the early decades of the twentieth century, many artists continued to engage in the imagining of a future form of integrated art, such as, for instance, the Futurist artists and Paul Klee's dream of a monumental work (Wiedmann, 1979, 25). The composer Richard Wagner (1813-1883) also sought to integrate the arts from their separate domains so that the arts could explore an amalgamation of all the arts. The Opera was where he explored the bringing together a shared unity of artistic expression and he developed an integrated art form of music-drama for opera. He wrote several essays on the subject. In his essay, 'The Artwork of the Future,' (Wagner, 1849 in Packer & Jordan, 2001) the concept of the *Gesamtkunstwerk* was used to describe how the opera could explore a music drama in which all the arts would be equally attended to in the final production and in which there was "the unification of music, song, dance, poetry, visual arts, and stagecraft" (Packer & Jordan, 2001, xx). For the purposes of our research and enquiry in this chapter, however, the specific selection of authors examined and analysed are those who imagined the possibilities of combining a mobile image of colour and forms with a musical performance and presentation and who sought to create a particularly visual music expression.

2.2 A FUTURE MUSIC WITH THE PLAY OF VISIBLE FORMS

2.2.1 INTRODUCTION

This section deals with the attempt to make music visible with the play of visible forms and figures. From the eighteenth and early nineteenth century, the following authors will be discussed: Louis-Bertrand Castel's (1725) vivid imagery for an 'ocular harpsichord' performance of colour; Philip Otto Runge's (c.1805) idea for a performance of a simultaneous and integrated presentation of multiple arts; Novalis's (c.1800) observation of music in patterns and ornaments in decorations and paintings. In the twentieth century, we will examine Leopold Survage's (1929) plans for a coloured rhythm art by means of film and Charles Bragdon's (1916–1917) actual monumental projected ornament performances that have been described by Bruce R. Elder as being 'large visual-music spectacles' and a 'concert of visual music' (Elder, 2008, 57). First, a short overview of the broader art cultural context of the eighteenth and nineteenth centuries is needed to set the scene.

From the eighteenth to the twentieth century, art contained the roots of modernism. In painting, this period consists of the romantic, symbolist and expressionist traditions in art. Before this development in art, painting depicted forms and objects that belonged to the natural world and colour was put to use to represent and imitate those natural 'real' forms. With advancement in the natural sciences and experimentation, however, the more hidden depths of nature were being revealed, so much so, that the whole notion of what constitutes reality was changing. Such new forms of knowledge and understandings of reality in both philosophy and the sciences had a profound effect on the arts. Theories of colour, for example, demonstrated that white light consisted of waveforms of different wavelengths which consistently represented a particular spectral colour, and that our physiological response to the sensations of the wavelengths gave rise to each colour. Thus the reality of colour could be conceived of as a specific hue occupying a particular spatial area, or as a wavelength of light, or as comprising a mixture of varying wavelengths, or as having a vibratory nature. Such different conceptions of colour was to change the conception of what role colour occupied in a painting. On the other hand, and in parallel, there were reactions against the more materialistic and mechanistic natural-scientific explanations of reality. Other hidden realities, such as the *feltness,* emotion and the sensation of colours and forms, as well as the possibility of a universal spiritual meaning common to all in art works, were explored and examined. In the humanities and arts, this meant artists deliberately set out to explore the emotional quality of the impact of their artwork, or its hidden spiritual meanings. They too grasped at other realities, just as the sciences grasped at their realities. Philosophers, too, argued that the acclaimed method of the natural sciences, that is, the method of observation, hypothesis and experimentation, should be applied to philosophy itself creating a comparable scientific method that would likewise rigorously examine the hidden realities of human thinking, consciousness, inner psychical realities, experience, including aesthetics and art.

In the midst of this intellectual environment, artists too were slowly developing an autonomy in their choices of subject matter for art, of colours and individual styles in their painting, and of the symbolic meanings of the content of their paintings. In this regard, artists explored the more expressive qualities and potentials of colour and forms as experienced in works of art as well as allowing themselves to develop their own sense of artistic expression and individual style. This independence was supported by a number of interested people and groups, such as philosophers, critics and theorists, as well as by artists themselves, equally influenced by the intellectuals of their time.

The Romantics were particularly interested in the issue of the unity of the arts. During this period, the general domain of 'art' had emerged steadily into the modern system of the arts as we

have come to know them today (Kristeller, 1951, Wiedmann, 1979), containing identifiable and separate arts such as music, painting, theatre, and sculpture. According to August K. Wiedmann (1979), it was the Romantic movement that laid down the aesthetic and intellectual foundation from which modern art evolved. Fundamental changes were taking place in the conception of the arts as separate entities too as artists, musicians and theorists developed an increasing interest in the issue of the unifying power of the integration and synthesis of the arts. This led to the search for the unifying principles underpinning all art-forms and to finding the unifying principles between the human being and the meaning of art. Such striving for unity, nevertheless, was in contradiction to the materialist and mechanistic explanations of the world that had emerged in the eighteenth century that were largely based on scientific observations, mathematical hypotheses and experimentations. This method mainly focused on explaining and quantifying the physical and physiological basis of phenomenon and processes, overlooking the aesthetic or experiential dimension of what artists were attempting to do in their art (ibid., 32). Not surprisingly, in the eyes of the Romantics this scientific approach to reality was in danger of denying 'the existence of soul and spirt, the essence of beauty' (ibid., 10). Science, however, was not rejected by the Romantics, they rather 'strove to heal the breach [between art and science] by demanding a form of science not only based on "analytic industry", but on imaginative intuitive understanding as well, an understanding peculiar to poetry and art' (ibid., 11). In this regard, Wiedmann draws attention to Novalis's remark, that 'the [theoretical] sciences must all be made poetic' (ibid., 10).

There is no doubt, then, that in Romanticism the belief in the unifying power of art was linked to a world-view that saw the foundation of life and the world that was firmly based on an idealistic foundation. Wiedmann, who conducted a comparative study of aesthetics in Romanticism and Expressionism in order to demonstrate what he called the romantic roots in modern art, concludes that '[W]hat characterized the Romantic movement above everything else and also characterised the Expressionist movement…was its universal striving for unity and integration with the living order of creation … [that is,] with the universe as their great ideal' (ibid., 3). R. Bruce Elder further notes that many of the artists who were interested in exploring the unities in the arts and in the synthesis of the arts were influenced by 'the idea that reality is fundamentally vibratory' and that bringing together of the arts could be on the basis of the shared 'vibratory nature of reality' (2008, 44). Hence, the concept of unity in the arts was explored from a number of perspectives, as a spiritual ideal, or as a vibratory phenomenon, or as both.

The art critic became a regular contributor to discourse and discussions on the arts and the field of aesthetics emerged (Wiedmann, 1979, 35). Thus at the turn of the twentieth century, the dominant philosophical positions of both natural scientific enquiry and idealist views of reality, often opposed to each other, yet also connected to the beginnings of phenomenology as underpinning our experiences of the visible world around us, provided a rich context for artists

themselves to become increasingly involved themselves in theorizing and writing about art, and writing about their own art. Several art groups emerged, where individuals banded together on a shared artistic cause or interest, for example, *Der Blaue Reiter* (The Blue Rider) group founded in Germany in 1905, the Bloomsbury Group founded in Britain in 1909 and the November group, founded in Germany in 1918. The membership of these groups consisted of painters, filmmakers, poets, theorists and commentators. They were involved both in exhibitions and in the promulgation of information about the arts to the general public. They were also involved in promoting the arts and promoting the exchange of ideas between the arts and printing newsletters, magazines, newspaper articles and pamphlets. Many of these publications include genuine correspondence between artists and critics themselves, so that cross-pollination of ideas and affinities between the arts was more readily sought.

2.2.3 EMBELLISH THE HARPSICHORD WITH A PLAY OF MOBILE FIGURES

Louis-Bertrand Castel (1688–1757) was a Jesuit priest, physicist and mathematician. He was an associate editor of the *Journal de Trévoux* and wrote several articles for this journal and for other journals. He was keenly interested in Newton and Kircher's experimental scientific work on the colour-tone analogy. Castel is most well-known for his attempts to build a colour organ in order to test out the colour-tone analogy idea (see section 2.3.6). Castel, however, was also interested in the artistic possibilities of providing a mobile visual element to a music performance. Wilton Mahon observes how Castel saw the potential for an accompanying play of colour and visual imagery attached to the harpsichord music instrument to provide a visual focus in formal concerts since, for Castel, 'many a formal concert, where only the sense of hearing is appealed to, is a source of visual embarrassment, and people do not know what to do with their eyes.' (Mason, 1958, 112). Castel believed that the body of the harpsichord instrument could be physically adorned with a wealth of visual imagery, but Mason draws attention more to Castel's visualisation of colours accompanying music performances, telling us how Castel imagines how brilliant it would be if not only were the adornments immobile but if they could be animated. The animation would give life through the movement of the visual elements:

> For example, one could make the colours themselves from true jewels…the greens with emeralds, the reds with garnets, rubies, carbuncles, etc. And what brilliance and lustre would not such a spectacle bring to light in every part, sparkling like the stars, with jacinths followed by amethysts, then rubies, etc., by the light of torches in an apartment furnished with mirrors? It would be an infinitely brilliant object, a sort of immobile decoration where everything would be varied. But what would it be if animated and given a type of life through movement, a regular, measured, harmonic, and lively movement? It would be charming, an enchantment, a glory, a paradise! (ibid.)

The paradise that Castel sees here, then, is the paradise of visual music, that is to say, of moving, animated life-like measured harmonic colours in some regular and ordered experiential patterns.

Castel goes on to describe the figures, both real and geometric, as well as patterns in an assortment of colours and in a variety of picturesque styles that could be 'played' in this imaginative exercise for a new 'clavecin':

> One could make a play of all sorts of figures, human and angelic animals, flying creatures, reptiles, fishes, four-footed beasts, even geometric figures. One could, by a simply play demonstrate all the concord of Euclidian elements. One could make a play of fantastic figures, of hippographs, of centaurs, etc., allegorical figures, muses, dryads, naiads, etc. Or one could make a play of flowers, taking the rose for the colour rose, the coxcomb for the purple, the violet for the violet, jonquils for the yellow, marigolds for the gold, so arranged that each stroke of the hand on the keyboard would represent a flower-bed, and the result of playing would be a moving diversity of animated flower-beds…Who would doubt then, that in place of a simple colour one could place an assortment of colours, and even a complete picture, a landscape, a historic scene, a scene from comedy or tragedy, something grotesque, marionettes on a string, and other things … If all Paris used the colour clavecin, to the number of 800,00, one could, without excuse of invention and imagination, make them so that there were no two which resembled each other, and that without costing more than making them all alike. *I should never finish* if I undertook to exhaust all the styles, all the designs of the new clavecin which one might wish to have made. (Castel, 1725 in Mason, 1958, 112)

Castel, in this imaginative exercise, was interested in more than just colour being presented with music as he clearly recognised that such an endeavour of combining colours played on unique 'clavecins' had unending possibilities.

2.2.4 PHILIPP OTTO RUNGE – THE ROMANTIC, ABSTRACT, FANTASTICAL, MUSICAL POEM

Philipp Otto Runge (1777–1810) was a German Romantic period painter and colour theorist. Like Castel, Runge too imagined an artwork that comprised a performance of integrated arts simultaneously. He was also well known for his colour theory ideas, and discussed these ideas with Goethe, with whom he had begun a friendship in 1803 (Kuehni, 2008, 83). In 1810, Runge published his theory on a three-dimensional colour order system in *Farben-Kugel* (Colour Sphere). Runge was one of many artists of his time who, along with composers and poets, considered music to be 'the highest and purest art form…[and]…saw in music the common primordial source of all the arts' (Maur, 1999, 10). Maur quotes Runge:

> Music, after all … is always that which we call harmony and serenity in all three arts. There must be music through words in a beautiful poem, just as there must be music in a beautiful picture, and in a beautiful building. (ibid.)

Runge too, like many painters, used musical ideas of harmony in the content and forms of his painting to evoke the aesthetic experience of beauty. His painting 'Lesson of the Nightingale' (1804–05), consisted of rhythmic motifs around the margins and this rhythm was based on the imitative principle of the musical form of the fugue. What is of interest here, is that he planned to create an integrated art work of music, paintings and poetry entitled the *Times of the Day*, but which, unfortunately, he did not complete, due to his untimely death. This integrated artwork,

nonetheless, was to combine music, four large paintings and the recital of poetry. The integrated work was to follow the musical structure of the symphonic form and the four movements corresponded to the times of the day, Morning, Midday, Evening and Night (see Figure 1). He made several sketches for the work, and he painted two versions of one of the movements – 'Morning' (see Figure 1).

He envisaged that this integrated art work would need to be presented in a purpose-built building. Wiedmann tells us that Runge regarded this work as an 'abstract, pictorial, fantastic-musical poem,' (1979, 6) and that Runge's plan was that such compositions 'could be viewed to the accompaniment of music and poetry in order to evoke in the beholder a "total" experience.' (ibid.)

Figure 1 Philip Otto Runge 'Times of the day', 1805. L-R: 'Morning', 'Evening', 'Day', 'Night'. Etching and engraving. Printmaker: Johann Gottlieb Seyfert. The Getty Research Institute; 'The morning', 1808, Hamsburger Kunsthalle. Arranged by thesis author.

This desire to create an artwork that was a synthesis of the arts, and one that could stir all the senses at once, was a particular dream of the Romantic artist. It was thus linked to their belief in an underlying unity in the world. As Wiedmann remarks,

> Their dream was of a 'total work of art', a joining together of poetry, painting and music into one *Gesamtkunstwerk* that stirred into activity man's various senses at once, engendering in the beholder a synaesthetic reverberation which lifted the soul from the commonplace to a feeling of oneness with the world. (ibid.)

Indeed, Runge's plan for a purpose-built building of which painting, poetry and music could be presented together was similar to Castel's idea. Both were seeking a visual element and medium to a music performance. Of more importance, however, both could imagine the artistic possibilities in the physical merging of the visual elements through a unified presentation and artistic pursuit of such higher or deeper musical unity.

The German philosopher, natural scientist and poet Novalis — a pseudonym for Georg Friedrich Philipp von Hardenberg (1772–1801) — was interested in visual patterns and forms and in particular the arabesque form that was popular in etchings, decorations and paintings at the time. To him, these forms and patterns represented a 'visual music' or 'visible music'. He uses this phrase to describe the character of these visual forms in their ordered and numerical basis, which was likened both to the order and numerical basis of the balances and proportions in music harmony laws and their rhythmic structure. An arabesque is a form of decoration based on rhythmic and decorative patterns, a figuration based on pattern rather than a figuration based on bodies and real objects. Novalis wrote a collection of reflections, in the form of fragments, on topics in art, science, philosophy, beauty and poetry. He intended to publish these reflections, but the book was not published in his own life time. It was, however, published in fragment form posthumously in various publications under various titles, such as '*Das Allgemeine Brouillon: Materialien Zur Enxyklopaedistik*', 1798/99. It was also translated into English several times, for instance, David W. Wood's translation is 'Notes for a Romantic Encyclopedia: *Das Allgemeine Brouillon* / Novalis' (2007). Novalis's phrase 'visual' or 'visible' music comes from a fragment in his collection of writings. The particular fragment in question makes a succinct statement about the 'music in visual forms' and compares the decorative aspect of visual images to be a form of visible music. The sentence in full, contains the phrase, in German is: '*Die eigentliche sichtbare Musik sind dies Arabesken, Muster, Ornamente*' (Novalis in Spitzer, 2004, 299). Wiedmann, in his chapter on 'Romanticism and the Aesthetics of Inwardness', translates this as 'truly *visual music* [author emphasis] consists of arabesques, patterns, ornaments' (Novalis in Wiedmann, 1979). However, '*sichtbare Musik*' is translated as 'visible music' on R. S. Pearson's online version of Novalis writings: 'The Arabesken, pattern, ornament etc. are the actual visible music (Pearson, n.d). Again, others have translated this as 'embodied music', for example: 'Arabesques and ornaments are embodied music' (Hope, 1891, 181). Others translate and interpret this as 'originate in music': 'the arabesques of painting originate in music' (Spitzer, 2004, 299). The general sense of this phrase, nonetheless, is that the pattern itself is the visual equivalent of music patterns. They exhibit laws of music in both the mathematical basis of harmony and tone and in the rhythmic basis of melody. The phrase could also be translated as 'these arabesques, patterns and ornaments are properly visible music', where attention is drawn to the word *eigentliche* which means real, or actual or proper, thus the ornaments are proper, ordered and true just like the order in music. The term ornament is also used to describe ordered patterns and arabesques. Arabesque was also a term used to describe the process of the melody. Eduard Hanslick (1825–1904) 'likened music to arabesque and the Kaleidoscope' (Hanslick, 1894 in Newcomb, 1997, 132) and conceived of melody and arabesque as being a similar thing. Thus, as Anthony Newcomb

explains, Hanslick sought to understand the meaningfulness of music and his answer was 'to locate those higher powers [in music and arabesque] in the power to induce a special, non-representative form of pleasure' that is decorative, and this is 'Hanslick's arabesque' (Newcomb, 1997, 132). Agreeing with Hanslick, Spitzer compares the arabesque as melodic process to a 'branch of ornamentation in the visual arts, namely arabesque. We follow sweeping lines, here dipping gently, there boldly soaring, approaching and separating, corresponding curves large and small' (2004, 299).

The approach to the arts at this time, then, sought to explore the unity of the arts, and many of the Romantics revisited the styles and approaches from the medieval period which was perceived as having a unity that had become lost. The arts from antiquity, through the medieval period, to the Renaissance equated music with its orderly aspects. Boethius (477–542 AD) understood music as being, 'the abstract science of harmonics, which showed … the patterns of musical consonances to be a manifestation of the same mathematical laws that gave order to the cosmos and governed the movements of the heavenly bodies' (Vergo, 2005, 16). The harmonic science of music 'led the mind to an understanding of quantity' (ibid., 141). Such harmonics and quantities could be understood with arithmetic, geometric ratios and were applied to pattern, architecture, design, decoration and painting. The arabesque patterns exhibited an analogous harmonic and repetitive pattern, based on relationships between quantities, parts and wholes. The highly decorative elements that were used in painting even extended the boundaries of the subject and content of the painting into the decoration of the edges. Novalis identified this decorative painting content with music, and in particular was referring to the more 'totally abstract configurations' (Wiedmann, 1979, 73) in painting, such as geometric patterns and shapes and ornaments. Such patterns, then, were a visual and visible music and a representation and embodiment of a music.

2.2.6   LEOPOLD SURVAGE – *LE RYTHME COLORÉ* (COLOURED RHYTHM) A VISUAL MUSIC

Writing in 1929 about the painter Leopold Survage (1879-1968) and his approach to achieving rhythm in the space of his paintings and his use of colour, Samuel Putnam estimates that Survage's painting is 'the nearest thing [he] know[s] to visual music' (Putnam, 1929, 112). Putnam uses the phrase 'visual music' several times and elaborates on what he means, stressing that:

> It is *visual music* when it is *successful*, when it achieves its aim. The painter's technical and esthetic aims, comprised in the Problem of Space, are, when analyzed, seen to be something perfectly analogous to music. For it is only when to the dead geometry of a picture an animating rhythm is given that the picture ceases to be an inert and static thing and comes alive by achieving motion. And rhythm is the principle of those sister arts and sciences, Arithmetic, Astronomy, Music. (ibid.)

Survage, nevertheless, was also interested in the expressive power of colour in painting. In this regard, Putnam also uses the phrase 'visual music', yet he does so again to refer to the musical effect of colour in a Survage painting:

> For the *colour* [my emphasis] in a Survage does, as the expression is, sing; there can be no doubt of that. The form — by which is meant the linear and graphic form — sings, too; but this, unfortunately, is a *visual music* [author's emphasis] for which the average eye has been spoiled by the drawing-master and his perspective. (ibid., 114)

In the appreciation of Survage's paintings, then, what Putnam suggests is that over attention to the 'drawing master' and *his* perspective on *static* art will prevent one from seeing the work of the colours, that is, the visual music in the singing of the colours themselves.

Survage, indeed, was intent on investigating further the possibilities of making colour mobile and, in an analogy with music, he envisaged a new type of autonomous art to be realised in film in which colour could become the content of the film, thus becoming a thing of motion. This planned cinema project he named '*Le Rythme colouré* (*Coloured Rhythm*)'. This work was to be a 'symphony in colour'. 'Coloured Rhythm' would not just be an interpretation of a musical work in cinematic form; it would rather establish an analogy with music's language, its harmonies, rhythms, dynamism and energy. The rhythmic motion was a principle that could inform both music and colour, and this art of coloured rhythm could be understood as being 'based on the same psychological premises as music' (ibid., 112).

Survage, alas, did not manage to make this film, as he was unable to procure either the financial or the technical support to do so. He, nonetheless, did prepare several hundred watercolours in a serial structured sequence, where each image was to be one frame of a film realized in time and over time. These paintings are now referred to as his 'Coloured rhythm: study for the film' series of paintings, and several of these watercolour paintings can be seen online on the MoMa website (The Museum of Modern Art, 2018).

Video artists have also compiled Survage's paintings into animations, giving us an idea of how such a coloured rhythm might have been realised (Checefsky, 2018). Survage, however, was supported in the artistic community for his ideas. He shared his plans for the film project with the theorist Guillaume Apollinaire and tells us of Apollinaire's reaction to his work:

> I gave myself over to speculations, which ended in the creation of 'Coloured Rhythm' for the cinema — symphonies in colour — in 1913. A year later, I took occasion to lay before Guillaume Apollinaire a description of the principles of 'Coloured Rhythm,' accompanied by plates. He received me in his little apartment in the rue St. Guillaume with that jovial cordiality which was always his. He was very enthusiastic, and at once published in the *Soirées de Paris* my description of the 'ninth muse,' as he called my creation. (Survage in Putnam, 1929, 174)

Here, Survage explores various aspects of colour, such as the relationships between simultaneous colour, and alternating colours in time and space, to capture the movement of colour in the experiencing of the work itself (see Figure 2).

Figure 2 Figure 3 Léopold Survage – A selection of paintings from 'Coloured Rhythm: Study for the Film', 1913. Part of 59 studies for the film at MoMA. © 2018 Léopold Survage / Artists Rights Society (ARS), New York / ADAGP, Paris [Moma.org, 2018]. Paintings arranged into a table grid by thesis author.

In an article for the *Soirées de Paris*, entitled 'On Its Analogy with Music,' Survage explains further his conception of a music and colour analogy. Colour is not just to be used to imitate an object or fill in a shape or a form, it is, rather, to be the actual moving content of the film:

> It is the mode of succession of their elements in time which establishes the analogy between music, sound-rhythm, and that coloured rhythm of which I am announcing the realization by means of the cinema. Sound is the primordial element of music. The combinations of musical sounds based upon the law of simple relations between the vibration-numbers of simultaneous sounds, for musical harmonies. These latter combine in musical phrases. Other factors intervene, the intensity of sounds, their timbre, etc… But music is always a mode of succession, in time, of various sound-vibrations. A musical work is a sort of subtle language by means of which the author expresses his soul-state, or, to make use of a felicitous expression, his interior dynamism. The performance of a musical work evokes in us something analogous to this dynamism of the authors. The more receptive the auditor is — the more like a receptive instrument — the greater the intimacy between him and the author. (Survage, 1914, in Putnam, 1929, 113)

In other words, the more the person who is capable of experiencing the moving unity created by the composer of the visual-music piece, the 'coloured rhythm', the more that receiver becomes in touch with the interior dynamism and creative tension present in the author of the piece itself expressed in the work itself. There is, then, a real point of contact here between the receiver of the work as re-creative artist and the creative artist that produced the work. Yet the artist and the artist's work come first. Just as with lyric poetry where the words are to be accompanied by music

as part of the whole emotional tone and flow of the work itself, so too the colours used in painting are to be set, over time and in motion, in musical-harmonic arrangement as part of the whole emotional tone and flow of the work itself, 'coloured rhythm'. It is not without reason, then, that Survage took kindly to Apollinaire's allusion to 'the ninth muse', the Goddess of lyric poetry, as the inspirational source at work in his 'Coloured Rhythm'.

2.2.7 Claude Bragdon's visual music in the projective ornament

The United States architect and stage craft designer Claude Bragdon (1866–1946) managed to successfully present an integrated arts music performance that Castel and Runge had only previously imagined. Bragdon was also interested in the connection between the visibility of music through geometric patterns and shapes upon which Novalis had commented. In 'Precursors of the Absolute Cinema: The Colour Organ and the *Lichtspiel*' (2008), Elder uses the phrase 'visual music' to capture the large experimental outdoor park music and light festivals that Bragdon helped to design that comprised choral, orchestra and community singing with 'projective ornaments' and coloured light concerts. He refers to these concerts, again with emphasis, as '*visual-music* spectacles' (Elder, 2008, 57). The festival concerts had the title 'Festival of Song and Light'. These were 'temporary environments defined by colour, light, sound, and ornament' (Massey, 2006, 597). The first festival was proposed by Bragdon in 1914 and Bragdon 'proposed that Rochester stage a pageant to "unite the arts of poetry, the drama, music and the dance in one synthesis of beauty"' (ibid., 594). Bragdon designed the 'projective ornament', lighting, and colour part of the concerts. He described the holistic effect of the colour, music, lights, participants and audience as being a 'cathedral without walls' (Elder, 2008, 57), and so, as tantamount to 'reproducing the visual effect of a Gothic cathedral, its "vast shadowy interior lit by marvellously traceried and jewelled windows, which hold the eyes in a hypnotic thrall"' (Bragdon, 1938, 72; in Massey, 2006, 599).

A description of the first festival of 'Song and Light' (see Figure 3) is provided by Massey who carried out extensive research on Bragdon's architecture and projective ornament (Massey, 2006). The outdoor concert consisted of a sixty-five piece orchestra and eight hundred singers wearing white robes standing on one shore of a lake in Central Park, New York in 1916. The sixty thousand audience were on the other side of the lake. The musicians were illuminated by white light and the projective ornament lanterns creating what was described at the time as 'light tempered for the eyes of the audience by coloured lanterns and shields that glowed like stained glass windows' (Massey, 2006, 596):

> A podium at its centre bore a circular shield, and tall pylons at either side supported large hexagonal lanterns. Vines and branches garnished these elements and the low rail that stretched between them. Overhead stretched cables bearing an array of seven circular screens alternating with six vertical rectangles, all bearing the unfamiliar

patterns of projective ornament. These coloured light fixtures were echoed by similar lanterns hanging from trees and nestling in shrubs around the lake and along the paths, and even the park lamps had been transformed by ornamental shades. (ibid.)

According to Massey, one of the main organising principles of Bragdon's design approach was the importance of harmonic principles arising from number and geometry and the techniques of 'pure design' and 'abstract harmonic compositional principles [taken] from monuments of Western architecture and art' together with musical harmony ratios whilst tracing these compositional diagrams over building and design plans (ibid., 581). 'Projective ornament' was also a particular theory of design that Bragdon devised in 1915. This was based on the transcription of music ratios to ornamental design and on the theory of n-dimensional evolutions (ibid., 579).

Figure 3 Claude Bragdon. L-R-T-B: Lamping plan for 'Luxorgan' and keyboard arrangement, 1920; Bragdon, watercolour drawing, ca. 1933, showing the colours intended for a colour-music film sequence and evoking the intensely luminous colour that had earlier characterized the festival light-screens [Massey, 2006, 609]; Diagrams showing how unfolded and projected three- and four-dimensional shapes can be combined with two-dimensional polygons and selectively inked to create projective ornament patterns. [Massey, 2006, 591]; Photograph of 'Song and Light', Central Park, New York, 1916. [photographer unknown]

Elder succinctly summarises Bragdon's contention about architecture and music, 'just as architecture is geometry made visible, so music is number made visible' (Elder, 2008, 57). Massey refers to earlier views expressed by Bragdon in *The Beautiful Necessity: Seven Essays on Theosophy and Architecture* regarding the unifying and relational principle of number across all the arts and the connection even with our own human bodies (Bragdon, 1902, 1910 in Massey, 2006, 581). Bragdon also references the music of the spheres, which is a reference to Pythagoras and the Pythagorean view of the formal mathematical dimension in matter that produces the audible and visible phenomena of the world as we know it and experience it. For the Pythagoreans, because *the motions* of the heavenly spheres and fixed stars evinced a manifest

order of number and of harmony of numerical propositions comparable to the visible sense of ordered aesthetic beauty among the ancient Greeks, included in this Pythagorean account, as Dijksterhuis points out, is a hidden 'acoustic harmony' of the spheres that 'need not therefore be audible' as 'the mind's eye here takes the place held by the ear in music' (1961, 7). This is why Bradgon stresses, as Massey notes, that:

> 'Number is the invisible thread on which the worlds are strung,' he proclaimed in *The Beautiful Necessity*, a treatise serialized in 1902 and published as a book in 1910. 'We are all of us participators in a world of concrete music, geometry and number — a world, that is, of sounds, odours, forms, motions, colours, so mathematically related and co-ordinated that our pigmy bodies, equally with the farthest star, vibrate to the music of the spheres. (Bragdon, 1910, 22 in Massey, 2006, 581)

By a world of 'concrete music, geometry and number' that underpins the world of 'sounds, odours, forms, motions, colours', then, Bradgon means the non-independent parts of music, geometry and number existing together (*concretum*) in our experiencing of the *whole* moving yet hidden ordered-world of colour, sound, touch, odour, and smell that 'vibrate[s] to the music of the spheres' (ibid.) .

As well as the projective ornament designs for the festivals of 'Song and Light', Bragdon was a member of a society called the *Prometheans* who were interested in colour-music, theosophy and in building colour-music instruments (Elder, 2008, 57). He designed a colour-music instrument called the 'Luxorgan' in 1917 (after the Latin word '*lux*' for 'light') to explore what he and his colleagues referred to as 'the art of mobile colour' in order to exploit 'the mathematical correlation among music, colour, and geometric form' (Massey, 2006, 608). This *Luxorgan* or light-organ (see Figure 3) is described in Massey's research as:

> a mechanism for simultaneously playing music and multicoloured projective ornament designs. In the first version, built in 1917, a keyboard controlled electric bulbs behind a large screen of projective ornament stencils filled with a variety of coloured gels. The second Luxorgan, completed three years later, achieved a wider range of visual forms by projecting light onto a screen through operable stencils. (ibid.)

Bragdon also made plans to create several colour-music films and drew several hundred watercolour drawings (see Figure 3) which he planned to animate in time with the music. He intended that the 'projective ornament patterns would have transformed in time with musical compositions' (ibid.). Unfortunately, none of these 'visual music' films were produced.

2.3   MOBILE COLOUR AND MUSICAL TONE

2.3.1   INTRODUCTION

Music itself in its artistic and scientific developments has always inspired a visual equivalent in art and visual form. In antiquity, the abstract and geometric reasoning that explained mathematical divisions of the musical scale by Pythagoras of Samos (ca. 582-507 BCE) provided a geometric relation of music harmony and geometric ratios for the intervals of music harmony.   The philosophers of the early Greek period believed that it was the mind that could grasp objective reality and that nature could be made intelligible by applying the mind to grasp nature and the universe, what was called the 'cosmos'.   Mathematics itself was such a process of deductive and abstract reasoning used to derive conclusions about the essential form of an object.   Pythagoras could show that there was a relationship of number that could deduce the relationships of the music intervals in a music scale to each other and to the octave (see Table 1) and he found that 'all consonant music intervals are arithmetically expressible by ratios of the first four integers 1:2:3:4' (McDonnell, 1998, 12), as could be shown in the octave, perfect 4th and perfect 5th intervals.

Table 1 - Geometric Ratios for Music Intervals

Interval	Ratio
Unison	1/1
Octave	2/1
Perfect 5th	3/2
Perfect 4th	4/3
Major 3rd	5/4
Major 6th	5/3
Minor 3rd	6/5
Minor 6th	8/5
Major 2nd	9/8
Minor 7th	16/9
Major 7th	15/8
Minor 2nd	10/9
Augmented 4th	729/512
Diminished 5th	36/25

Isaac Newton's (1642-1727) also sought to demonstrate through a science experiment that the physical proportions of colour in white light had a similar proportionate relationship of part to whole in a demonstratable analogy with the geometric proportions of music intervals in their relationship to the whole of the music scale.   Newton's colour-tone analogy, played a key role in the development of the idea of a colour music art. This section examines the way in which a

colour-tone analogy was used by Newton to explain the ordering of colours and their relationships in his experiment with light. The discussion will then turn to how a variation of the colour-tone analogy was explored in a practical sense by the theorist and inventor of a 'colour organ', Louis-Bertrand Castel.

2.3.2 AFFINITIES BETWEEN COLOUR AND TONE

The exploration of the affinities between colour and musical tone, like music and painting, has a long history in philosophy, science, art and aesthetics. The mathematical underpinnings of the order and balance of a musical tone, the overtone series, tonal music harmony, and musical scales were all applied in a somewhat direct analogy to the domain of colour. When viewed from a more general mathematical point of view, colour and music shared similar properties of number. In this regard, one of the central and common traits seen as being of value to the analysis of colour and tone was the idea of balance. The balance of a music work was found to be in its tonality, between its keys, scales, melody construction, and its application in both compositional and tonal harmony. In a picture, the balance was articulated in the ordered use of the shades and tints of a colour and the order of mixing and putting colours together in a relationship to each other in a consistent balance of colour across all its tonal (light to dark) ranges in the whole of the picture in the art work. Colour and music also shared properties of vibration from a hidden order perspective. The pitch of a music instrument, for instance, was determined by its timbre, the overtone series, the mixture of its harmonic motions, the vibrations and the resonances of the instruments body and the exciter that enables the sound to sound, such as, the pluck of a string, or the strike of a hammer on a string, or the blowing of reed in a flute. Something like timbre had a hidden order that also could be shown to possess a proportioned and relative mathematical order. Each colour, too, from a non-visible perspective, is vibratory, has a frequency and an intensity, and it occupies space. From a natural-scientific interpretative viewpoint, a colour, as seen by the eye, comprises a mixture of red, green and blue wavelengths and that mixture is, in turn, affected by the intensity of the light. Light conditions affect our actual experiencing of the colour in its particular tint or shade. Explorations into such affinities between a mobile colour and a musical tone, then, not only caught the imagination of the natural scientists but also visual and music artists. Indeed, the theoretical and artistic explorations into the blend of colour and music became such a focal a point of reference for some artists that the phrase 'colour music' was used to denote and describe a new art that was directly committed to the presentation of mobile colour *and* music performance.

Since antiquity, Philosophers and natural scientists have used music and tones as a model of comparison to colour and the relationships between colours. These comparisons are commonly referred to as colour-tone analogies. Newton in his theory of optics used an analogy between music and colour in order to explain the mixture of wavelengths and colours that make up white light. However, the colour to music analogy did not start with Newton's theory; it was a common analogy that can be traced back to the origins of Greek natural philosophy in the sixth century. Newton would have been familiar with the philosophical and scientific texts from antiquity, and with the use of sound and light analogies in the discourse on nature and was intrigued by the possibility of parallels between musical harmony and colour harmony (Keuhni, 2003). Newton, nevertheless, was the first to use the analogy as a basis for developing an optical theory by developing a mathematical proof to demonstrate the validity of the sound to light or colour-tone analogy. In antiquity the sound to light analogy, and the use of analogy as a natural philosophical method was part of a way of thinking and doing science in antiquity. Oliver Darrigol traces these analogies to the Pythagorean idea of a universal harmony:

> There were nonetheless analogies drawn between conceptions of hearing and seeing, both by atomists and by Aristotle. These analogies resulted in part from the existence of a common conceptual framework for all forms of perception, and also from the Pythagorean idea of universal harmonies in the various realms of perception. (Darrigold, 2010a, 119)

Pythagoras found that the frequency of a vibrating string is inversely proportional to its length gave the Greeks a means to describe music intervals by numbers (Chalmers, 1993, 7). The numerical ratios of these proportions such as 2:1 for the octave, 3:2 for the fifth and 3:3 for the fourth and so on, were also considered to be the ratios that represented a universal harmony that was used and usable in architecture, painting and sculpture. Pythagoras found that the most pleasing, smooth and stable 'consonant' intervals corresponded to the smallest whole number ratios: 1:2, 2:3, 3:4 (Vergo, 2005, 34). Number was also considered by the Pythagoreans to be the 'principle of all things' and the early Greek philosophers of nature sought causal explanations for phenomenon in particular through geometry and number, which replaced the 'traditional appeal to supernatural forces' (ibid.).

The splitting of the 'whole' of a thing/ phenomenon into distinct steps and the comparing of both the whole of the thing and the steps to other similarly divided-into-steps phenomenon was a common way to use analogy and to generate knowledge up to the seventeenth century. For example, Athanash Kircher (ca. 1601–1680) attempts an organisation of colours in his *Ars Magna Lucis et Umbrae* (The Great Art of Light and Shadow) (Kircher, 1646) by organising them according to a proportional geomteric diagram 'symbolized by imbrications of half-arcs' (Saint-Denis, 2017). Kircher adapts both Aristotle and François d'Aguilon's theories of colour. He

applies the gemoetric ratios of music harmony in an analogous manner to colours and to other phenomenon resulting in a diagram consisting of a graphical depiction of these analogies mapped to simple harmony ratios (see Figure 4).

This type of diagram was commonly used to depict the harmony and proportions of what was under study. Keuhni explains the diagram:

> In the cusps formed by semicircles the mixture colours of the two chromatic colours invovled are place: aureus, viridis, and purpureus. Below the peaks of the semicircles are located important tonal colours resulting from the mixture of the chromatic colour with white or black (Keuhni, 2008,39). This diagram also included a table of analogies between tastes, ages of man, qualities of mind and beings, colours, greek names for musical strings. (Hutchinson, 2004)
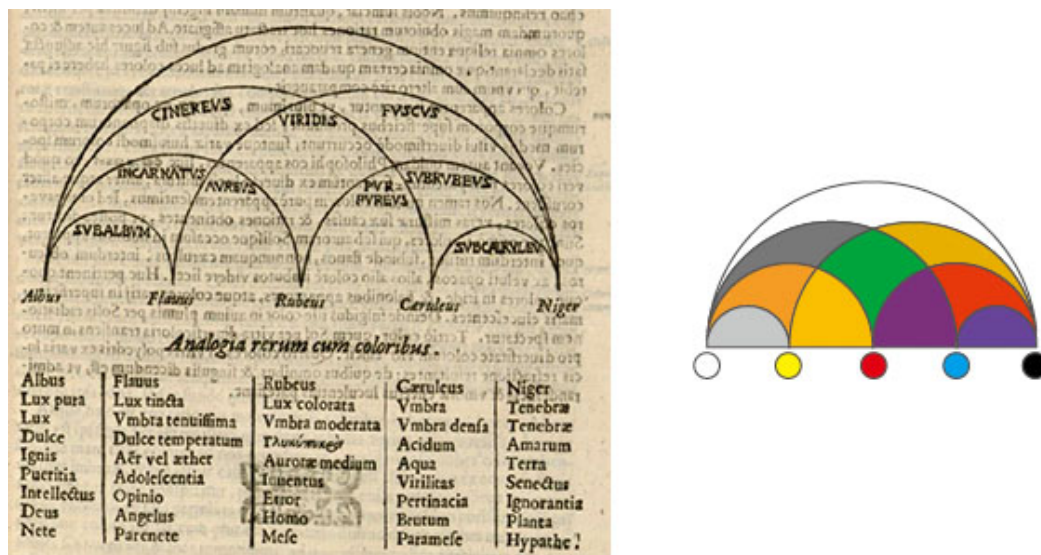
Figure 4 Athanash Kircher: L-R: Kircher's analogies between music strings, colours, greek names, qualities of mind, ages of man, taste and colours in *Ars Magna Lucis et Umbrae* (1646, 67); Adaptation of Kircher's diagram to denote the colours depicted in the diagram. [(EIZO Desktop Colour Handbook, 2009-10, 9]

Analogy, as Jörg Jewanski tells us, was a way of conducting science up to the seventeenth century (Jewanski, 1999, 228), that is, before the advent and dominance of the natural scientific method of enquiry that emphasised 'experiment as the source of knowledge, mathematical formulation as the descriptive medium, mathematical deduction as the guiding principle in the search for new phenomena to be verified by experimentation' (Dijksterhuis, 1961, 3).

Therefore, the comparing of a visual phenomenon of colour to the more established and mathematically worked out system of music, that had already demarcated the division of the

whole of the octave into the parts of the musical scale via the use of mathematical ratios, was a common form of analysis. The musical octave (diapason) and its geometric ratio divisions into the intervals and tones of the various types of musical scales were often the starting point for a step by step analogy with colour and also with other phenomenon. Such simple ratios, therefore, were considered to be the most stable and well balanced, and hence the logic was that revealing such simple ratios in other phenomenon was a way to access the most balanced and stable aspects of that phenomenon too. Thus in the case of colour, the critical question emerged regarding how was one to reproduce the nuances of a colour in its shade or tints and to repeat the reproduction of that colour in another painting? If found, a relative geometric system of organising the steps and intervals of the light and shade of a colour would be of great use in making for a balanced reproduction of colour.

Aristotle, in *On the Senses,* is considered to be the first to compare the physical properties of colours with the tones of music (Vergo, 2005, 60). Vergo explains:

> [Aristotle] compares colours with musical consonances in terms of the mathematical relationships by which the latter are governed — or rather, he relates the effect of specific combinations of colours ('pleasant' or 'unpleasant') to the ratios that produce the fundamental concords in music. He does not, however, seek to describe any particular aesthetic effect. (ibid.)

Aristotle observed that when mixing colours, if the same proportions are used that are used in the proportions that are used in music harmony, then the resulting mixed colours were beautiful and pleasing to the eye in an analogous manner to the music harmony tones that are pleasing to the ear. Aristotle compared purple and red, to be compared to the musical intervals of a fourth (4:3) and a fifth (3:2). 'If black were the keynote, with white an octave above it, purple presumably contained four parts light, to three of dark. The ratio in red would be 3:2, of light to dark' (Hutchison, 2012). Aristotle discusses the ratio underpinnings of mixing colours:

> It is conceivable that the white and black should be juxtaposed in quantities so minute that either separately should be invisible, though the joint product would be visible; and that they should thus have the other colours for resultants … . We may suppose that many [colours] are the result of a [numerical] ratio; for the blacks and whites may be juxtaposed in the ratio of 3 to 2, or of 3 to 4, or in ratios expressible by other numbers … . Accordingly, we may regard all these colours as analogous to the sounds that enter into music, and suppose that those involving simple ratios, like the concords in music, may be those generally regarded as the most agreeable; as for example, purple, crimson, and some few such colours, their fewness being due to the same causes which render the concords few. Or it may be that, while all colours whatever are based on numbers, some are more regular in this respect, others irregular; and that the latter, whenever they are not pure, owe this character to a corresponding impurity in their numerical ratios. This then is one way to explain the genesis of intermediate colours. Colours will thus, too, be many in numbers on account of the fact that the ingredients may be combined with one another in a multitude of ratios; some will be based on indeterminate ratios, while others again will have as their basis a relation of quantitative excess. (Kuehni, 2003, 24 quoting Aristotle, *De anima*, 439b-440a)

Many more after Aristotle did likewise. Other authors who drew analogies between colour and musical tones and sounds from sixteenth to nineteenth century were: the Italian music theorist Gioseffe Zarlino, 1562; Giuseppe Arcimboldo, 1560s to 1580s; Athanasius Kircher, 1650; French philosopher and physician Marin Cureau de la Chambrethe, 1650; Belgian mathematician François d'Aguilon 1613; Anthony Cooper (third Earl of Shatesbury); the Scottish philosopher Adam Smith, 1811; Voltaire, 1738; David Hume, 1738; Erasmus Darwin, 1794; John Locke, 1695, David Ramsay Hay, 1845; Julian Leonard Hoffmann, 1786; Thomas Young, 1801; James Clerk Maxwell, 1871; Hermann von Helmholtz, 1856–67. (Confer Elder's chapter 'Precursors of the Absolute Cinema. The Colour Organ and *LICHTSPIEL'* (2008, 44) and '*Colour and Culture: Practice and Meaning from Antiquity to Abstraction*' by John Gage (1993).

2.3.4   SIR ISAAC NEWTON'S HUE PROPORTIONS IN ANALOGY WITH THE DIVISION OF THE OCTAVE

The seventeenth century science experiments by Sir Isaac Newton demonstrated that colours 'were simply a function of the variable refrangibility of white light – the red component being subject to the least refraction and the violet the most when a ray of light is passed through a triangular prism' (Gage, 1999, 15). This became an exceedingly influential theory of colour and had far reaching consequences not only for the understanding of the spectral colours, white light, the science of colour, scientific method, conceptions of colour harmony, and painters application of colour, but also for a parallel development and evolution of an art of colour music pertaining to explorations in colour. Such an art was based on the continued use and application of various versions of a colour-tone analogy.

Newton's theory of colour and colours was first published in 1675 in the *Philosophical Transactions of the Royal Society* and in his *Opticks* (1704). Newton had observed that, under certain conditions, distinct spectral colour components of white light consisted of varying wavelengths for each colour ray observed and that when the space of each distinct colour within the space of the beam of white light was measured they exhibited proportional relationships. Newton opted eventually for the division of white light into seven distinct colours. He also observed that the different coloured rays of light were not actually coloured themselves, and so, concluded that the experience of varying colours belongs to a sensation of the mind as a result of the different wavelengths of the light frequencies. Thus any natural 'objective' account of the objects of 'colour experience' itself is set aside from a natural-scientific explanatory point of view. He used instead a musical analogy to compare the mathematically proportionate relationships of each of the separate colours to each other, arguing that the divisions of the beam of white light into the separate colours correlated to the divisions of the mathematical divisions that produce the tones of a musical scale, the scale he used was a modal one, the Dorian scale (see Figure 5).

Newton's colour to musical tone analogy was not that surprising for its time. Yet many commentators note that his choice of a seven-colour spectrum was precisely because he was keen to 'sustain an analogy with the musical octave, in which colours might be established on the same proportional basis as music harmony' (Gage, 1999,15). Newton, however, had been able to prove the measurable quantitative dimension behind the experiencing of colours and that colour was inherent in light. This added credence to the association of colour with tone and the belief that there was a similarity between the physical phenomenon of light and sound. This became a source of much artistic experiments thereafter, and this continued to appear in textbooks published after the first third of the twentieth century (Peacock, 1988, 398)
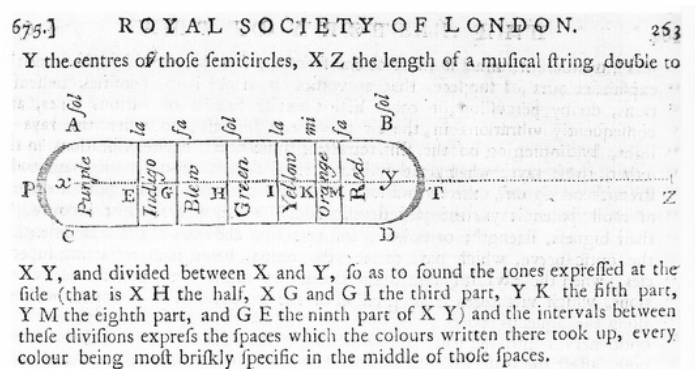
Figure 5 - Newton's comparison of the division of white light into seven colours to the tones of a musical octave (Gage, 1999, 140)

Other consequences of Newton's experiment are the beginnings of an investigation into complementarity in colour as worked out in systems of circular arrangements of colour in colour wheels, a theory of colour harmony, as well as the continued search for the basic primary colours from which all other colours can be mixed from, something that painters had already been doing for centuries.

2.3.5   COLOUR THEORY AFTER NEWTON

Johanne Wolfgang von Goethe approached colour from a different methodology to Newton's mathematical analysis of colour. He approached the study of colour from a physiological perspective where through analysing the phenomenon of after images, he was able to relate how our subjectivity as the beholder perceiving the colour influences the perception and affectivity of colour. John Gage, who has conducted extensive research into the histories, theories and uses of colour, makes a useful distinction between two general accounts of colour in the history of the theory of colour in the Western tradition, namely, the geometrical optics account of colour and the perceptual account of colour (Gage, 1999, 121). The geometric account is concerned with

the causes of colour; it can be traced back to Euclid, Descartes and Newton. In this approach, the main emphasis is on finding 'the objective status of colour in the world, what its nature was and how it could be organised into a coherent system of relationships' (ibid.,, 43). This interest culminated in the seventeenth century in the identification of light and colour:

> Colour was inherent in light, and light was the efficient cause of colour in all its manifestations, for colour was the inevitable consequence of the variable refraction of light. (ibid., 121)

A geometric approach to ordering colour according to its properties and divisions was a common natural scientific approach to the study of colour. Colour, here, was considered as an analysable reality in itself, and so, if light was uncovered to be involved in the reality of colour and colours, light was understood to be more like a carrier or 'vehicle of colour' (ibid.). By contrast, the 'perceptualist' account of colour runs from Aristotle to Michel Eugène Chevreul (1786–1889), and to Newton again, and is concerned, according to Gage, 'not with the causes of colour, but its effects, with the way in which a radiant stimulation of the human visual system becomes identified as colour at all' (ibid., 121). Here, the emphasis is on the subjective aspects of the experience of colour and how colour is generated by the physiology and mechanism of human perception and vision (ibid., 43). These two approaches to colour denote respectively the objective and subjective basis of colour, which are taken to be the facts of colour as a whole for the natural science of colour. In theories of colour-harmony, Gage identifies three groups (ibid., 55). The Newtonian group contain those theories of colour harmony that are based on the theory of the spectrum and white light in an analogy with the musical scale and the colour-tone analogy approach to colour. The Johann Wolfgang von Goethe group contain theories of colour harmony where the focus is on the arrangement of colours in harmonious arrangements, such as, for instance, in a relation of complementarity, and the main basis of these theories are the primary colours. Finally, there is the Friedrich Wilhelm Ostwald colour-solid group where harmony in colour and between colours is determined by the juxtaposition of 'value-content' hues. Artists, inventors and painters had many sources of influence and colour theories to work from, and to experiment with, artistically, in their use of colour in their art.

The revolution of Newton's experiment, however, was that light came to be understood with colour itself and his use of the analogy of colour with music meant that many could explore the relationship between colour and the principles of harmony. Music had already well established the link with harmony in music for many centuries. The colour-tone analogy approach to understanding colour, then, focused on providing a comparable division of colour that was based on some interpretation of the application of the mathematical ratios in music harmony (for dividing the music scale into its constituent music intervals and tones) as components of white light. Yet despite the fact that this research into colour may have started with analogies and a

discussion of the parallels between sound and colour, colour theory itself evolved into its own science of colour, developing theories and systems around the colour primaries, the mixing of colour, the tonal ranges of colour, the ordering and organising of colour and colours, and the identification of some principles of colour relations.

The conception of an art of colour music evolved out of these various approaches to colour and colour harmony. In many respects, the emergent art of colour music arose from experiments in exploring the instrumentation — that is, the making of an instrument to play colour — of the colour-tone analogy in a practical form. It is of importance to note, however, that parallel to this interest in an art of colour music, music composers and commentators also used visual metaphors and metaphors of colour to describe new techniques and developments in music theory and music practice itself (Spitzer, 2004).

2.3.6   CASTEL'S '*CLAVECIN OCULAIRE*'

One natural scientist who investigated the colour-tone analogy as the basis for the invention of a colour instrument that was modelled on a musical instrument, a harpsichord, and that could play colour, was Castel (see section 2.2.3). Although Castel was initially influenced by Newton's *Opticks* (1704), and clearly interested in Newton's colour-tone analogy, he was also interested in the possibilities of inventing an art of mobile colour and an art of colour harmony that was based on music harmony.

Firstly, Castel changed the colour-tone scale from the one that Newton had deployed. There were also many differences between Castel's approach to the colour-tone and colour scale to Newton's. Castel adapted the divisions of the scale from seven divisions of colour by Newton and devised instead a new scale 'based on a twelve-colour circle and a chromatic scale of twelve notes over twelve octaves' (Gage, 1999, 141) (see Figure 6).

Maarten Franssen remarks that Castel had mistakenly used the C-major scale as the basis of his building of the instrument, instead of the D-minor or Dorian mode scale used by Newton (1991, 24). Castel distinguished many more colours in the spectrum to Newton's seven colours. (According to current research limits, Castel found about two hundred colours (Kuehni & Schwarz, 2008, 58).) Castel also described his colour scale in terms of colour segments in a spiral spring, that repeated, rather than as a (geometric) circle. This was to facilitate the repeating of colours in higher or lower segments creating lighter or darker shades of a colour (ibid.), thereby betraying the influence of musical motifs (of higher and lower sounding notes) on his investigation into *the playing* of colours. Castel, nonetheless, did not provide any illustration of diagram of his spiral colour scale.
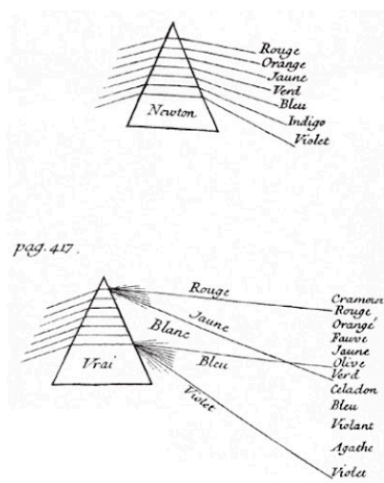
Figure 6 Castel diagram demonstrating the difference between Newton's seven hue spectrum colour scale and Castel's own twelve hue spectrum colour scale. Originally in Castel's *L'optique des couleurs*, 1740, 415. [Castel, 2018, Kuehni & Schwarz, 2008, 58]

Castel was also influenced by Jean-Philippe Rameau's (1683–1764) theories of music harmony (Gage, 1999, 141) and relied more on Athanasius Kircher's 'observational analogies between sound and light…[that] associated colours not with individual *pitches* but with musical *intervals*, the more consonant intervals being compared to the brighter colours, the more discordant to the darker ones' (Vergo, 2005, 236). Castel also tellingly quotes Kircher's conclusions about the possibilities of a new art that is founded on the basis and in the study of an analogy between the harmonious *art forms* of tone and colour, for:

> if, when a musical instruments sounds, someone would perceive the finest movements of the air, he certainly would see nothing but a painting with an extraordinary variety of colours … [and that] the colours also have their harmony, which pleases no less than music, and this analogous harmony even has a very strong power to excite the affects of the mind. (Kircher, in Franssen, 1991, 19-20)

The instrument that Castel devised was named the '*clavecin oculaire*' – an ocular harpsichord (Franssen, 1991). In many of his accounts for this invention, he is motivated and interested in the beauty of the effect that excites 'the affects of the mind' and of its performative potential as well as an experimental investigation into colour and the colour-tone analogy. Thus questions about what such an instrument would reveal were raised by Castel and other theorists at the time. Could one understand music from this playing of colour? Could a deaf person understand music from this playing of colour? This issue is comparable to the famous Molyneaux problem that John Locke (1632–1704) tried to address in 1688, regarding whether a congenitally blind person whose sight was restored would recognise shapes that originally were only experience via the sense of touch (Degenaar and Gert-Jan C., 2005). Was there an absolute connection between colour and music phenomenon through these similar mathematical proportionate relationships? Could there be a new art of playing colour that had a basis in this scientific colour-tone analogy experiment?

It cannot be proven that Castel did actually build the instrument, as there is no physical remains of it, and there are no detailed plans of how to build it (Peacock, 1988, 400). There are, nevertheless, several accounts and descriptions of presentations or performances of the instrument, yet it would appear from the writings, and from Castel himself, that the instrument and its plans was designed more for the purposes of a natural philosophy experiment and investigation. However, it is generally accepted that Castel built two instruments, one that he mentions in an outline of his idea in an article published in 1725 and written for the *Mercure de France*, '*Clavecin pour les yeux, avec l'art de peindre les sons, et toutes sortes de pièces de musique*'. In this brief mention, he introduces his ideas to his invention of an ocular harpsichord in terms of an instrument that could 'play music for the eyes, by way of colour'. Vergo provides several quotes from Castel who describes the main purpose of the harpsichord as an instrument to make sounds visible to the eye:

> [A]ll that of music of which sound is capable …to paint sounds, I say, really paint them: not merely paint them, but paint them using appropriate colours – in a word, to render sounds perceptible to the eye, just as they are to the ear, in such a way that a deaf person would be capable of enjoying and of judging the beauty of a piece of music. (Castel in Vergo, 2010, 235)

Castel built a prototype of the instrument in 1730 (Gage, 1999, 141). It consisted of a 'keyboard controlling coloured-glass filters and mirrors' (ibid.). He also built and exhibited a full-scale one in 1734 and another in the 1757 (ibid., Vergo, 2005, 241). Castel describes a version of the ocular harpsichord in a six-part article published in the *Mémoire de Trévous* during the summer and autumn of 1735. (Vergo, 2005, 238), and he discusses public performances of the instrument in a letter in 1755 (ibid., 240). Vergo quotes from Castel's writing in the letter, detailing two performances of the harpsicord in Paris to a select audience in 1754 and 1755:

> [T]here was nothing but acclamation and clapping of hands in consequence for the space of half an hour that I played…Everyone wanted to see, and see again this novelty. I put them off to New-year's day… The Harpsichord played, and two hundred persons owned that they had never seen anything more beautiful, or more brilliant… I alone assuring them, that this was not even a sketch, a beginning of it, so far was it from perfect. (ibid., 240)

Georg Philipp Telemann (1681–1767) 'saw Castel's model during his stay in Paris in 1737–38 and was so impressed with the idea that he published a pamphlet on the instrument upon his return to Hamburg in 1739' (Franssen, 1991, 38). Franssen quotes Telemann:

> To have it sound a tone, one touches a key with a finger and presses it, and thereby a valve is opened that produces the chosen tone ... At the same time, when the key opens the valve to produce the tone. Father Castel has fitted silken threads or iron wires or wooden levers, which by push or pull uncover a coloured box, or a ditto panel, or a painting, or a painted lantern, such that at the same moment when a tone is heard, a colour is seen. (Telemann in Franssen, 1991, 28)

A. Butler gave accounts of having seen the prototype (Butler, 1803, 65). Jean-Philippe Rameau (1683–1764) was so impressed with this music for the eyes that he supported Castles efforts initially, but both his support for this new art and Castel's experiment drew criticism from Voltaire, who was sceptical of such an art, sarcastically noting that even the blind were invited to enjoy such a spectacle, writing:

> [A]t present you are to engage a man who composes music for the eyes. He paints minuets and beautiful sarabands. All the deaf in Paris are invited by him to a concert which he has been preparing for them these twelve years, and there is not a dyer who does not promise himself inexpressible pleasure from the Opera of Colours, which the Reverend Philosopher intends to represent by his ocular harpsichord. Even the blind are invited. (Chaudon, 1786, 36)

Castel, nonetheless, wished to explore the arrangement of different colours that could be played in such a way so as to be able to appreciate the effect of the colour mixtures as a new art, an art he described as 'a music of colours' (Franssen, 1991, 15).

2.3.7   COLOUR SCALES ON A MUSIC ANALOGY TO COLOUR-ORGAN INSTRUMENT INVENTIONS

Newton presented his colour-to-tone correspondences from the spectrum experiment in various forms, one of these being a colour circle. His colour-tone scale correlated C to red; D to orange; E to yellow; F to green; G to blue; A to violet; and B to indigo. George Field's modern diatonic analogous scale of sounds and colours of 1816 divides colours into primary, secondary and tertiary harmonies and creates a universal scale of colours: from the note C on the base clef to the G above the treble clef, yielding the following colours for the scale of C to C^1 :C to blue; D to purple; E to red; F to orange; G to yellow; A and B to different shades of green (Field, 1817, 79). Each author presented their analogies in graphs, circles or diagrams and wrote about their theories in publications (see Figure 7).

Many other authors and inventors devised colour scales based upon an analogous relation to music. Bainbridge Bishop (1837–1905), for instance, devised a harmonic series colour-to-tone scale that he also called a chord of sound and light and invented a colour organ in 1877. He wrote about his ideas in *A Souvenir of the colour organ, with some suggestions in regard to the soul of the rainbow and the harmony of light* (1893). Alexander Wallace Rimington (1854–1918) devised a chromatic scale of colour-to-music and invented a colour organ in 1893. He too wrote about his theories in *Colour-music: The Art of Mobile Colour* (1911). On the other hand, Alexander Scriabin (1871–1915) devised his colour circle from the cycle of fifths in music. Thus there were not one but many colour-tone analogies devised and claimed to correlate colour with sound. Fred Collopy, in his article 'Three Centuries of Colour Scales' (Collopy, 2004), provides an excellent summary chart from a selection of colour-tone analogies devised by scientists, theorists, inventors, artists, composers and painters during these three centuries.
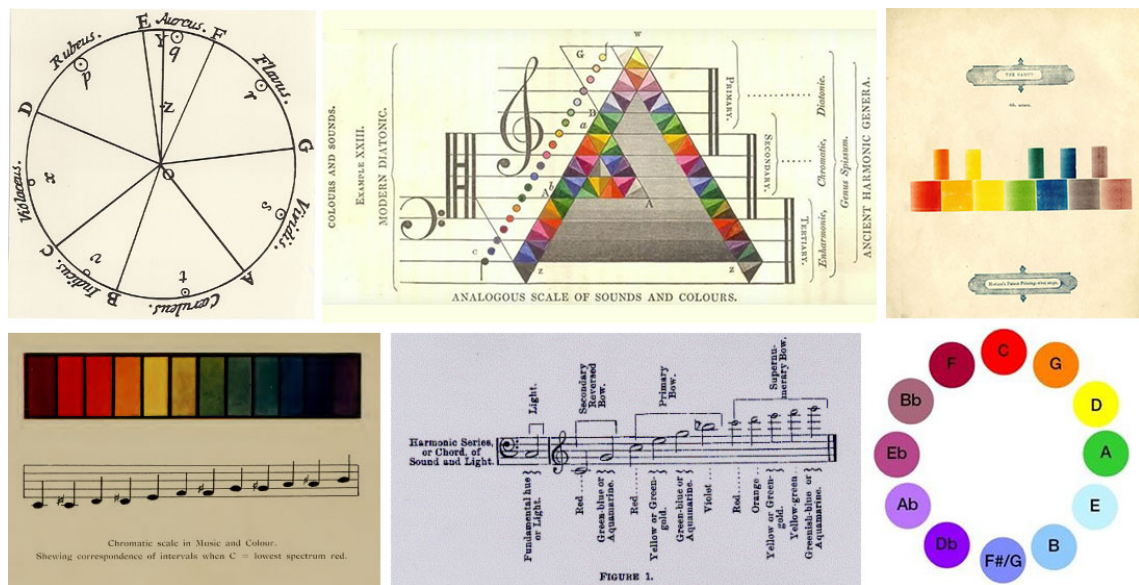
Figure 7 Colour-tone analogies. L-R: Sir Isaac Newton's colour circle [1704]; George Field's 'Analogous Scale of Sounds and Colours'. [1817, 79]; D.D. Jameson's colour to music scale, 'The Gamut, 4th octave' [1844]; A. Wallace Rimington's chromatic scale of music and colour. [1912, 18]; Bainbridge Bishop's harmonic series or chord of sound and light [1893]; Scriabin's circle.

2.4   INSTRUMENTS TO PERFORM, NOTATE AND PAINT COLOUR MUSIC

For several centuries after the invention of the 'oracular harpsichord', Castel's ideas of inventing an instrument that could play mobile colour was taken up by subsequent colour-music instrument inventors. The term 'colour organ' came to be associated with such inventions that facilitated a playing of 'mobile-colour' or 'colour-music'. Many of these designs were based on a music keyboard interface. Each of the inventors, however, used their own unique and particular versions of a colour-tone analogy and their own individual conception of the correlation of colours to musical notes and tones. Some of the correlations were based on the music scale, others on a system of intervals, others on the presentation of merged colours or simultaneous colours, others on the free-play of colours and forms.

2.4.1   NEW ARTS OF LIGHT AND COLOUR

As these inventions became more sophisticated, what emerged amongst some of the inventors was a recognition that the playing of this coloured light, through its operation in an instrument form, had its own characteristics and expressive qualities that could be expressed on its own terms that were similar to a music expression but did not have to be necessarily connected, either physically or analogically, to the forms of a music scale in order to explore a colour music. In other words, these inventions could generate their own forms and structures, and so, could bring about and belong to its own species of art, that of a colour music art. Some of the phrases used to describe this new art were as unique as the names of the instruments, such as, for instance,

'musical coloured light', 'mobile colour', or 'Lumia'. Yet, despite this, they all had one thing in common, namely, an interest in the musicality of light but within the material and forms of its own substance and its own artistic expressive quality potential and with its own structures. The most enduring phrase to describe this development in the instrumentation of coloured light and music was 'colour music'. Thus Rimington's theory of colour music dealt with the performing, notating and painting of colour music (1911). Such, then, was the increasing interest in the connections between colour and music, that in the early twentieth century the University of Hamburg hosted several international Colour-Music congresses (Kongresse für Farbe-Ton-Forschung) in 1927, 1930, 1933, and 1936 (Keefer, Ox, 2005). A team of experts and artists attended these conferences. Colour organ performances were held and a variation of a colour music that did not use an organ instrument design, the *Reflektorische Lichtspiel* (Reflectorial Colour Play) by Kurt Schwerdtfeger and Ludwig Hirschfeld-Mack was performed on specifically designed performance machines which were shown at this event (Elder, 2008, 50). The congresses also presented exhibitions of paintings that had been inspired by music, such as those by the 'Musicalist' painters (see chapter 3 section 3.5.5).

In his article on 'Instruments to Perform Colour-Music: Two Centuries of Technological Experimentation', Kenneth Peacock (1988) provides a detailed account of the mechanisms and operations of several of the colour music instruments inventions, placing this analysis in the context of the interest in understanding the connection between sound and light. The inventions and inventors he mentions and describes are: Fr Castel's *clavecin oculaire*; Erasmus Darwin's Argand oil lamp projections through coloured glasses (1725 [*varied dates in literature*]); D.D. Jameson's colour music instrument and notation (1844); Frederick Kastner's *Pyrophone* (1879 [*varied dates in literature*]); Bainbridge Bishop's *Colour organ* (1877 [*varied dates in literature*]); Alexander Wallace Rimmington's *Colour-Organ* (1893); Scriabin's (*Chromala* and *Luce score* (1911, 1915); Alexander Hector's colour projectors (1920s); Mary Hallock-Greenewalt's *Sarabet* and her art of colour music that she named 'Nourathar' (1920s); Adrian Klein's colour projector for stage lighting (1921); Leonard Taylor (1920); Achille Ricciardo, the *Teatro del Coloure* (year); Richard Lovstrom (1919); Zdeněk Pešánek's colour-keyboard (1924 [*varied dates in literature*]); Alexander Lazlo's *Sonchromatoscope* (1925) and a special system of notation for preludes for piano and coloured light projection; Ludwig Hirschfeld-Mack *Farblichtspiele* (1921); Thomas Wilfred's *Clavilux* (1930s [*varied dates in literature*]); George Hall's *Musichrome* (1930s); Frederick Bentham's *Light Console* (year); Bulat Galeyev's *Prometei* music-kinetic art experiments (1970s). Michael Betancourt has gathered together the US patent documents for some of colour organs of the early to mid-twentieth century in *Visual Music Instrument Patents* (Betancourt, 2004). Many such instruments were invented over the course of the eighteenth, nineteenth and twentieth centuries and are still being invented today.

Each inventor invented their own name for their instrument. (For a chronological list of colour organ and instrument inventions, along with the name and the estimated year of the invention, see Appendix 1.)

A common feature of these colour instruments was their use of the medium of light for the purposes of generating the illumination necessary to produce coloured light reflections of various hues – a coloured light. Light in these instruments not only made colour mobile but also made its mobility playable in the manner of the playing of a musical instrument. What was of interest in many of these inventions, nonetheless, was the interest to forge a correspondence between musical tones and colours, albeit often coloured lights. There were many problems to solve in the use of a colour to tone system for generating a play of colours, the first and main one being how to create powerful enough illumination. Early instruments had to rely on candle light to generate the illumination required. It was, then, only with the invention of electricity and the incandescent light bulb (1879) that the art of coloured light becomes feasible (Vergo, 2005, 253).

Addressing and overcoming the differences that exist between musical tones and coloured light was also a challenge. The octave in the music scale could be repeated at higher and lower registers, and each pitch had its own unique frequency and wavelength at different registers, for example, a low pitched 'A4' is 440 Hz and a higher pitched 'A8' is 7040 Hz. Colour, however, does not have unique frequencies or wavelengths for different shades or tints of a colour, for example red operates in the frequency of 400–484 THz. There are not higher or lower colour frequencies that could be mapped onto a scale of octaves in the manner in which the music scale operated. Rather, the degree of illumination of a hue of colour (its colour) is determined the chroma or strength of the colour and our perception of it. The lightness and the darkness of a colour determines the different tones, tints and shades of a colour. Inventors devised their own means and workarounds for extending colour beyond the limits of one scale of colour. This is why the art of colour music evolved out of, and alongside the colour-organ tradition and many inventors also wrote theories of colour music.

Although most of these inventions were based around a keyboard input instrument design, during the twentieth century the interface for accessing and creating mobile colour was less bound to the metaphor of a keyboard. Custom interfaces, instead, were designed. This, in turn, reflected in the freer forms of mobile colour generation that took place in the early twentieth century. These devices (e.g., Thomas Wilfred's 'clavilux') were often referred to as kinetic inventions because they explored an art of light that was based on the interaction of mechanical moving parts and objects that can reflect light and generate a more kinetic and mobile coloured light.

Thomas Wilfred (1889–1968) became famous for his coloured light and inventions for playing colour, and for setting up an Institute of Light in New York to investigate the art of light, which he called 'Lumia'. He wrote about his art, for example, the article 'Light and the Artist' (1947) and the article 'Composing in the Art of Lumia' (1948), Wilfred had contact with Bragdon (see section 2.2.7) as both shared an interest in a new art of light and its potential for instrumentation and performance. 'Lumia' remains today a consistent term that is used by contemporary artists and inventors, for example, George Stadnik's 'Digital Lumia' (Stadnik, 2005) and Trent Kim's 'New Lumia' (Kim, 2018). Recently, a retrospective exhibition on Thomas Wilfred's Lumia art took place in which many of his instruments were either re-built or resurrected and refurbished, along with film versions of the light compositions which he had created. Wilfred named his Lumia art instruments 'clavilux', devising several versions of Clavilux instruments, for example, the 'Luminar' (a tabletop Clavilux), a 'Clavilux Jr.' and a 'Home Clavilux', instrument as well as a Clavilux for concert hall use. He created lumia compositions for these devices and used the musical term 'Opus' to name his compositions. The compositions he created for his colour instruments were capable of being performed repeatedly. He also recorded the lumia compositions (see Figure 8).

Figure 8 Thomas Wilfred's 'clavilux' concert stage set-up, newspaper 'Popular Mechanics' (Popular Mechanics, 1924); Thomas Wilfred in front of the home 'clavilux'; A detail of Thomas Wilfred's Lumia Suite, Op. 158 (1963–64), which was restored for the exhibition (Orgeman, ed. 2017, 138)

Regarding Wilfred's 'clavilux' concert stage set-up, one critic in a newspaper article reports and concludes that 'one of the thousand or more colour forms, constantly changing in tone and in hue, and the "organ" with which they are projected on screen before audience at the touch of an artist upon its keys: the result has been hailed as the creation of a new art' (Kirn, 2015).

Musicians who were interested in both colour and music being performed together at the same time also invented colour organs. In some instances, musicians also invented appropriate colour music notations for their instrument.

2.4.3.1   D.D. JAMESON'S 'COLOUR-MUSIC'

In his 1844 pamphlet *Colour-Music*, the musician D.D. Jameson describes a colour music instrument based around a piano keyboard and a new colour music notation for what he announced as the new art form of colour music. He introduces this field as a new type of music, a 'colour-music', remarking:

> The object of this short treatise is of a simple and practical nature – to introduce a new music, called *colour-music*, a practical system of which is now constructed for the first time; and to apply some of its principles to render the study and practice of *sound-music* easier and more popular than they are at present; substituting distinct and definite sensations, which, being the language of nature, are at once understood, for the arbitrary mnemonics [in sound-music] in use. (Jameson, 1844, 2)

Jameson's colour music score converted musical information into colour information.   It consisted of a series of colour bars of varying heights and combinations that were tightly aligned, nonetheless, to the original music score. He mapped each note to a colour, the octave of the note to the height of the colour, and the duration of the note to the length (width) of the colour. This can be seen in his colour music score for *Di tanti palpiti* by Nicholas Charles Bochsa (1810), where the music has been transcribed into a series of bars of colour of varying heights and widths and, if placed beside the extract of the score, the colour music relation can be seen quite clearly (see Figure 9).

Figure 9 D.D. Jameson's colour music score (1844). L-R: Diagram of time and length of notes to colours (1844, 17); an illustration of the gamut of colours of the fourth octave; an excerpt from the score 'Di tanti palpiti'; Jameson's colour music notation for Di tanti palpiti (1844)

Jameson was also interested in exploring a colour sensation for music, making it an 'ocularized tune' (Jameson, 1844, 16) and enabling the colour music to be seen. He was also interested in what he called the sensic effect of colour (ibid., 11) and the sensic correlations of colour and sound (ibid., 7) and how to compose with colour. To play his instrument and follow the score, he recommended:

> The instrument being prepared, the learner should touch keys of the same colour and height as those on the paper; making their length, in time, on the instrument, equal to their length in space, on the paper; accenting according to intensity of colour; and pausing for times equal to the blank spaces. (ibid., 18)

Some fifty years later, the architect Edmund Lind (1829–1909) wrote an essay titled *The Music of Colour* in 1894 that also explored a similar analogy of colour and music to Jameson's. For Lind, the colour music notation represented two arts – that of colour and music in harmony. This approach can be described as the representation of one quality in another as Jeremy Kargon observes (2011, 11). Lind devised a chromatic scale of colours and a notation in which the colour of the note indicated its sound and the size its duration. Thus he was able to derive a visual rhythm from a musical one (Kargon, 2011, 6).

2.4.3.2 ADRIAN BERNARD KLEIN – THE ART OF COLOURED LIGHT

A major study was published by artist, theorist and colour organ inventor Adrian Bernard Klein (a.k.a. Adrian Cornwell-Clyne, 1892–1969) on colour music in 1926, entitled *Colour-Music. The Art of Light*. It was re-published under the different title of *Coloured Light: An Art Medium*, in its third edition in 1937. Klein documents many of the colour music inventions including his own invention which he named 'Colour Projector', and he articulates a theory of colour music. His colour organ was performed and accompanied by music. Elder provides a succinct description of Klein's invention:

> His machine consisted of a large spectroscope that dispersed spectral lights over a cinema-type screen. These lights were controlled by a keyboard on which …[Klein]…performed many concerts of his own improvised music. More than 150 combinations of coloured lights could be generated by his Colour Projector. (Elder, 2008, 56)

The explanation of his theory of colour music and experiments with light, then, is set in the context of the development of art from painting to an art of light *through the medium of light*. He thus makes arguments for the potential of colour and light as new mediums and a new art language for emotional expression.

2.4.3.3 MARY HALLOCK-GREENEWALT – NEW ART OF COLOUR

Noteworthy are the inventions that sought to vary the illumination of the colour. For example, the musician, artist and colour organ inventor Mary Hallock-Greenewalt (1871–1950) invented an improved version of the Rheostat, patented with the U.S. Patent Office in 1920 (USA Patent

no. 1,357,773) to create a variation of light values that would result in a variation of colour shades and tints (Greenewalt, 1946), thereby 'allowing her to dim or brighten electric lights across 267 levels of gradation' (Guerrieri, 2017). Elder explains how her interest in colour music came about:

> She developed a desire to control the ambience in which delicate music such as Chopin's was performed; this led her to experiment with light modulation. She contrived ways to fade light up and down smoothly, using a rheostat and a liquid mercury switch (both of which she developed). (Elder, 2008, 77)

Greenewalt was also a musician and patented several inventions, from 1920 to 1934, related to the illumination of light and colour play. She invented a colour organ based on many of her inventions for controlling and associating light with music and named her light colour instrument invention a 'Sarabet'. Greenewalt also invented a notation system for the instrument (see Figure 10).

One example of her interest in the colour associations with music, is a painting that she did in response to a fragment of music score by Claude Debussy. She also devised a more precise colour scale based on listening to his music (see also Figure 10).

Figure 10 Mary Hallock-Greenewalt. L-R: Graphic in response to fragment of Debussy's music score; Design for a Colour Accompaniment of Debussy's piano composition '*Et La Lune Descend Sur Le Temple Qui Fut*'; 'Light Score' for the 1st movement of the Moonlight Sonata by Beethoven for use with the Sarabet Player; Mary Hallock-Greenewalt playing her light instrument, the 'Sarabet'. [https://hsp.org/, n.d.]

Her interest in a colour music came from her desire to perform colour music based on correspondences of mood rather than on a specific colour-to-tone mapping. She also named her art of colour music 'Nourathar', a made-up word derived from the Arabic for 'essence of light' (Guerrieri, 2017). In 1946, she published a textbook on her art, *Nourathar: The Fine Art of Light Colour Playing*. She also made some hand-painted films in 1909–1912, but the dates for these are disputed as the evidence seems to suggest that they were not produced before 1925 (Betancourt quoted by Elder, 2008, 78).

Music composers were also interested in exploring a projected mobile colour to accompany music composition performances, such as, for example, the Russian composer Aleksandr Scriabin (1872–1915) and the Hungarian composer and pianist Alexander Låszlo.

2.4.4.1   Alexandr Scriabin – *tastiera per luce*

Scriabin devised a colour light score for his music composition *Prometheus, Poem of Fire* in 1911, and the coloured light part was scored on a music stave at the top of the score, using music notation to denote configurations of coloured light (see Figure 11). This stave acts as the colours to be played in a simultaneous presentation with the music performance. He labelled this stave '*Luce*' in the score and it was referred to as the '*tastiera per luce*' ('keyboard for light', the part for colour light) in writings about it. The notes in the stave matched his own system of colour to tone correspondence, which was based on the 'cycle of fifths' (Scriabin's circle of fifths colour-tone circle, 2011) (see Figure 11).

Figure 11 L-R: Scriabin's circle of fifths system of colour to tone mapping. (Scriabin's circle of fifths colour-tone circle, 2011); Scriabin's own home colour-light apparatus made by his friends in 1911. (Scriabin Museum, 2018); Score Fragment from Scriabin's opening of '*Prometheus: Poem of Fire*' showing the 'Luce' score part for a colour keyboard (Scriabin, 1915).

Reading the colours from the score, the notes denote the hues of the colours to be played and the rhythm values denote the duration of the colours. There are two simultaneous pitched parts to the *Luce* score, and they interact. A further level of information is provided by the notation, the lower registers notate colours for a long duration and the higher registers are for colours playing in a more rhythmical and fast changing manner. This results in the combination of hues in a colour harmony that is analogous to the tonality and music harmony that is in the music parts of the score. According to Elder, Scriabin does not explain in the score the colour-pitch relations, and performers have to rely on accounts by his contemporary Leonid Sabeneiev and other contemporaries (Elder, 2008, 59). It was envisaged that the '*tastiera per luce*' would be played on a colour-light organ. Scriabin did build a test device in his home for studio experiments, described as:

> [A] primitive light-music instrument (12 coloured bulbs, fixed in a circle on the disc, the light being directed to the ceiling). It allowed to perform only single layer of '*Luce*', with no nuances at all. (Vanechkina, 1979)

For later performances, other colour organs and light instrument inventions and systems were devised and deployed for the composition. The first successful performance with colour took place in Carnegie Hall, New York in 1915, but to mixed reviews and was deemed underwhelming by audience members (Galeyev, 1988, 386). This is attributed to the limits of the technology of the colour organ at that time for large-scale performances. One commentator notes the difficulty of having to divide one's attention in order to hear the music and understand the coloured lights in tandem with the music. (Eaglefield Hull, 1916, 227). There has, indeed, been analysis and evaluation of the earliest performances with colour and light by Irina L. Vanechkina in an online article 'On the performances of A. Scriabin's "Lighting Symphony": Myths and Reality', (Vanechkina, 1979). There have been many performances in recent times that have interpreted Scriabin's colour to tone correspondences and presented a simultaneous light and colour performance alongside the orchestral music performance. For example, the laboratory of 'colour music' set up in Moscow led by K.L. Leontiev performed Scriabin's *Prometheus* in 1962 and 1975, following the score (Galeyev, 1988, 388) and there was a television production of *Prometheus* with light for Leningrad television in 1982 (ibid., 390). A recent concert in 2009 with programmed lights that were devised by Valentin Afanasieff (Afanasieff, n.d.), based on his own system and an analysis and research into Scriabin's '*Luce*' score and using a colour tone analogy based on the circle of fifths, and a mapping of music tonality such as music melody, harmony and key signature to a chromatic colour scale based on the circle of fifths and using colour complementarity and colour harmony rules. The performance of Scriabin's Prometheus performance with lights was held in Ice Palace of St. Petersburg (Record of the world premiere of the concert "Prometheus" on February 19, 2009 in the Ice Palace of St. Petersburg., 2009).

2.4.4.2 ALEXANDER LÁSZLÓ – COLOUR-LIGHT MUSIC

The Hungarian composer and pianist Alexander László (1895–1970) conceived of a new art of colour-light music and invented a colour organ to realise his art in performance. He presented coloured light projections in accompaniment to his music performances. The music that he performed was both his own and those of the Romantic period as well as Alexander Scriabin and Sergei Rachmaninoff's music. He published his book *Die Farblichtmusik* in 1925 that documents his theory of colour-light music. Jörg Jewanski, who has conducted research on László colour-light music (2009), explains that László conceived this new art form as light ornamentation where music and light primarily communicated mood. Elder quotes László's views on colour-light music as an effort to reach a 'higher unity' for music and painting, remarking:

> Colour-light music seeks to merge two previously separate art genres, art in notes – i.e. music – with art in colours – i.e., painting – into a higher unity, a new art...[László

determines]…the basic colour of a musical piece, calls one of them 'Preludes for Coloured Light and Piano Blue,' another, 'Ref,' and retains the basic colour throughout the entire piece. Depending on the changing musical events, such as dynamic or rhythmical changes, or the appearance of new themes or a new key, the basic colour is supplemented by new colour hues…understood by analogy to the rules of musical variation. The colours are in turn occasionally supplemented by parallel phenomenon to certain musical figures, plastic configurations such as wavy lines or wedge shapes. (Elder, 2008, 67)

László conceived of his art of colour-light music to comprise two equal and independent creative parts that created, nonetheless, a 'higher unity' and 'a new art'. The visuals consisted of 'mixed colours and forms in a new type of artistic synthesis [that] he called *Farblichtmusik'* (Jewanski, 2012, 135). He collaborated with the painter Matthias Holl to create light paintings for his music. Holl illustrated one of László's colour-light concerts in 1925 for László's book (see Figure 12).

László invented a multiple projection system, with the help of engineers, to project visuals with the music performances. He called this devise a colour-light piano and named it 'Sonchromatoscope'. It consisted of four projectors and four footlight machines that are controlled from a switchboard (see Figure 12).

Figure 12 Alexander László. L-R: A Colour-Light Concert by Alexander László painted by Matthias Holl, published in Alexander László's book *Die Farblichtmusik* (1925) [Jewanski, 2009]; The total multiple projection surface by Matthias Holl for László's prelude 'Rot'(red) [Jewanski, 1997, 26]; László's Sonchromatoscope multiple projection invention [ibid., 23]

In 1926, László also collaborated with the abstract filmmaker Oskar Fischinger (1900–1967) and projected Fischinger's abstract films in a multiple projector presentation in several cities across Germany (Goergen, 2012, 43). Thus, the bond between 'visual music' and 'abstract cinema' became part of the historical evolution of 'colour music'.

2.4.5 PAINTERS INVENT COLOUR MUSIC DEVICES

Painters too built colour organs to explore their ideas about colour, and some of these conceived of these devices as being presented alongside a music performance.

The Ukraine born Paris based painter Vladimir Baranoff-Rossiné invented a colour music instrument which he named the '*Piano Optophonique*' (see Figure 13).

Figure 13 Vladimir Baranoff-Rossiné. L-R: Reconstruction of *Piano Optophonique* by Jean Schifrine in 1971, exhibited in the exhibition, Sons & Lumières: A history of sound in 20th Century art, Centre Pompidou, Paris, 2004. Photo credit : © Philippe Migeat - Centre Pompidou, MNAM-CCI /Dist. RMN-GP Domaine public; an *optophonique* disc, 1920–1924; View of inside mechanism of *Piano Optophonique*. [Baranoff-Rossine, n.d.]; One visual effect of the piano *Piano Optophonique*. [120years.net, n.d.]

He started work on it in 1916 and performed with it in the Bolshoi theatre in 1924. The instrument generated sounds as well as projected imagery onto a wall or ceiling. The coloured projects were operated by the keys of the piano and the internal mechanism of the piano consisted of revolving painted glass disks, mirrors, lights and lenses. It also made use of a photo-electric cell to create variations in opacity of the light reflecting through the disks and filters. Like many other instrument and colour organ inventors, Baranoff-Rossiné believed this announced the appearance of a new art. Writing about himself in the third person, he remarks that 'Thanks to his optical piano, Baranoff-Rossiné has created a new art form that as a consequence has its own unity, and it does not involve purely and simply superimposing one phenomenon on another' (Baranoff-Rossiné, 1925 in (Baranoff-Rossine, n.d.).

The French painter Charles Blanc-Gatti (1890–1966) was one of the Musicalist painters (see chapter 3 section 3.5.5) who was interested both in the correspondence between music and painting and in exploring the temporal element of colour and form as the subject matter of his painting work. He wrote on the topic and published his first text in 1932. He also invented a colour music instrument that he called the 'Chromophonic Orchestra' and patented it in 1933 (see Figure 14).

His invention consisted of a screen of 'multicoloured luminous effects of light' (Junod, 1998, Blanc-Gatti, n.d.) that was to be displayed in 'absolute synchronism with a piece of music' (ibid.). He was interested in the presentation of light projections with music concerts as well as for the presentation of staged poetry. He also saw the potential of these light projections for

advertising and interior decoration. Elder explains and describes the colour-tone analogy of his device, noting that '[H]is device displayed colours based on a system that equated the frequencies of sound with colour vibrations: low tones were red (red has a low rate of vibration); medium tones were yellow and green; and high pitches were violet' (Elder, 2010, 5).
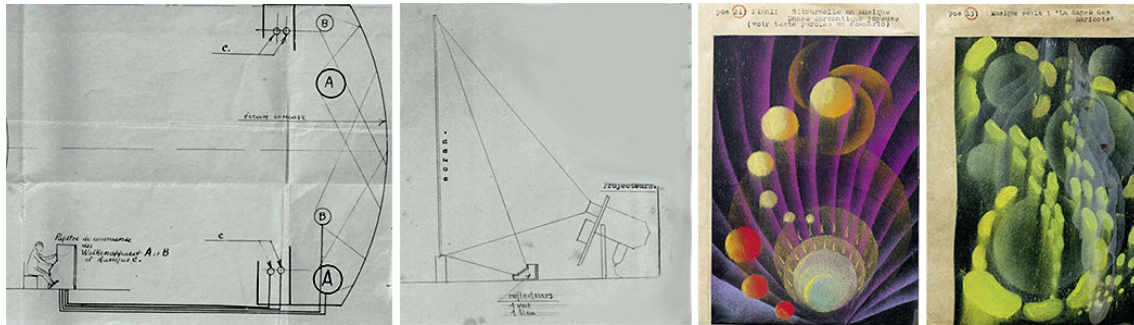
Figure 14 Charles Blanc-Gatti. L-R: Section of plan detailing a light projection on the circular chromophonic screen, 1934, coloured pencils on paper print. MCBA / SIK-ISEA; Another section showing the projection set up (Lespressesdureel.com, n.d.) *étude*, 1935. Image: Courtesy SIK-ISEA, Lausanne, Archives suisses de l'art, ISEA-AR107. Photo Jonas Marguet (Elac Gallery Exhibition "Vertiginous Parallels" (Ecal.ch, n.d.)

Blanc-Gatti also worked on film projects in the area of advertising film. He created, however, a film that explored his ideas of the correspondences between sounds and colours, professing this as a new art that he called 'Chromophony' in 1939. Blanc-Gatti also configured the new content in film with artistic light and colour effects from purpose-built devices that could be used to project with music performances in terms of a new art.

2.4.5.3   SYNCHROMY IN KINETIC FORM

The two Synchromist painters (see chapter 3 section 3.5.2) Stanton Macdonald-Wright (1890-1973) and Morgan Russell (1886–1953) were interested in moving beyond the medium of paint in order to explore a more mobile colour expression and to perform colour and form as an art of colour music (Zilcher, 1987, 118). Russell, in his colour studies in painting, was interested in exploring and combining movement and light in his paintings. Alexandre Thibault explains:

> Russell had been thinking about the effect which light, transparency and the conjunction or succession of images might have on his art, how such different factors as time, movement and light could be combined, not as dynamically as in a film, but with a variation of electric lights 'coming and dying out' behind the painted surface, the medium used being oil on tissue paper or some similar medium. (Thibault, 2002, 207)

Russell created designs for a 'Kinetic Light Machine' invention (Zilcher, 1987, 118) to explore these aspects of colour in a surface (see Figure 13); but it is not certain whether he actually managed to build a device. Macdonald-Wright, however, did design and, with professional assistance, build a colour-making instrument that he named the '*Synchrome Kineidoscope*'

conceived in the 1950s, with the first machine built to his specification in 1960 (Zilcher, 2016, 24) (see Figure 15).
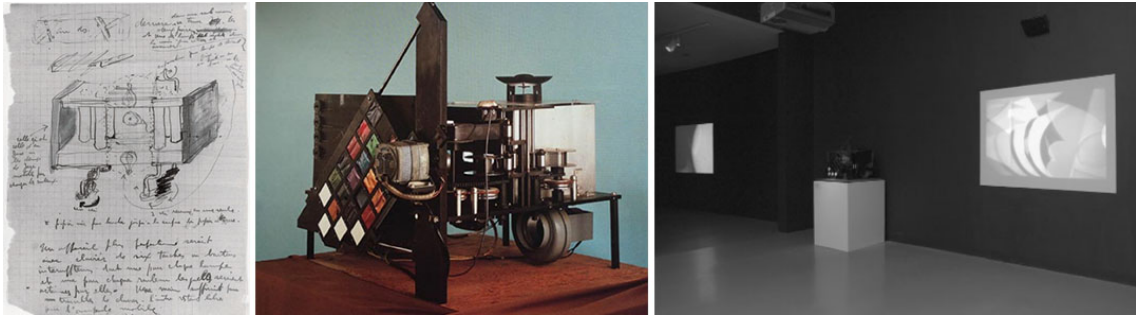
Figure 15 Synchromist painter's colour music. L-R: Morgan Russell's plans for a 'Kinetic Light Machine' (Zilcher, 1987, 118); Stanton Macdonald-Wright, *Synchrome Kineidoscope* (Colour-Light Machine), 1960–69; Stanton Macdonald-Wright, *Synchrome Kineidoscope* beside a screen excerpt of documentary performance by Randy Sprout, 2004, installed in the *Visual Music* exhibition, Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, Washington, DC (photo: Lee Stalsworth) (Zilcher, 2016, 24)

Macdonald-Wright intended this device to project colour and form with orchestral music (Macdonald-Wright in Zilcher, 2016, 23) and referred to the creations from this device as 'the new art of kinetic colour and form' (ibid.). This machine projected colour and light and thus was able to extend and realise the music metaphor at work in their painting to the element of time. Macdonald-Wright wrote a students' text book on *Treatise on Colour* (1924) and describes the role of colour and music in using this device along with a music performance:

> Do you think it possible to follow the themes in a musical composition abstractly in form and line and colour? … I do not mean a direct imitation of the theme – not a mathematical replica, but a free-moving intertwining of linear movements, made with colour until the whole *écran* becomes, as it were, a translucent mass of composed and balanced colours moving wawy always toward a given climax just as the musical composition moves. This at least would have the advantage of interested attention. Ata fortissimo passage let these colours seem to fairly leap out at the audience, let them be synchronised with the music at such moments and I feel that a definite reaction can be had. (Macdonald-Wright, 1925, in '*Sons et Lumière*', 2005)

2.5 ANALYSIS AND PRELIMINARY CONCLUSIONS

2.5.1 DECLARATIONS OF A NEW ART

Looking back over the history of efforts to make music visible, many declarations of a new art (of colour music) were made by theorists and inventors in pursuit of this aim. The new art that was mentioned and declared, under different appellations, in this chapter are: colour-music, lumia, nourathar, colour-light-music, *Farblichtmusik*, chromophony. All of these, however, have in common some basis in the exploration of a correlation between colour and music of some sort,

whether considered as a 'higher unity' or simply as a new art form through the medium of light and colour. Central to this endeavour, nonetheless, was the invention and creation of some kind of instrument that could realise these imaginings and plans. Some of the inventions of such a colour-music instrument were modelled on a music instrument design and function, others move towards building an instrument that projects an image consisting of forms of mobile colour and light. All could be said to belong to an art of colour music. Each inventor and artist, nevertheless, devised a colour music art according to his or her own research interest, whether such emerged from his or her scientific or artistic practice, or from both scientific and artistic practice. Here, experimentation in science supported experimentation in the creation of visual music and *vice versa* — creations of visual music raised questions for existing theories of colour and sound in natural science. Many of the inventors imagined that their invention would be developed into commercial versions and become as popular as a music instrument, but these devices, in reality, are better characterised as being once-off custom inventions.

2.5.2 COLOUR INSTRUMENT CATEGORIES

Although unique, early colour organs and colour music instruments can be grouped into three distinct categories according to those inventions that were (1.) musician led, (2.) painter led, or (3.) music composer led:

(1.) Musician-led inventions have the following characteristics:

(i)   The colour performance instrument is to be played in a music performance setting and accompanied by music;

(ii) The identification of musicianship attributes, such as, the note of a tone, the duration of a note, and the higher or lower register of a note are applied to colour attributes, such as, the hue of a colour, the width or height of the colour and other such mappings of musicianship properties;

(iii) The invention of a colour-music score to assist in the plating to the colour music on the colour music instrument in performance.

(2.) Painter-led inventions have the following characteristics:

(i)   The artist wishes to extend their exploration of light and colour in painting to explore the visual expressive possibilities of a mobile colour;

(ii) Explore, in addition, analogies between the expression of mobile colour and music;

(iii) The output of the colour instrument results in forms of motion painting through light and these motion paintings are to be presented alongside a music performance. They accompany the music.

(3.) Music-composer led inventions have the following characteristics:

(i) The composer wishes to add a visual dimension to the performance of their own music compositions and this visual dimension is to be an integral part of the music performance;

(ii) The score may include a unique colour music notation;

(iii) The colour part is an independent part but an important integral part of the composition in performance. The colour part is not about synchronisation with music but is an integral art, more akin to being like an orchestral part belonging to the whole of the music composition. Colour is like its own instrument with its own unique characteristics similar to the unique characteristics of the timbre of a music instrument part in the music composition. The colour thus can contribute to the mood of the music, its pace and add another artistic element to the overall performance producing a 'higher unity' achievable than dealing discretely with either colour or sound respectively and individually.

2.5.3   THE INTEGRATED ARTS

What held most promise for many of these individuals engaged in this research, then, is how many of them imagined forms of an integrated art that laid equal importance to music and visual art concerns, as well as including other arts, such as, for instance, poetry and architecture. The presentation of various arts at the same time in the form of an integrated unity of expression had tremendous appeal. This integration of the arts, however, was not about a synchronisation of the arts; it was, rather, more of the appeal to what can be achieved artistically by presenting various art forms in relation to a common and unified purpose of making music visible at the same time.

Chapter 3   THE 'VISUAL MUSIC' OF FORM AND CONTENT

3.1   INTRODUCTION

In the previous chapter, we noted that the attempt to make music visible, formally, either through the use of colour-tone analogies in scientific experiments or the building of colour-organs of the eighteenth and nineteenth centuries led to the phrases 'visible music', 'colour music' and 'visual music' being used by inventors to characterise a new art into the twentieth century. The term 'visual music', however, was also used to describe a particular new form of painting, which we now refer to as 'abstract art', that began to emerge in Western art at the turn of the nineteenth century and into the early twentieth century.

This chapter deals with the pioneer artists and art theorists who put forward arguments and practices for painting to be a free and independent art that finds a language and method in its own material means. In this development, the new art of colour-music in the early eighteenth and nineteenth centuries that sought to produce objectively coloured music (Castel, Runge, Survage) through tonal harmony gives way to a new art in the twentieth century of expressing colour and form both objectively and subjectively (Kandinsky, Klee) more akin to music composition. Deciphering this turn towards subjective approaches in abstract painting reveals just how much music influenced the aesthetic and artistic goals of abstract artists work, indeed, so much so, that at the time some critics described this newly emerging form of painting as a 'visual music'. This chapter focuses on how painting developed its own autonomy, modelling itself on music, yet, at the same time, provoking its own unique form of pictorial expression. This will inform our exploration and treatment of the relation between painting, colour and music in 'visual music' as evidenced in the context of abstract art painting.

The relationship between music and the new form of abstract painting emerging in the twentieth century is intricate and complex. This chapter, therefore, begins by first outlining in section one the general art cultural context which sought to explore connections between the arts, focusing attention in particular on those, like Walter Pater and Gotthold Lessing, who argued that all of the arts, including the visual arts, should be more aligned and understood in relation to the art of music. Several artists and commentators compared painting to music. At this time, nonetheless, the painting arts was interested both in exploring its own expressive language independent and free from representational concerns of an external world (characteristic of the natural sciences and natural art paintings) and, at the same time, in appealing to objective and mathematical laws of harmony and proportion in their handling of objects, form and colour. Music, therefore, was considered to be an appropriate art to which commentators and painters

could turn in conceiving and contemplating a new type of art for painting. It is in this context that we will examine in section two painters and critics who used the phrase 'visual music' to describe what they were observing in the content of painting. Several painters wrote about their theories of art. Section three examines their views on painting. This examination throws light on how painters understood the new realities sought in painting. Here, however, one can detect a tension emerging between an objective and non-objective approach to form and content in painting. Section four, therefore, deals with painters who used and deployed specific music structures, translated into a pictorial language, in their painting. Section five concludes the chapter, dealing with painters who explored a colour-tone analogy in their paintings. In this endeavour, colour in itself was something that many painters compared to music. In approaching colour and tone in this manner, they returned to and advanced the idea of practically implementing colour-tone analogies already explored in colour organ inventions.

3.1.1 THE RELATION BETWEEN MUSIC AND PAINTING

A recurring theme in the development of the arts, in different art periods, is to make comparisons between music and the visual arts. Several studies examine how both arts have mutually influenced each other (Zilczer, 1987; Kagan, 1995; Maur, 1999; Shaw-Miller, 2004; Vergo, 2005; Düchting, 2007; Vergo, 2010; Shaw-Miller, 2013; Zilczer in Kaduri, ed. 2016; Junod, 2017). A useful categorization of the field of study has been undertaken by Peter Vergo in his study *Music and Painting* (2010). Vergo categorises three broad approaches for 'extolling music, and pointing to its affinities with visual art' (ibid., 192). These are: 'one, music's capacity to appeal to emotions because of its non-material and spiritual nature; two, music's abstract nature without dependence on subject-matter or narration; and three, music's orderliness with its systematic laws based on mathematics and acoustics (ibid.).

3.1.2 THE APPEAL TO PROPORTION IN EARLY COMPARISONS BETWEEN PAINTING AND MUSIC

In antiquity, painting was linked to craft and skill, and belonged to those arts that were considered to be 'the product of the eye and hand [rather] than that of the faculties of judgement and intellect' (Vergo, 2005, 139). In this regard, music held a higher intellectual standing in antiquity. Music had a proven physical and mathematical basis in the study of acoustics, and thus music knowledge presupposed and required knowledge of mathematical-theoretical laws pertaining to number, harmony and order and in particular the mathematical ordering of the physical basis of music's science of harmonics (ibid., 141). Thus when the arts are taken as a whole, critics, theorists, musicians and artists have focused on music's orderly aspects and its numerical and mathematical foundations. In antiquity (and later), such mathematical laws underpinning music's laws were

considered to be representative of a cosmological order, and so, were deemed to give order to the cosmos and this gave music a special respect and status amongst the arts (ibid., 16).

Many of the earliest arguments for an improved standing for painting was also based on devising just how much painting too was an ordered system based on number. This was done by devising a mathematical basis for formal compositional methods and for the ordering of colour. In the Renaissance, painting argued for a higher standing through the writings of Leon Battista Alberti (1404–1472) and Leonard da Vinci (1452–1519). Alberti argued for the intellectual worth of painting (Vergo, 2005, 139), believing that the objects in a painting 'should appear "like real objects"' (ibid., 143), and so, he enumerates systems, rules and proportions to represent objects in three-dimensional space (ibid., 143). Leonardo claimed that proportionality in the relationship between objects in a perspectival space are similar to proportions in the music scale. For example, in his system of 'proportional diminution' (ibid., 144), Leonardo observed simple fractions could express the sizes of objects to be placed in the perspective grid of the painting. Martin Kemp says that Leonardo's perspective system convinced Leonardo that he was 'dealing with a form of visual harmonics in which the perspectivist forms his "intervals" in the way musicians does with his notes' (ibid.) (see Figure 1). One of the diagrams that D. Stephen Pepper devises to illustrate Leonardo's perspectivist systems demonstrates the ratios of the musical scale as it applies to perspective, where the perspective 'lines would cut a string, in such a way as to give you the major scale' (Pepper, 2001, 36). Leonardo also observed a geometrical proportion in relation to light and darkness (see also Figure 16). During this period, then, painting was interested in the representation of objects in space, and so, perspective was an important technique with which to represent accurately these laws of nature.
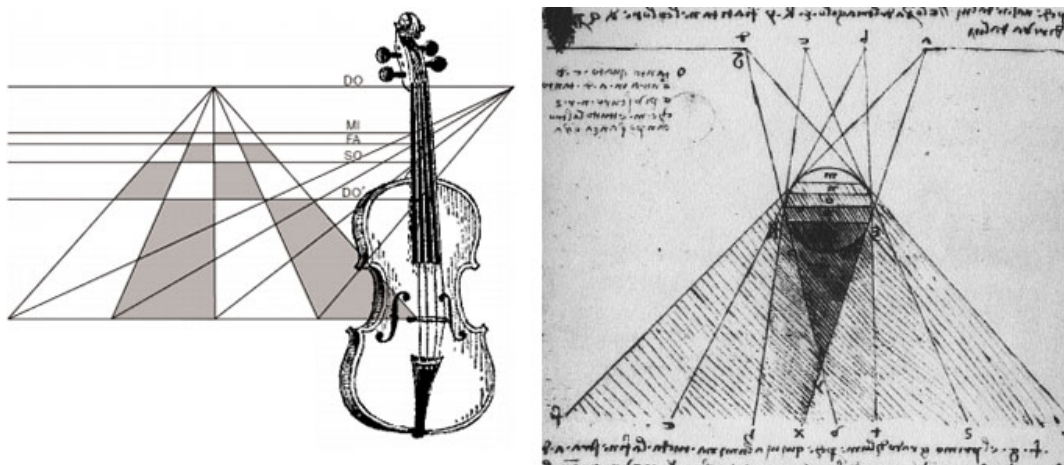
Figure 16 L-R: Diagram demonstrating Leonardo's relation of perspective to the music scale devised by D. Stephen Pepper and labour committee members. Pepper describes the pattern: 'Tile pattern shows the relationship between perspective and the harmonics of the musical scale. In the special case shown, the division of the plane corresponds to the diatonic scale'(Pepper, 2001, 35); 'Leonardo da Vinci, Notebooks, drawing of gradation of light and shadow, Manuscript B.N. 2038, fol. 13v.' (ibid., 39)

The mathematical underpinnings of music were compared to the mathematical underpinnings of visual forms and patterns, such as, of arabesques (see chapter 2 section 2.2.5). Artists, however, adapted theories from other disciplines that also sought to find the mathematical, proportional and measurable basis of other phenomenon such as perceptual phenomenon. For example, the psychologist Charles Henry (1859–1926) believed that there 'is a simultaneous one to one relationship between outer stimulus and psychic or perceptual reaction which can be mathematically calculated' (Henry, 1885, in Argüelles, 1969, 49). The painter Paul Signac (1863–1935), who worked as a draughtsman for Henry, was influenced by this theory and, in particular, by one of Henry's concepts of 'continual auto-genesis' (ibid.) which was used as way of explaining an analogy between music and painting. Henry learned this concept from the music theorist Hauslich, 'who compares music, ornamental sculpture, and arabesque' (ibid, 53). Explaining 'continual auto-genesis' and how it was applied in Signac's painting, José Argüelles remarks:

> [Continual auto-genesis is] is an intuitive concept which is the energy source and content of arabesque-musical as well as visual. By arabesque one can take to mean any 'decorative' motif: often intricate, repetitive, self-reproductive, and, ideally, self-mutative… As such, continual autogenesis is a universal principle, trans-cultural and embracing all media, for it is an organic or natural principle. (ibid., 49)

Referring to Signac's painting *Portrait of Fénéon* (see Figure 17), Argüelles uses the term 'visual music' to describe Signac's understanding of Henry's concept, in the following passage:

> From about 1886 to the early 1890's Signac labeled all of his works with opus numbers, but only in the *Portrait of Fénéon* does he attempt a real break with the idea of painting as representation. It is in the background of this canvas that Signac's understanding of Henry is revealed as *visual music*, later revering to the visual music being 'a reformulation in paint of the cosmic law which we *know* only at the most profound level of psychic experience'. (ibid., 51, my emphasis)

Figure 17 Paul Signac: L-R: 'Opus 217. 'Against the Enamel of a Background Rhythmic with Beats and Angles, Tones, and Tints. Portrait of M. Félix Fénéon', 1890; 'Opus 227. Woman Arranging Her Hair (Arabesques for a Dressing Room),' 1892; 'Opus 237. Houses in the Port Saint-Tropez', 1892.

Arguëlles, then, teases out the conception of what was considered by Henry and Signac to be a natural principle underpinning art, that is the nature of art itself as a version of a cosmic law and the importance of intuition. The cosmic law can be intuited and this explains how, in Signac's work, such a natural principle reveals itself to be a visual music. The visual music is the cosmic law of nature that, having already been well worked out in the mathematics of music, was being used by Signac in painting. The paintings 'Opus 217', 'Opus 227', and 'Opus 237' demonstrate how patterns, arabesques and the tonal use of colour contribute to a universal principle underpinning the paintings (see Figure 17).

3.1.4   Lessing and Pater – the call for art to serves its own material

Over the course of the eighteenth and nineteenth century, two critics made arguments for the creative arts to have the freedom to explore their own distinct field. The first is the German dramatist and critic, Gotthold Lessing (1729–1781), who used this argument to support and promote the separation of the arts. The second, the novelist and literary critic, Walter Pater (1839–1894), nearly a hundred years later, used similar arguments to promote the unity of the arts. Yet both were calling on each of the arts to serve its own material. These two themes of the separation and the unity of the arts were consistent themes right across this period and into the twentieth century.

In his often-quoted 1776 essay 'Laocoon; an essay upon the limits of painting and poetry' (Lessing, 1776, in Frothingham, 1957). Lessing makes the case for each art to be a separate, distinct and unique sphere of activity. He argues for each art to have the freedom to work with its own medium, exploring its own unique features and characteristics. He thus calls for each art to be independent and autonomous and that the arts need to remove the obligation of an art to be bound to another art, or to be bound to the principle of imitation. To illustrate his argument, he uses the example of poetry and painting and argues for their separation based on the poetry of Milton. Poetry had a close connection to painting in that its role was to provide pictures and that these pictures could be depicted in painting (ibid., 87). Lessing explains that, in Milton's poetry, the poet is no longer concerned with providing pictures for the painter simply because the pictures he provides can no longer be converted to the canvas (ibid.). Thus the freedom of each art to express its own ideas (in word or in picture) is of importance artistically, according to Lessing, because:

> When we compare poet and painter in particular instances, we should be careful to inquire whether both have had entire freedom, and been allowed to labour for the highest results of their art without the exercise of any constraint from without. (ibid., 62)

Although both painter and poet engage in imitation in their art, this does not mean that their imitations make their art bound to each other's. According to Lessing, poetry and painting employ different types of imitation.

Lessing, therefore, wanted each art to explore its own medium for its own ends and purposes. As each art, however, attempted to do this, the freedom to explore one's own medium became as much about creating boundaries and demarcations between the arts, defending those boundaries, and putting forward arguments for separation within the arts, for, as Daniel *Albright notes* in his 'Series Editor's Foreword: The Need for Comparison among the Arts' to James Leggio's edited collection on *Music and Modern Art* (*2002,* xiii), 'the purity of one medium must not be compromised by the encroachment of styles or themes from other artist media'. The argument for the boundaries and separation of the arts and of the art mediums, was a consistent one, right up to the early twentieth century.

Near the end of the nineteenth century, Walter Pater, another widely quoted author in the discussion of the separation and integration of the arts, wrote in his *The School of Giorgione* (1887) that music is the art that has found the means to devote itself to its own material, and so, in doing this, music's form and content are inextricably moulded together to become the ends in themselves of the music. On this basis, Pater makes the case for the theoretical unity of the arts in pursuing a common goal based on this fusion of form and content that is most notably found and exemplified in music. Thus, he famously writes:

> All art constantly aspires toward the condition of music. For while in all other kinds of art it is possible to distinguish the matter from the form, and the understanding can always make this distinction, yet it is the constant effort of art to obliterate it. That the mere matter of a poem, for instance, its subject, namely its given incidents or situation — that the mere matter of a picture, the actual circumstances of an event, the actual typography of a landscape — should be nothing without the form, the spirit, the handling, that this form, this mode of handling, should become an end in itself, should penetrate every part of the matter: this is what all art constantly strives after, and achieves in different degrees. (Pater, 1877, in Leggio, 2002a, xvii)

Commenting on this, James Leggio explains that there is a unity in art that is based on a common purpose or aspiration for the 'self-definition of each separate art form within the clear boundaries of its own medium' (ibid., xvii). Yet, it is 'the condition of music', for Pater, which is the common source of that aspiration. All of the arts measure up to it. In this regard, the common purpose for art, since antiquity, to pursue the imitative or representative principle was replaced now at the beginning of the nineteenth century with a new common purpose which was that each art was moving towards developing its own autonomous and independent content, and moving towards a merging of their forms and contents, just as in music. Thus, Vergo concludes:

> As the nineteenth century drew to a close, artists and critics anxious to explore the communicative potential of painting as a means of expression in its own right – that is, independent of subject-matter or any kind of representation – looked increasingly

> to music as a model for what would eventually become an entirely non-narrative, even, 'non-objective' form of visual art. (Vergo, 2005, 21)

This, then, both explains and announces the turn towards full abstraction in painting characteristic of many artist's paintings in the early twentieth century. It is in this context of applying the art of music to the art of painting, that some painters expressed musical ideas more explicitly in their art-work, going that bit deeper than looking to music in its expression as a model of autonomy through devising comparable forms of expression analogous to music yet suited only to painting. Critics noticed this change and started to comment on it.

3.2 THE 'VISUAL MUSIC' OF PAINTING AND DESIGN

3.2.1 RUSSIAN SYMBOLISM AND THE ABSOLUTE

One of the earliest uses of the phrase 'visual music' can be found in an article describing Russian symbolist art in 1909.

Symbolism was a movement in painting that occurred across Europe in the nineteenth century, where the subject matter of painting followed symbolic themes. At the turn of the twentieth century, Russian symbolist art was a particularly active movement extending to, and including many art practices, discourses by philosophers, political theorists, critics, writers, artists, and composers. At its core, symbolism sought to explore the spiritual in art based on religious beliefs about the nature of spirit in man and the manifestation of a 'world' spirt or 'world-soul' (Elder, 2008, 211). In his account of symbolism in Russian art, R. Bruce Elder (2008) remarks that the writers, at this time, were both concerned with the dehumanizing effects of the Industrial Revolution and also involved in a revival of 'religiosity of traditional Russian culture' (ibid., 206). They believed that there was a sacred dimension to reality that had been muted through the mechanization of the world picture, and thus sought to 'reunite all nature with the Divine' (ibid.). Central to this endeavour was the notion of the incarnation of the God-man as the personification of God's wisdom (ibid., 208), thus room for religious belief and wisdom or religious knowledge was viewed as the unifying element in all of human knowing. One of the leading Russian Symbolist philosophers, for example, Vladimir Sergeyevich Solovyov (1853–1900), argued that there is a kind of knowledge that is found in 'faith' by means of an 'intuition of the Absolute' (ibid., 209). This knowledge, however, is not reducible to the other two kinds of knowledge that we can possess: empirical knowledge that we can obtain through our senses and sensible experience; and rational knowledge, obtainable through and by reason alone (mathematical knowledge) (ibid.). The intuitive knowledge of the Absolute, nonetheless, assists in giving form to the other two types of knowledge. Thus Elder explains both this pivotal role and what Solovyov means by 'intuiting the Absolute':

> Intuiting the Absolute leads to union with the Absolute; and the Absolute, as an object of knowledge, gives content to reason and form to experience. Intuition does not provide knowledge of the sort that can be expressed in propositional form: through intuition we can know that God exists, but we cannot learn about His nature. Insight into his nature comes only through reason and experience. (ibid.)

According to Solovyov, insight into God's nature only comes through our powers of reasoning and sensible experience, then intuiting the unities and unity of God in all things experienced, as it were, becomes the driving source of the human beings desire for knowledge of the world, its laws and intelligibility and, importantly, the absolute's unifying presence left in the world. In Solovyov's view of the human being, like God, the human being displays a triadic structure, constituted by subject, spirt and individual character:

> First, there is our primordial, indivisible, and integral subject. This subject, in a sense, contains the peculiar content of our spirit, our essence or idea, and this in turn determines our individual character. (ibid., 211)

In this conception of the human being, the striving for unity and desire for knowledge that is the defining feature of the integrity of the individual (un-divided) human being is also the most important task for the human being to accomplish. That all created things and especially the human being contain this spiritual unity, means that the 'adventure of being is the quest for even higher unities' (ibid., 212). This higher reality is the vital reality and it is here that according to Solovyov, 'the symbol is the site where the eternal meets the transitory' (ibid., 225). These symbols reflect a higher reality and art has a special role to explore and express this higher reality. Solovyov gives an example from poetry, where one of the functions of words is to impart meaning to experience. In the art of poetry, the understanding of the experience is revealed and raised to a higher level of meaning through the words. This is a concrete reality whereby the 'concreteness', that is the togetherness of the unity of the experience with the understanding of the words with the expression in the words of the poem. Solovyov considered this type of encounter of togetherness is a representation of spirituality (ibid., 219). One could say then that just as words of the poem both raise and express the concrete, experienced reality to a higher level of meaning, so too do colours, in an artist's painting, raise and express the meaning and inner spirituality of the concrete reality of life experiences. This is why, in Solovyov's estimation, as Elder quotes: '[P]oetry, then is given the responsibility of actuality or inward apprehension of absolute reality' (ibid.). In this regard, we could say, paraphrasing Pater but changing the specific art, for Solovyov, all art constantly aspires towards the condition of poetry where the form and content that in inextricably expressed together in the meaning of the words raises the significance of the understanding of our life experiences to a higher level of absolute reality of God as integrated spirit. This is why Solovyov encouraged artists to 'explore the harmonies that revealed this higher reality' (ibid., 225) in all their 'concreteness' (ibid. 217). Both the empirical positive sciences that focus exclusively on gaining knowledge about the natural world conceived along

mechanistic lines and the mathematical sciences that seek abstract, atemporal, ahistorical, eternal truths outside of time overlook the knowledge that is necessary to unify the spiritual quest for meaning found in the individual human being. Elder writes:

> Russian Symbolism had as the core of its aesthetic doctrine an epistemological principle: positivist reason cannot apprehend the inner truth of reality. Only a higher, non-rational form of cognition can grasp ultimate reality; this form of thinking is the domain of the poet and the artist – thus, poets and artists, because they rely on intuition and imagination, have access to this reality. Quoting Goethe's statement 'All that exists is just a symbol,' Symbolists declared that adequate symbols led 'the soul of the spectator *a realibus ad realiora* [from the real to a higher reality] (Elder, 2008, 228)

Many of the Russian artists who belonged to the art movements of Futurism, Suprematism, Cubism, Cubo-futurism and Constructivism embraced the Symbolist spiritual concerns (ibid., 227) and the ideal of the unifying and divine nature of spirit at work in both artist and art. Whether one emphasises the symbolic nature of poetry in motion or the motion in poetry, many of these artists 'embraced the doctrine that all art has affinity with cosmic music and that the "music of the spheres" can be heard in the sounds of nature, many also accepted that there is an organic parallel between sound and colour' (ibid., 226).

3.2.2   D. IMGARDT, ART AND 'VISUAL MUSIC'

In 1909, the phrase 'visual music' is used specifically in the art criticism article, '*Zhivopis I revoliutsiia* (Painting and Revolution)' in the fifth issue of the Russian art journal *Zolotoe runo* (Golden Fleece) by D. Imgardt (pseudonym for an what is widely believed to be an unknown author). Elder, however, attributes the author behind this pseudonym to be the Russian symbolist writer Aleksandr Blok (1880–1949), a prominent figure in the second wave of Russian symbolism (Elder, 2008). These art journals were an important part of cultural life in Russia. The *Zolotoe runo* [Золотое руно; Golden Fleece] was an illustrated journal of art and literature, published monthly in Moscow between 1906 to 1910 (Monoskop.org, 2016). In its earlier issues, the journal was closely linked with the Russian symbolist artists, activists, painters and poets who supported and contributed to the journal and combined art and literature. The journal also sponsored illustrations for its articles and commissioned portraits of symbolist artists. It wrote reviews of exhibitions and sponsored the first exhibitions in Russia of modern art and contemporary French art (Monoskop.org, 2016). The Golden Fleece group organised two exhibitions in 1908 and 1909 that included the works of Russian symbolist artists, post-impressionist artists and the French avant-garde artists (Dorontchenkov, 2009, 5)

In the article in question, Imgardt is making a general call for an art that seeks connections between visual art and music. He acknowledges, advocates and supports a new role for artists who have more freedom to choose the subject and content of their own paintings. He also

encourages artists to have more freedom in exploring music ideas in their paintings and urges artists to find a new basis for 'producing and assessing colours and musical tones' (Elder, 2008, 233). Imgardt called for '*visual music* [author emphasis] and phonic painting without themes' (Bowlt, 2002, 71, Shaw-Miller, 2013, Leggio, 2002a, 71, Elder, 2008, 233). Imgardt credits the music composer Richard Wagner as starting a revolution in art and refers to a new aesthetics in painting where music, colour and tone can be connected. As a result of these changes, the author predicts that a new type of revolutionary artist in which the artist-connoisseur of patrons will be replaced by a type of inspirational artist now imbued with a sacred and mystical task to enrich the world (Imgardt, 1906 ; see Figure 18).

Figure 18 Russian Symbolist paintings. L-R: Pavel Kiznetsov, 'Blue Fountain', 1905; Pavel Kiznetsov, 'Morning, A New Man is Born', 1905; Pyotr Savvich Utkin, 'Flood-lands',1908; Pyotr Savvich Utkin, 'Lunnoye', 1906.

John E. Bowlt in his article on 'The Blue Rose: Russian Symbolism in Art' (1976, 570) draws our attention to this new content for painting, being both a colour tone, yet also containing, unconsciously, the musicality of painting. Bowlt quotes Imgardt's prophetic announcement:

> New artists will be true prophets and priests — the heralds of the Universal Soul's inspirations. With a language of phantoms, dreams, colours and sounds they will begin to prophesy where positive scientific knowledge will lapse helplessly into silence … The particular sphere of painting is the colour tone just as the musical tone is that of music…in music only the musical tone is necessary and important. The same with painting… It is of consolation to learn that there exist certain young artists who have gone further and who, in their inspired enlightenment, alien to any kind of literariness or preconceived philosophical ideas, have advances as far as unconscious musicality. (Imgardt, 1906 in Bowlt, 1976, 570)

Symbolist paintings often followed thematic subjects, such as, times of the day or allegorical stories. Increasingly, however, the painters relied on exploring how colour and its relationship can create new themes for painting, such as, for example, Pavel Kiznetsov, 'Blue Fountain', 1905; Pavel Kiznetsov, 'Morning, A New Man is Born', 1905; Pyotr Savvich Utkin, 'Flood-lands',1908; Pyotr Savvich Utkin, 'Lunnoye', 1906 (see Figure 18).

Ingardt used the phrase 'visual music' to refer to the new unity of music and painting and new themes for painting in Russian Symbolist art in 1909. A few years later, the influential English art critic, artist and member of the Bloomsbury group, Roger Fry (1866–1934) also used the phrase 'visual music' in his essay 'The French Group' (1912). This was one of three introductory essays that were written for an exhibition catalogue for the 'Second Post-Impressionist Exhibition' (5 October–31 December 1912) of British, French and Russian artists art works held at the Grafton Gallery, London, England, an exhibition that he had helped to organise.

Fry was an influential art critic. He had been involved in earlier exhibitions of European artist's paintings and had observed the musical links in paintings, and was one of the first to recognise the trend towards abstraction in painting. In a lecture at the close of the first post-impressionist art exhibition that he helped organise in London on 'Manet and the Post-Impressionists' (Nov. 1910 – 15 Jan. 1911), he wrote an article for *The Fortnightly Review* (May 1, 1911). Fry addresses what he identified as the non-representational nature of a new art and the idea that this art addresses itself directly to the imagination through the senses. He explicitly compares some of the material of painting to music, remarking:

> There is no immediately obvious reason why the artist should represent actual things at all, why he should not have a music of line and colour. Such a music he undoubtedly has, and it forms the most essential part of his appeal. We may get, in fact, from a mere pattern, if it be really noble in design and vital in execution, intense aesthetic pleasure. And I would instance as a proof of the direction in which the post impressionists are working, the excellences of their pure design as shown in the pottery at the present exhibition... Particular rhythms of line and particular harmonies of colour have their spiritual correspondences, and tend to arouse now one set of feelings, now another. The artist plays upon us by the rhythm of line, by colour, by abstract form, and by the quality of the matter he employs. (ibid.)

It was in this context, therefore, of comparing the material of painting to music, that Fry proceeded to use the phrase 'visual music' to describe the new move towards abstract form and non-representational art that he observed occurring in French painting at the turn of the twentieth century, that he observed as starting with Paul Cézanne (1839–1906). This, in fact, was both a recognition and an acknowledgement of a significant change that was taking place in painting from impressionism towards expressionism and abstraction. Fry, indeed, had considered using the term expressionist, instead of post-impressionist, for the title of the exhibition, as many of the paintings exhibited would have been considered as belonging to the newly emerging expressionist style of art. Yet the skill and the methods that artists were using to create these new forms was identified by Fry as a new 'abstract language of form – a visual music' (Fry, 1912). Fry was responsible for sourcing and selecting the paintings from French artists for the exhibition and in

his short essay explains the significance of the French artists work in the exhibition, making general observations and predictions of their impact on the future of art.

In this essay, Fry also deals with earlier negative criticisms of similar works of art that had been shown in an exhibition on 'Manet and the Post-Impressionist', which Fry had been involved in organising at the same Grafton Galleries in London in 1910. Paintings in this exhibition included works by Vincent Van Gogh, Paul Cézanne and Gauguin, amongst others. His collaborator Desmond MacCarthy described this exhibition as 'the Art-Quake of 1910' (Cork, 1999, 59), referring to its immediate impact on the 'academic front of art'. Richard Cork remarks, nonetheless, that '(N)either Fry nor MacCarthy could, however, have foreseen the astonishing antagonism and notoriety aroused by the show…and during its three-month run *Manet and the Post-Impressionist* quickly became the most scandalous art show ever mounted in Britain' (1999, 60).

By the time of the second 'Second Post-Impressionist Exhibition', then, Fry was well aware of the public's initial negative reception and criticism of the artistic skill of the painter Cézanne and other painters in the exhibition as being either 'clumsy' or as demonstrating 'incapacity' in skill and technique, or simply capricious, extravagant and eccentric French artists (Fry, 1912). Fry in this essay defends the skills that Cézanne and other artists have in relation to art as being a 'skill which was completely subordinated to the direct expression of feeling'. He continues to explain why skillful representational of their art would cancel the very significance and meaningfulness of their works of art, defending the point that:

> It is not the object of these artists to exhibit their skill or proclaim their knowledge, but only to attempt to express by pictorial and plastic form certain spiritual experiences; and in conveying these, ostentation of skill is likely to be even more fatal than downright incapacity. (ibid., 25)

Misunderstanding what is involved in this artistic endeavour, therefore, invites proper clarification of its meaning. This is why Fry endeavours to understand why the public would be so resistant to the new French art, identifying such misunderstanding as coming 'from deep-rooted conviction, due to long-established custom, that the aim of painting is the descriptive imitation of natural forms' (ibid, 26). In his essay, then, he tries to educate the public about what *these artists* are aiming to do in relation to form.

> Now, these artists do not seek to give what can, after all, be but a pale reflex of actual appearance, but to arouse conviction of a new and definite reality. They do not seek to imitate form, but to create form; not to imitate life, but to find an equivalent for life. (ibid.)

It is in this context of forecasting the 'logical extreme' of these new methods and skills in painting for the future of art which he found present in 'these artists' that Fry describes and emphasises the logical outcome of this new reality for art as it moves towards a completely abstract art as

leading to the creation of 'a purely abstract language of form — a visual music'. The passage in full is quoted below:

> The logical extreme of such a method would undoubtedly be the attempt to give up all resemblance to natural form, and to create a purely abstract language of form — a *visual music* [author emphasis]; and the later works of Picasso show this clearly enough. They may or may not be successful in their attempt. It is too early to be dogmatic on the point, which can only be decided when our sensibilities to such abstract form have been more practices than they are at present. (ibid., 27)

This essay, without any changes, was used again in 1913 for the catalogue of another post-impressionist exhibition, called the *Second Post-Impressionist Exhibition,* staged at the same Grafton Gallery (Jan. 1913). This second *Second Post-Impressionist Exhibition* comprised mostly of the same exhibits with some slightly amendments to the body of paintings and sculptures exhibited. The exhibition contained 242 exhibits in 1912 and 252 in 1913. For the exhibition catalogue, two other essays, in addition to Fry's 'The French Group', were included: 'The Russian Group' by Boris von Anrep and the 'The English Group' by Clive Bell. Exhibits from Russian and England were also exhibited. The exhibition also included some of Fry's paintings and paintings by other members of the Bloomsbury group of which he was a member. Amongst the French artists' works in the exhibition were works by Henri Matisse, Paul Cézanne, Pablo Picasso and Georges Braque (see Figure 19).

Figure 19 Paintings exhibited at the second Post-Impressionism exhibition at Grafton Gallery, London in 1912, organised by Roger Fry. L-R: Henri Mattisse, Le Danse, 1909/1910 (REF); Pablo Picasso, 'Buffolo Bill', (Picasso, 1911); Georges Braque, 'Kubelick', 1912, Promised Gift from the Leonard A. Lauder Cubist Collection (Braque, 1912)

Commentators, however, have pointed out that the paintings which Fry describes as moving towards a visual music were not completely abstract paintings, although they were moving in that direction at the time. In this regard, Benedict Nicolson in his article 'Post-Impressionism and Roger Fry' (1951), believes that Fry failed to pick up on the 'synthetic cubism' aims of some of the painters in the exhibitions, such as, Braque and Picasso, arguing that '"Visual Music"…in this show, was the opposite of what Cubism, tied as it was to the object, wished to emulate' (ibid., 15). Yet what Fry was noticing was what he took to be an aesthetic quality in the

paintings and that was the expression of pure form (ibid.). Here, then, it would seem that Fry was predicting that full abstraction in painting to be the next, albeit extreme logical step for art, which of course did happen eventually, especially in the art work of Kandinsky. This is why Nicolson concludes that '[A]ll the same, his [Fry's] words are more strictly applicable to the recent experiments of Kandinsky than to any member of the School of Paris' (ibid.).

Kandinsky's work was first seen in Britain among an exhibition containing of more than 1,000 exhibits, mostly of British artists, organised by *the Allied Artists*' Association's second London *Salon*, *held* at the Royal *Albert Hall* in 1909. In a review of a subsequent exhibition organised by *the 'Allied Artists'* Association' for *The Nation* (2 August 1913), Fry uses the phrase 'visual music' again, this time, directly in relation to the paintings of Kandinsky's of which a selection of his paintings were exhibited. In this review, Fry singles out the three Kandinsky paintings exhibited as being the best pictures in the exhibition, both for their 'expressive power' and for their successful use of non-representational forms (ibid., 153) in what he calls 'abstract visual signs' (ibid.). He comments on the approach to form in the paintings, distinguishing between the form of the thing seen in the landscape painting, noting that 'of the three pictures by Kandinsky, the landscape strikes one most at first. Even if one does not recognise it as a landscape, it is easier to find one's way about in it, because the forms have the same sort of relations as the forms of nature' (Fry in Reed, 1996, 153). By comparison, his use of form in the other two 'improvisation' paintings, where 'form has to stand the test without any adventitious [representative] aids' (ibid., 152) and 'the forms and colours have no possible justification, except for the rightness of their relations' (ibid., 153), indicate the 'visual music' constitution of his compositions (see Figure 20).
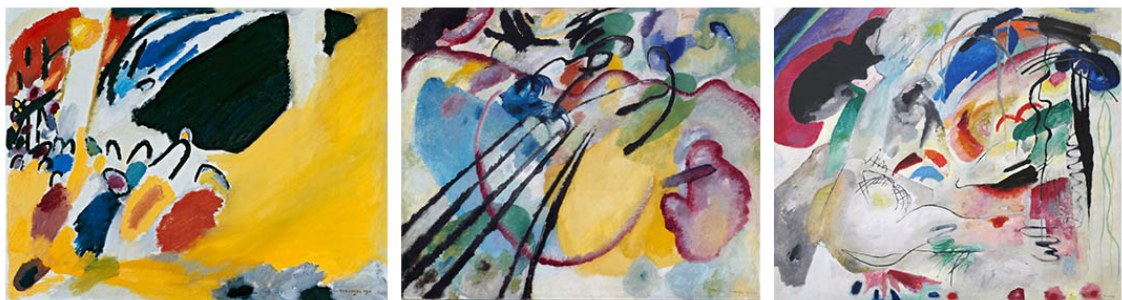
Figure 20 Paintings by Wassily Kandinsky at the time of Roger Fry's writing circa 1912-13. L-R: 'Impression III (Concert)', 1911; 'Improvisation 26 (Rowing)', 1912; 'Improvisation', 1913.

This is why Fry notes and stresses that:

> After a time the improvisations become more definite, more logical, and closely knit-
> in structure, more surprisingly beautiful in their colour oppositions, more exact in their

equilibrium. They are pure *visual music* [author emphasis], but I cannot any longer doubt the possibility of emotional expression by such abstract visual signs. (ibid., 67)

Fry's phrase 'visual music' above was widely quoted for several years after its initial use, in encyclopaedias on cubism art, and in newspaper articles. For example, in the *Universal History of the World*, 1929, 188; *The Annual Report of the Smithsonian Institute*, 1913–1914, 739; *Practical Knowledge for All* by Sir John Hammerton, 1953, 73; *Encyclopaedia of the World Art,* Vol. 1, 1959, 296 and many more.

3.2.4 ARTHUR W. DOW AND COMPOSITION IN 'SPACE ARTS' – A 'VISUAL MUSIC'

Arthur W. Dow (1857–1922) was a painter, art educator and photographer. He taught at major universities in the Unites States of America and published in 1899 (with a revised edition in 1903) his study *Composition,* with a subtitle that explains the art pedagogy content as: *A series of exercises selected from a new system of art education*. In the opening pages to the publication, written in 1898, in a section titled 'Note', Dow talks of a new movement of art instruction, which he names 'Composition' and which he has been involved, for several years, with Professor Ernest F. Fenollosa (1853–1908), curator of the Oriental collection at the Boston Museum of Fine Arts. Fenollosa had extensive knowledge of Western and Eastern art and had views on a new conception of art that ought to include models from all arts, such as the ornamentation of the decorative arts and art from other cultures and not just on the representational models in the fine arts. He had constructed an art-education system of arts based on this, with which Dow agreed. Dow's own publication was based on Fenollosa's conceptions of art and his system of arts. Dow uses the phrase 'visual music' to describe Fenollosa's new conception of art as 'space-art' in this art-educational system, and that such art is closer to the ideal art of music whose essence, according to Dow and Fenollosa, is pure beauty. Space-arts refer to visual arts 'based on a harmonious spatial synthesis of elements to create "visual music"' (Fischer, 1992, 19). Thus the emphasis in the creative process is not on imitating nature but on the way in which the essential elements of line, light, and colour can be combined into a unified whole (see Figure 6). Dow accounts for Fenollosa's particular ideas about art, telling us that:

> He [Fenollosa] believed Music to be, in a sense, the key to the other fine arts, since its essence is pure beauty; that space-art may be called "*visual music*" [author emphasis], and may be criticised and studied from this point of view. Following this new conception, he had constructed an art-educational system radically different from those whose corner-stone is Realism. Its leading thought is the expression of Beauty, not Representation. (Dow, 1903, 6)

Dow's system of art instruction was different to what he called 'a thoroughly scientific drill related chiefly to Realism' (ibid., 6) and the prevailing system of 'nature-copying' (ibid.). The

new view of art, he tells us, ensures that art education develops the appreciation of beauty. He explains how this can be done.

> Art study is the gaining of an experience, and art instruction is the guiding of tendencies toward appreciation, and the training of mind and hand to create. This guidance and training, we believe, can be given by a series of exercises beginning, as in Music, with the simplest. In fact, the main idea in the system is to help the pupil at the very outset to originate a beautiful arrangement, say — a few lines harmoniously grouped together — and then proceed onward step by step to greater appreciation and fuller power of expression. (ibid.)

Later in the publication, Dow uses the phrase 'visual music' again, this time in relation to his instructions on the use of the artistic technique device of 'Notan', a Japanese word for '*no-tan*' (dark, light), which he devised for progressively mastering the use of line, light and dark in an ink drawing or painting composition (see Figure 21).
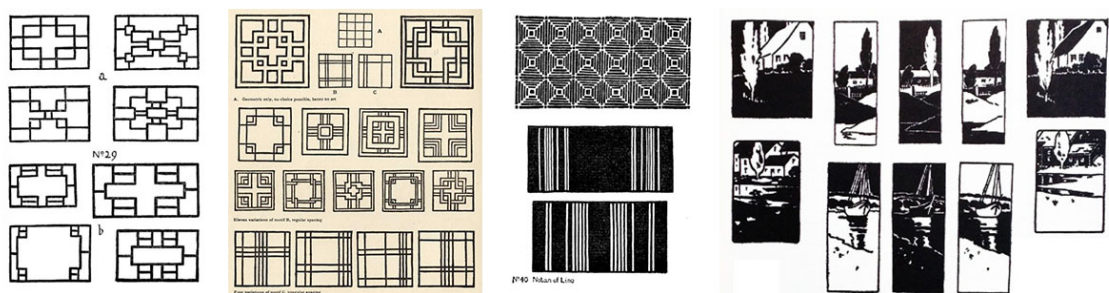
Figure 21 Arthur W. Dow: L-R: Composition in rectangles variation (Dow, year, 39); Ways of creating harmony, aesthetic line-ideas, *Composition*, 1899 with variations on motif A, B, C with regular and irregular spacing (Dow, 1903, 48); Notan, harmony-building dark-and-light, Notan of line (ibid., 73); Two-values - variations – design (ibid., 89)

He compares the quality of light and dark in nature, such as, for instance, 'a grove of dark trees against a light hillside', as exhibiting a 'picturesque' quality, perceived and appreciated as beauty. The light and dark picturesque quality as perceived by the artist, he likens to music.

> This quality, which makes the natural scene a good subject for a picture, is analogous to music. Truthful drawing and 'conscientiousness' would have nothing to do with an artist's rendering of this. This is the kind of '*visual music*' [author emphasis] which the Japanese so love in the rough ink painting of their old masters, were there is but a mere hint of facts. (ibid., 37)

This is Notan, where the darks and lights are in harmonic relations and is considered to be the second structural element of space-art, as Dow says as a kind of 'visual music'.

3.3   THE NEW 'REAL' AND 'CONCRETE' WORLDS OF ABSTRACT PAINTING

There were many painters at the turn of the twentieth century who explored new contents in painting, some of these contents can be referred to as non-objective, non-representational and

abstract. Some painters were influenced by the theoretical ideas in operation at the time, such as, the quest for the spiritual and inner human meaning in the arts, the importance of the unique artists' viewpoint in the choice of subject matter, style and content, and the issue of the unity amongst the arts. Many painters took inspiration from music.

J. P. Hodin (1905–1995) discusses the emergence of the modern conception of the arts, citing critics' differing views of what contributed to this emergence, such as, the philosopher Henri Bergson's *Essai sur le données immédiates de la conscience* (1888), the exhibition of the paintings of Claude Monet and Pissarro in the *Salon des refusées* in France 1863, or in the new painting that no longer dealt with realism themes in the paintings of Odilon Redon and Paul Cézanne in 1889 (Hodin, 1951, 343). He identifies a distinguishing feature of modern art, from 1850 to 1950, is 'to be found in the influence of empirical-analytical science' (ibid.). He thus concludes that realism and non-realism both play an equally important part in contemporary art, and he claims that the modern realism in abstraction is helped by the permeation of science (ibid., 345). He provides an extensive schematic of the modern visual arts up to 1950, dividing it into three epochs: early, middle and late. The early epoch is divided into the different movements in the arts from Realism, Impressionism, Neo-Impressionsm (Pointillism or Divisionism), Symbolism, Cézanne, Fauvism, Expressionism, Fantastic art, New-Primitivism, New Realism, and to Neo-Humanism. The middle epoch comprises Cubism, Futurism, Dadaism, Surrealism, Picasso, Abstract art (Rayonism, Simultaneism, Orphism, Suprematism, Constructivism, Neo-Plasticism, Purism, Amorphism, Functionalism, Style Mecanique, Non-objective art, Concretism, Synchronism). The late epoch contains the followers of Cubism, Surrealism, Abstract art, existentialist art (ibid., 347).

3.3.1   WASSILY KANDINSKY – NON-OBJECTIVE, NON-REPRESENTATIVE, ABSTRACT PAINTING

In the twentieth century, the appeal to objectivity in art as a measure and criterion of art was highly contested and questioned by many, and in many different ways. Kandinsky was one of the first painters to eventually work fully both with non-representational forms in the content of a painting and a non-objective approach to art making. Kandinsky promoted what he called the 'purely pictorial composition' (Kandinsky, 1912, *Spiritual in art*, in Lindsey & Vergo, *et al.*, 1982, 162). This position could be seen as part of the argument that objectivity, in the manner of appealing to truths and the measurement of some physical phenomenon of the material of the art, was not possible in art (or desirable) because art was connected to feelings. Thus Clive Bell argues in *Art* (1914) that objective truth is not possible in an art that can only be recognised through our feeling for it.

> It will be said that the objects that provoke this emotion vary with each individual, and that therefore a system of aesthetics can have no objective validity. It must be replied that any system of aesthetics which pretends to be based on some objective

truth is so palpably ridiculous as not to be worth discussing. We have no other means of recognising a work of art than our feeling for it. (262)

Kandinsky, however, was concerned to justify art on objective grounds, and was involved initially in designing and contributing to several art school programmes in Russia and then at the Bauhaus in Germany. While Kandinsky was the head of the Institute of Artistic Culture (Injhuk) in Moscow, he gave a presentation in 1920 about his plans and approach for his art programme for the Institute of Artistic Culture, published in 1933 (Kandinsky, 1920 in Lindsay & Vergo, *et al*., 1982, 455; Poling, 1983, 21). Here, he promoted the objective working out of the scientific basis of art, through appraisal of its materials, content, methods and functions (Lindsey & Vergo, *et al.*, 1982, 455). At the same time, he was also interested in analysing the intuitive and subjective nature of art because he felt that an over reliance on objective approaches to art resulted in an art that was devoid of that inner meaningfulness that comes from the artist devising and creating forms according to the artist's own inner need and intuition. The objective approach focused overly on the external form of art and on the object. In painting, for example, this could be the academic rules of composition about how to use the material of the artist's chosen art form, or it could be to focus on the representation of natural objects. The inner aspect of art was what Kandinsky felt defined art as art and separated art from decoration or ornament. For Kandinsky, then, what makes a work of art as an aesthetic work of art was that the forms in art were not the given external forms that are already known in nature, but forms that arise from the artist's inner need to make content and to create form to fit that content with the tools and material of their chosen art form, which he refers to as the chosen 'means of expression' (ibid., 464).

The problem, nonetheless, that emerged for Kandinsky was this. How could he articulate what he saw to be an essential and important part of art, this inner and intuitive aspect of art that arises through the artist's authentic engagement with the material, with the artist's desire to express their own form of content through material means? In other words, what he 'sought', as he says in a draft text he prepared for a lecture in Cologne in 1913, was 'that objective element which could justify the [choice of] colours' (Kandinsky, 1913, in Lindsey & Vergo, *et al.*, 1982, 395). He refers to his painting 'Composition II', where he uses colour without concern for the representation (see Figure 22), as both the successful complete break from representation and break-through to what he was seeking to objectively create, that is, the element of his own artistic expression. In this lecture, Peter Selz explains by quoting Kandinsky:

> Only very slowly did I come to free myself from this prejudice. In Composition II, one can see the free use of colour without regard for the demands of perspective …[Kandinsky] felt that reality could be fully comprehended only by means of creative intuition. (Selz, 1957,128)

By the 1920s, Kandinsky's expressive abstract style had so developed that he was able to explore geometric forms and the psychological effects of colour and forms, without recourse to representation, as can be seen in his painting 'Composition 8', 1923 (see Figure 22).

Figure 22 Wassily Kandinsky: Sketch for 'Composition II', 1909-10, Solomon R. Guggenheim Museum, New York Solomon R. Guggenheim Founding Collection; 'Composition 8', 1923, Solomon R. Guggenheim Museum, New York Solomon R. Guggenheim Founding Collection.

Here, Kandinsky was able to find a theoretical basis for including this essential aspect of art both in the design of art programmes and in his theory and practice of art. He promoted investigation into the means of expression for each art. The next step was to investigate the unifying purpose of all arts, that is, the effects of art on the human being. Thus he argued that 'the ultimate, unifying purpose will be a single approach: the investigation of the effect of the elements on the psyche' (Kandinsky, 1911–1912, in Lindsey & Vergo, *et al.*, 1982, 465).

At this time, many of his colleagues in Russia, however, did not agree with his approach and the inclusion of such subjective and intuitive elements (Lindsey & Vergo, *et al.*, 1981, ibid., 456); instead, they moved away from his abstract art and artistic concerns goals, and more towards a utilitarian approach to art, focusing on its usefulness. Thus, Kandinsky worked alongside many practitioners and theorists who promoted a more industrial approach to art. Indeed, a break-off from the non-representational approach to art-making lead to the growth of graphic design and design for industry. Kandinsky eventually left his position in Russia and moved to Munich.

Kandinsky, then, continually questioned the artistic nature of an overly mechanical approach to the means of expression of painting and other arts, noting that this does not account for the inner meaning and spiritual process of the artist in the art work. A popular form of art making at the turn of the twentieth century was the focus on constructing form and in particular on creating geometrical patterns and ornaments. This form of picture-making was considered to be a form of abstraction. For Kandinsky, such geometrical and ornamental approaches to form was not art but decoration, and he was not happy with how abstract art was being interpreted

along these lines. Although Kandinsky, therefore, 'acknowledged that pure decoration had a "life of its own",' he nonetheless, 'maintained that ornament in the past was ungoverned by inner spirit and represented what amounted to a capricious play of form unable to express any inner motive' (Morgan, 1992, 239).

Peter Selz distinguishes Kandinsky's approach from other artists at the time (Arthur Dove, Adolf Hoelzel, Delaunay) who also started to work with painting in a non-objective vein, by noting that 'Kandinsky made non-objectivity the very foundation of his pictorial imagery' (Selz, 1957, 127). Kandinsky himself professes the date of 1911 as being the year he completed his first abstract paintings, where representation disappears fully in the content of his painting. By 1911, therefore, Kandinsky had expunged any natural or realist forms from the content of his paintings; instead, his painting comprised a fully abstract content brought to life through fully artistic means only. Kandinsky, then, was the 'first champion of non-objective art' (ibid.) and abstract art.

Non-objective art does not negate objects, or nature in the artistic domains, it rather enables an artist to choose from all of nature the forms in an art work which the artist finds appropriate to create new real artistic worlds. Such worlds are beside nature, not separate from it. They are artistic worlds. Over his lifetime, nonetheless, Kandinsky became cautious of deploying the term 'abstract' art. He felt that this term could be misunderstood or, more significantly, be identified with those approaches in abstract art where there seemed to be the removal of the importance of the artist's need to create the content and forms of the art from their own inner quest to do so. He preferred to call it instead 'concrete art' (ibid.) or 'real art' (Kandinsky, 1936, 785). Selz explains what Kandinsky means by the term 'concrete'. It refers to where, for the artist, 'exclusively artistic means are used, resulting in "pure" art' (Selz, 1957, 130). The inner necessity was as of importance as the technical techniques and mastery of means. Thus, 'in my [Kindinsky's] view, the best name would be "real art," because this kind of art puts a new artistic world, spiritual in nature, alongside the external world. A world that can be brought about only through art. A real world' (Kandinsky, 1936, 785). What is placed together in this *concretum*, therefore, is the (abstract) world of the artist brought about solely in and through the artist's expression and the external world of nature.

In a short article Kandinsky wrote in the *Blaue Reiter* in 1911 for an exhibition in Munich entitled 'The First Exhibition of the Editors of the *Blaue* Reiter', Kandinsky explains the motive behind this approach to art. Here,

> we do not seek to propagate any one precise and special form; rather, we aim to show
> by means of the variety of forms represented how the inner wishes of the artist are
> embodied in manifold ways (Kandinsky, 1911–1912, in Lindsey & Vergo, *et al.*,
> 1982, 113).

We can thus understand why Kandinsky cautions against thinking that subjectivity is not a serious endeavour in painting and tells us that though the artist does examine their materials the artist approaches them through estimating and weighing their inner worth through the artist's choices in the art work.

> Consciously or unconsciously, artists turn gradually toward an emphasis on their materials, examining them spiritually, weighing in the balance the inner worth of those elements out of which their art is best suited to create. (ibid., 91)

This is why Kandinsky can argue in his article 'Abstract Painting' in 1936 that, in abstract art, 'analysis is part of acquainting oneself with the "technical," whereas the *basis* of one's creative force has become a synthetic one' (Kandinsky, 1936, 788). Viewed in this light, Kandinsky says:

> The abstract painter derives his 'stimulus' not from some part or other of nature, but from nature as a whole, from its multiplicity of manifestations, which accumulate within him and lead to the work of art. This synthetic basis seeks its most appropriate form of expression, which is called 'non-objective.' Abstract form is broader, freer, and richer in content than 'objective' [form]. (Kandinsky, 1936, 789).

Thus, we can see why Kandinksy's later use of the term 'concrete' to describe the 'synthetic basis' and 'nature as a whole' for his art is consistent with his earliest views on abstract art. And in these views, Kandinsky was of the firm conviction that all the arts were moving towards the abstract and the immaterial (Kandinsky, 1912, trans Sadler, 1913, 40) and that music had been leading the way and had already been doing this for years. Kandinsky declares in his book *Concerning the Spiritual in Art*:

> And the natural result of this striving is that the various arts are drawing together. They are finding in Music the best teacher. With few exceptions' music has been for some centuries the art which has devoted itself not to the reproduction of natural phenomena, but rather to the expression of the artist's soul, in musical sound. (ibid., 41)

3.3.2 WASSILY KANDINSKY – FORM AND CONTENT

According to Kandinsky, all arts are the same in terms of a general principle that the artist seeks out a meaningful use of a chosen means of expression. That means of expression can be any form of art production, such as, music, painting, sculpture and poetry. This meaningfulness that the artist seeks with the means of expression is referred to by Kandinsky as the spiritual aspect of all art. An objective approach to art, in which the focus is on external pre-given and established forms, does not always result in art, if this artistic meaningful and spiritual aspect is not present. This is why, for Kandinsky, the means of expression is secondary to the fact that an artist needs to express with the chosen means of expression that which drives the artist to work with those means. The artist, then, through this drive to express, creates the content that best suits this drive. The artist does not apply academic rules that pertain to the proper creation of forms; nor is the

artist subject to review by aestheticians who decree what is and what is not correct art in their judgement of what makes an art an art. Kandinsky, rather, draws attention to the drive to express, what he calls an 'inner necessity', that the artist has within. This is what assists the artist in making art and in deciding what the best forms there are to answer the call of such inner necessity. That means that not only is the content of art created as a result of the artists inner necessity but also directs the artist's process of finding the form and content that meets the expectation of that inner necessity. In this way of doing art, forms are *adjusted* in order for the content to be created. Selz comments on the significance of this inner necessity for Kandinsky, remaking that,

> the choice of subjects must originate from the inner necessity of the artist; material, or objective, form may be more or less superfluous. He insists that the artist must be given complete freedom to express himself in any way that is necessary according to the 'principle of inner necessity' (Selz, 1957, 130).

Such a process is very different to the process of planning and plotting a pre-determined design and schema for a painting. This process, rather, for Kandinsky, is more akin to how a music composer composes with music a composition through the material of the art – the material expresses the composition, and the forms comes forward in the material as the composer adjusts some aspect here and another aspect there in order to make the forms suit the whole composition. The composer has the whole of the work in mind when making choices about the forms. The form in the art arises from this process of the artist working through the material to create the form. This, for Kandinsky, is an 'inner necessity' and he describes it as a spiritual quest.

3.3.3 KAZIMIR MALEVICH – THE ABSOLUTE CREATION IN PAINTING

The Russian painter Kazimir Severinovich Malevich (1879–1935) was one of the founders of the suprematism art movement in Russia and was also influenced by Futurism and Cubism. He wrote the *Suprematist Manifesto*, originally entitled *From Cubism to Suprematism in Art, to the New Realism of Painting, to Absolute Creation* in 1915 (Chilvers & Glades-Smith, 1998, 687) and 'On the New Systems in Art' in 1919.

In early paintings, Malevich formulated his own variant of cubism and futurism. He was impressed by the way in which they depicted motion and speed, as Golding explains, 'the Futurists have succeeded in destroying the "wholeness of things"' (Golding, 2000, 60) but he did not approve of the Futurists over reliance on the 'outward appearance of things' (ibid.). Malevich, however, identified in cubism a similar destruction of the object that he saw in futurism in which the identity of things are 'leaving the field of objectivity' (Malevich in Golding, 2000, 61) and where the picture is 'cracking apart dynamically' (ibid.). Pictures contained explosive effects and 'all matter disintegrates into a large number of component parts which are fully independent' (Malevich, 1919, in Golding, 2000, 61).

He was interested in the formal properties of movement and in his painting, 'The Knife Grinder', 1913, the subtitle is 'Principle of Flickering' (see Figure 23), exploring in a similar manner to the cubist and futurist painters, a sensation of movement (Golding, 2000, 56). From 1913 onward, his work moved towards pure abstraction. He was interested in proportion and geometry and in both the ideal and mystic properties of geometry (ibid., 47). In Malevich's white phase of painting, his paintings consist mainly of white surfaces with squares, circles, and crosses placed within them, giving a feeling of geometric shapes 'projected onto a weightless world of infinite space' (Elder, 2008, 237).

One of his most famous paintings is the 'Black Square', 1913 (see Figure 23). This painting represents what Golding says is the emblem of suprematism (Golding, 2000, 62). It consists of a motionless static form and yet it is also a construction. Golding explains that under a recent X-ray examination that underneath the black square are compositions of coloured shapes (ibid.). Malevich refers to the black square as the face of the painting. In his manifesto he writes, '[A]ny painting surface is more alive than any face … a surface lives, it has been born. It is the face of the new art. The Square is a living royal infant' (ibid.). Malevich wants to draws our attention to the significance of the surface in the painting.

Figure 23 Kazimir Malevich paintings. L-R: 'The Knife Grinder: Principle of Glittering', 1913; 'Black Square', 1913, The State Russian Museum, 1920, The State Russian Museum; 'Suprematism', 1915; 'Painterly Realism of a Boy with a Knapsack - Colour Masses in the Fourth Dimension', 1915, The Museum of Modern Art.

Malevich was trying to create a sense of infinity in his paintings that contained pure universal forms. Thus he was interested, like other artists of his time, in theosophy and the fourth dimension (ibid.). Golding explains how artists sought to bring this fourth dimension into their art expression:

> All its advocates agreed that it represented a space outside sensory perception and that it reversed the dialogue as to what was real and unreal, or logical and illogical, in our perception of the three-dimensional universe around us, which is in fact illusory … virtually every painter interested in the concept agreed that it involved or implied a recognition of infinity. (ibid.)

Malevich's white phase of painting, then, refers to the role of the canvas as being a window through which we discover life. Thus, he self-reflexively raises and responds to his own questions about what a canvas is, what is to be represented on the canvas, and the choice of colours that is made, when he writes:

> What is the canvas? What do we see represented on it? … a window through which we discover life … blue does not give a true impression of the infinite. The rays of vision are caught in a cupola and cannot penetrate the infinite. The Suprematist infinite white allows the beam to pass on without encountering any limit. (Malevich, quoted in Golding, 2000, 74)

3.3.4 PAUL KLEE – THE CONCEPT OF ARTISTIC CREATION – MAKING VISIBLE THE INVISIBLE

Paul Klee, like many artists wrote about his conception of art. His notebooks and writings contain a good account of his views on art. In an edited volume of articles on *Paul Klee. Philosophical Vision: From Nature to Art* (Sallis, ed., 2012), several authors draw attention to the philosophical underpinnings of Klee's theory and practice of art. Sallis refers to Maurice Merleau-Ponty's discussion of the invisible of the visible, referring to the inner framework that is hidden within the object, and thus painting celebrates visibility (ibid., 22). Alejandro Arturo Valega notes that, for Klee, all painting has a subject matter and a reference regardless of whether it is abstract or representative of the 'factual presence of things' (ibid., 26). Valega goes onto explain the significance of Klee's concept of the originality of a work of art, explaining that, for Klee, the work of art has its own life and being:

> For Klee, paintings and works of art are not copies or reproductions of nature. The work of art has its own life. Indeed, the work of art is an event, an originary, dynamic event, that must be engaged as a kind of originary energy (literally a being at work), prior to any reference to things, nature, names, and ideas based on the factual presence of things. (ibid.)

Thus the language that Klee needs to express his views on this originary power of a work of art is one that belongs to many 'differentiations', as Valega explains, because it is a language that exists and lies 'in between distinct fields of experience: language, painting, nature, and life in terms of originary energy' (Valega, 2012, 26).

Klee attended a great deal to the 'genetic experience in nature', conducting many studies of the growth and patterns of things of nature, such as trees, leaves, light. Klee is interested in getting underneath the immediate perceptual appearances of nature. That an object, such as a leaf, for instance, has a point of origin and a force for growth was of interest. So, too, of interest to Klee, were the patterns and unfolding of the growth into the shape of the form and how this occurs in time. When Klee wishes to distinguish a work of art by its 'originary energy', he means, as Valega says, 'the work of art exposes the originary energy underneath, the undercurrent that gives rise to life. The work of art exposes us to a dynamic event much like the genesis of life —

that is, if one learns how to engage the work of art in its originary being at work' (Valega, 2012, 26). Klee, then, saw a problem for painting precisely in terms of how to explore the space-time movement of form in painting.

In nature, form is dynamic and is a form of movement. In painting, form is configured from the progression and tensions of its basic elements, such, as line, tone and colour. Movements, then, happen in all the elements, not just in line movement but also in colours where 'tones and colours expand and contract, vibrate, leap. It is this movement, this life-giving energy, that remains the guiding thread for the artist' (ibid., 30). This is why Sadlis is correct to note that, for Klee, form is not static, or a shape, or a thing, but a dynamic form-giving. As Klee remarks in relation to his elementary theory of creativity:

> Form must on no account ever be considered as something to be got over with, as a result, as an end, but rather as genesis, growth, essence... What is good is form as movement, as action, as active form... Form-giving is movement, action. Form-giving is life. These sentences constitute the gist of the elementary theory of creativity. (Klee in Sadlis, 2012)

Thus, in Klee's estimation, the task of the modern artist is to render visible the interplay of states of growth of a form, but that form emerges from the pictorial elements, it is not constructed or thought of beforehand. The artist, then, is creating a 'formal cosmos'. In his 'credo' writing, Klee is against the representation of appearances and, instead, in favour of 'rendering visible' that which is not visible to everyday immediate vision. Thus, as Sadlis concludes:

> Rather, for Klee, to abstract means 'to distil pure pictorial relations: light to dark, colour to light and dark, colour to colour, long to short, broad to narrow, sharp to dull, left-right, above-below, being-in front, circle to square to triangle. In regard to the question, 'Abstract?' the treatment of direction is crucial. If you set the yellow forward and the blue back, then that is abstract. (Sadlis, 2012, 92)

3.3.5 FRANTIŠEK KUPKA – AESTHETIC CREATIONS IN PAINTING

The Czech painter František Kupka (1871–1957) makes an argument for a new role for painting using comparisons with music. He is calling for paintings to be independent aesthetic creations:

> Music is the only art of sounds that are not in nature and almost entirely created. Man created the articulation of thoughts by words. He created writings, he created the aeroplanes and the locomotive. Therefore, why may he not create in painting and sculpture independently of the forms and colours of the world around him? (Kupka quoted in Warshawsky, 1913)

In a general sense, here, for Kupka, works of art, whatever form they take, whether in language (writing, poetry, speech), music, artefacts, machines, and so forth, are essentially human products, human works of creation and thus distinguish themselves from nature around us. Thus Kupka, like many artists at this time, wished to explore both artistically and scientifically the nature of

colour and was interested in the unity and total effect of colour in a painting, in particular in creating new realities that would display a kinetic energy in painting

He was a member of the Abstraction-Création art group, and was one of the founders of Orphic cubism. His work moved from realism into abstraction. Painting titles reflect his interest in music and abstract composition in painting, for example: Nocturne (1910); Arrangement of Verticals (1911); Disks of Newton (1911) (see Figure 24); Amorphia, Warm Chromatics (1912); Abstract Composition (1925); Combined Harmonics (1936); Music (1936) (see Figure 24).
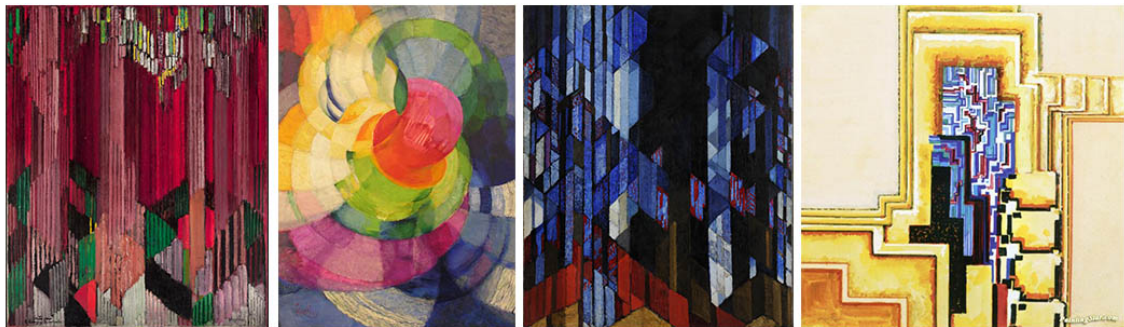
Figure 24 František Kupka paintings. L-R: 'Study for the Language of Verticals,' 1911 ©VEGAP, Madrid; 'Discs of Newton' (Study for 'Fugue in Two Colours', 1911, The Louise and Walter Arensberg Collection, 1950; 'The Cathedral', 1912-1913, from the collection of Museum Kampa; 'Combined Harmonics', 1936. Private collection.

In many of his paintings he works with a serial step by step progression of forms, suggesting chromatic steps and movements. In many other paintings he worked with vertical bands as in the painting 'Cathedral' (1912–13). Kupka's work with verticals arise out of an interest in the sense of the vertical in a cathedral and in what he refers to the 'dizzying musicality' and spiritual character of stained glass windows' (Maur, 1999, 51). In the Discs of Newton, Kupka creates expanding bands of vibrating colour influenced by Newton's science experiments with colour. In all of this, the non-representational but creative expression of paintings' possibilities demarcate what makes these works of art, art, of human art.

3.4 Music structures translated into a pictorial language

Music served many purposes for the painters who employed music ideas and constructs in their visual thinking and painting. Many artists, for instance, pursued musical themes in the subject matter of their painting, from the cubist paintings of Georges Braque's 'Violin and Poster' (1912) to the more abstract painting by the futurist painter, Giacomo Balla and his 'The Violinist's Hand (Violinist's Rhythms)' (1912). There were many other painters, however, who went deeper into the language, forms and expression of music endeavouring to translate such aspects of music into a visual language for the purposes of constructing and composing pictorial forms. Others went

deeper still and focused on the shared and universal expression to which both visual art and music belonged. The painter Paul Gauguin (1884–1903) declared that colour now plays a musical role in painting because, for him, '[C]olour, which is just as much oscillating waves as in music, is capable of expressing the most universal and thus the most vague thing there is in Nature: its intrinsic force' (Quoted in Maur, 1999, 19). Music assisted painters in conceiving of colour and form in painting as being what the painter Matisse called 'the autonomous language of colour and pictorial organisation' (ibid., 20). For many artists, colours and lines could be arranged to suggest musical forms and musical expressiveness. Music also had a role to play as being a model of autonomy as it could create and pursue its own forms and structure of its own material for its own ends. Music's non-representational aspects were aspired to in painting. Painters sought to find the contents, material and laws of painting that enabled painting to be its own autonomous art and not subject to the representation of nature and real objects in a realistic style. Kandinsky lists some of these methods from music that are used in painting as originating from the 'modern desire for rhythm in painting, for mathematical, abstract construction, for repeated notes of colour, for setting colour in motion' (ibid., 41).

Examples of painters who were influenced by music are: Georgia O'Keefe (1887–1986), Augusto Giacometti (1887–1947), Arnold Schoenberg (1874–1951), Wassily Kandinsky (1886–1944), Arnaldo Ginnani-Corradini (1890–1982), Duncan Grant (1885–1978), Francis Picabia (1879–1953), Sophie Taeuber-Arp (1889–1943), František Kupka (1871–1957), Johannes Itten (1888–1967), Josef Matthias Hauer (1883–1959), Robert Delaunay (1885–1941), Sonia Delaunay (1885–1979), Hans Richter (1888–1976), Viking Eggeling (1880–1925), Miroslav Ponc (1902–1976), Paul Klee (1879–1940), Boris Bilinsky (1900–1948), Piet Mondrian (1872–1944), Stuart Davis (1892–1974), László Moholy-Nagy (1895–1946), and many more.

The structures of music that were translated into pictorial and graphic forms were at first tied to music's tonality and its musicianship, such as, tone, notation, scales and rhythm. The more structural elements of music form and composition were also used to generate methods, techniques and approaches to developing a pictorial structure in the structuring and composition of pictorial elements.

Music, then, offered a way to create invisible but important structures in a painting and a way to develop pictorial forms from those invisible structures. Musical forms, such as, polyphony, prelude, sonata and fugue were all interpreted in visual form to develop a visual language of pictorial form and process to aid in composing the image and content of the painting. These forms, however, also inspired a new type of content in the painting and a new type of experience, as painters focused on including a spatial-temporal element into their painting, desiring to explore vibration and motion. Allied to the translation of musical structures in painting was the new understandings of the vibratory and harmonic nature of colour since one of colour's

fundamental physical properties was motion, just as it is for sound. Comparing the vibratory phenomenon of sound with colour inspired many artists to explore how to access that vibratory nature of colour, and so, in this regard music sometimes acted as a model.

Colour theories were also of major influence on painters working with colour as they came to understood its perceptual and subjective nature, without having to work within the bounds of a representation of a real object and reproduce its colour and light forms; it was like moving beyond form into what was underneath.

What is of importance to conclude and note from this, is that the language of abstraction in visual art was deeply influenced by encountering and understanding the forms and structures of music as well as understanding the science of music and colour. Atonal music also created interest for artists who recognised that in order to create a harmonious composition, some element of dissonance or non-harmony needs to be present, in order to add tension to a painting. Painters were interested in abstraction for its own sake in order to explore form and colour for itself and for painters to paint from their own interests and subjectivity, unfettered from the need to represent the fixity of adventitious forms in nature. In this, music assisted them both towards and onto this path of non-representational artistic content obeying its own laws for its own sake.

3.4.1   MIKALOJUS KONSTANTINAS CIURLIONIS – SONATAS, PRELUDES, FUGUES

The Lithuanian music composer Mikalojus Konstantinas Ciurlionis (1875–1911) wrote for symphony, ensemble and organ and piano. He also took up painting late in his career. His painting explored correspondences between structures of music and painting. Some of his paintings were also included in Roger Fry's Second Post-Impressionist Exhibition in 1912 (see section x). He strove towards a synthesis of the arts and did not believe that there should be divisions between the arts. Karin Maur quotes Ciurlionis. 'Music combines itself with poetry and painting and has it own architecture' (Maur, 1999, 26). Ciurlionis translated the musical principles of the fugue and the sonata into painting. He painted seven sonatas and they are numbered and titled. As he was also a symbolist painter, he used the symbols as motifs in his paintings and applied structural forms of music to both the structure and composition of the painting and through the composition of the symbolist motifs. In his 'Fugue' painting of 1908, for example, the principle of inversion and the close harmony of polyphonic composition is applied to the succession of rows of the trees and their reflection in the water (see Figure 25). One of his sonata series of paintings, Sonata No. 5 is also titled '*Sonata of the Sea*', as it consists of symbolist motifs of the sea. The series consist of three paintings titled 'Allegro', 'Andante' and 'Finale' and a music composition consisting of the same titled three movements (see Figure 25).

Figure 25 Mikalojus Konstantinas Ciurlionis. L-R: 'Cycle Sonata No. 5 (Sonata of the Sea). Allegro,' 1908; 'Cycle Sonata No. 5 (Sonata of the Sea). Andante,' 1908; 'Cycle Sonata No. 5 (Sonata of the Sea). Finale,' 1908 (Ciurlionis, 1908b); 'Fugue, from cycle the diptych "Prelude. Fugue",' 1908 (Ciurlionis, 1908b)

Ciurlionis, then, used pictorial motifs on a flat surface without a sense of depth or perspective, layering instead the elements in an analogy with the rhythmic and melodic layers of the melodic lines of a music composition structure.

3.4.2   PAUL KLEE - POLYPHONIC PAINTING

The whole idea of form was crucial in painting for Klee. From his studies of form in nature, Klee observed that many forms are involved in a metamorphosis or transformation of some sort and that this takes place in space and over time as the form unfolds. To solve the problem of how to depict such evolving form in space and time in paintings, Klee experimented with some music ideas and found some solutions in the application of structures and compositional devices from music in his paintings.

Like many painters at the beginning of the twentieth century, Klee concentrated on the idea of rhythm, but his studies into rhythm were influenced by his own appreciation of music (Düchting, 2004, 14). Klee was an accomplished violinist and he particularly liked the music of Bach and Mozart. Klee calls for a unique language of painting to be recognised because everyday linguistic language is limited in being able to explain painting. The language in painting is not consecutive as in the understanding of the language of words in speech and writing (linguistic language). In painting, there are many simultaneous dimensions occurring at the same time and they mix together to create the overall whole, style and composition of the work. A painting can contain many themes and events that happen simultaneously in the art work. In everyday language we can only say one thing at a time, and we cannot express simultaneity or many themes at once (Sallis, 2015,18). By comparison to linguistic language, as Sallis notes, the language of '[m]usic overcomes this deficiency by means of polyphony, which allows several temporalities, several rhythmic-tonal lines, to sound simultaneously. Painting can surpass the deficiency [of linguistic language] more decisively' (ibid.). For Klee, then, polyphony in music offered a

solution to structuring the unfolding of form in time in his painting. Several of his paintings have 'polyphony' in the title (see Figure 26).
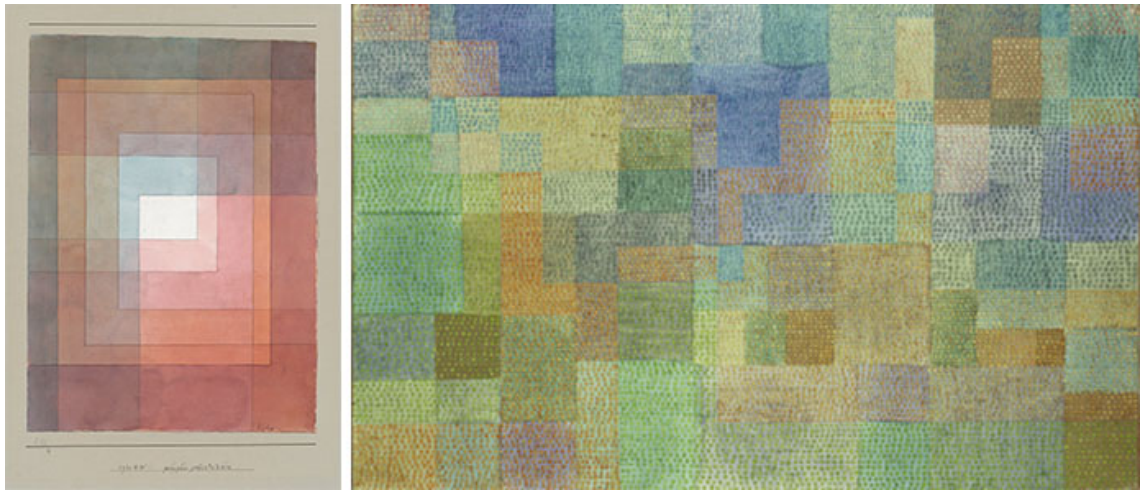
Figure 26 Paul Klee. L-R: 'Polyphonic Setting for White,' 1930, Kunstmuseum, Berne; 'Polyphony,' 1932, Kunstmuseum, Berne.

Polyphony in music refers to those parts of a piece of music that are of equal significance and are sounded simultaneously, for example, the various voices of a soprano, alto, tenor and bass choral work, or the various melodic lines in an instrumental work. By translating into pictorial format the concepts underpinning polyphony in music, Klee was able to create voices or parts in his pictorial compositions, and these parts (colours and forms) could be presented simultaneously. Each part is independent but connected through the whole of the painting. By using a visual form of polyphony, Klee could explore the possibility of capturing the unfolding of a temporal movement unfolding in the form in its place in the picture. Form, here, was not a static shape of figure; it was one, rather, that evolves both in the process of art making *and* in the process of contemplating the picture through the content of the painting. He explored the polyphonic form of the musical fugue in many of his early works (see section 3.5.4). At the end of his Bauhaus period, he painted a series of works that he referred to as polyphony and, from the 1930s onwards, he applied this term 'polyphony' to many of his paintings. In the painting 'Polyphony' (1932, see Figure 26), he uses a form of pointillism colour application technique. The painting consists of an underpainting that is then overlaid with separate fields of rows of dots in opposing colours. Düchting describes the polyphony at work in this painting.

> Dots of the same colour have been arranged together into clearly differentiated fields, thereby providing a stronger contrast to the background. The chessboard pattern in tones of blue and green is overlaid with a separate system of fields comprising horizontal rows of dots in opposing colours. Viewed simultaneously the two systems permeate one another to form a coloured organism of many sounding voices. The floating, luminous effect is intensified. (Düchting, 2004, 74)

Polyphony in painting, for Klee, therefore, is constructed from simultaneous complex intermingling forms and movements of forms. Klee created complex imagery of overlapping forms, lines and colours, which he describes as 'the overlaying of one moment of movement' (quoted in Düchting, 2004, 66). In his Bauhaus lectures, Düchting explains that 'the layering of various structured areas produces a composition of "many voices", a harmony of forms' (ibid., 65). Klee also experimented with using colour to add a qualitative element to the forms, and to contribute to the polyphony. Klee layered colours on top of each other to create a tonal and luminous effect in the painting suggesting transparency and depth. In this, Klee was striving for 'a polyphonic alliance of line, dots and colour into a unified composition of many voices' (ibid., 71). Thus painting, in Klee's estimation, could do a more accomplished job of polyphony than music because it could give expression to the spatial and the temporal dimension in 'a two-dimensional representation as overlapping and intersecting planes' (ibid., 78). In Klee's diary, between March 1916 to December 1918, he writes, '[p]olyphonic painting is superior to music in that here the time element becomes a spatial element. The concept of simultaneity stands out even more richly' (Klee, 1957 in Klee, 1964, 374). Such painting, in other words, could hold together over space and in time, as it were, the polysonic soundings of colour music in many simultaneous forms and times for the viewer that listening to polyphony in music can only hold on to over one time for the hearer.

3.4.3   WASSILY KANDINSKY – THE FREEDOM OF DISSONANCE

Many aspects of music influenced Kandinsky in his painting. He found, however, Arnold Schoenberg's (1874–1951) music and music theory, in particular, both a freedom and a way to articulate and explain both what he was trying to achieve in his painting and by his painting as well as his art theory. Schoenberg's music did not typify the 'beautiful' music of the time, as it did not follow the conventional rules around tonality and harmony, seeking instead, what Kandinsky calls a free and 'unfettered art' (Kandinsky, 1914, 35). Although this atonal music at that time may sound for some to 'ugly' to the uninitiated, Kandinsky nevertheless believed that there was a new harmony in the dissonance in Schoenberg's music and in abstract painting. In a letter to Schoenberg in 1911, Kandinsky shares his view about modern harmony that what is today's dissonance is tomorrow's harmony:

> At the moment there is a great tendency in painting to discover the 'new' harmony by constructive means whereby the rhythmic is built on an almost geometric form... I am certain that our own modern harmony is not to be found in the 'geometric' way, but rather in the anti-geometric, anti-logical way. And this way is that of 'dissonance in art', in painting, therefore, just as much as in music. And 'today's' dissonance in painting and music is merely the consonance of 'tomorrow' (Kandinsky, 1911, in Albright, 169)

Freedom does not mean no rules or capricious invention; it is, rather, about the artist, in this case, Schoenberg the composer, or Kandinsky the painter, enabling their artistic need to express and create forms with the material of their art, music and colour. It is according to this need to express that the form of the material, music or colour, arises. Freedom, then, is not the condition but the result, as it were, of the activity in this process for the artist when led through the material driven by the inner necessity.

After attending one of Schoenberg's concerts in Munich in 1911, Kandinsky read an extract from Schoenberg's article 'On Parallel Octaves and Fifths', written in 1910, which featured in the programme note. In this article, Schoenberg attacked the rule in composition that there should be no parallel octaves and fifths, pointing out that '[I]f, then, parallel octaves and fifths are not bad, why should the student not be allowed to compose them?' (Lindsay & Vergo, 1982, 94). Kandinsky was so impressed with this extract that he initiated contact with Schoenberg, beginning an exchange of letters and ideas between them around art and music.

Kandinsky translated Schoenberg's article 'On Parallel Octaves and Fifths' into Russian and had it included, alongside his own comments, in footnotes, in the published catalogue for the exhibition *Salon* 2 curated by Izdebsky from 1910–11 (ibid., 92). The novelty in Schoenberg's music was both his abandonment of the conventional rules of tonality and his devising of his own arrangement of tones in a more dissonant relation than would be the case in a consonant one. Kandinsky's friend and fellow artist The painter Franz Marc, who attended the concert with Kandinsky, in a letter to his painter friend August Macke raised and answered a question he had about the concert in terms of its dissonant content:

> Can you imagine a music in which tonality (that is, adherence to any key) has completely disappeared? Schoenberg starts from the principle that the concepts consonance and dissonance simply do not exist. A so-called dissonance is simply a further-removed consonance. (Macke in Lindsay & Vergo, 1982, 91)

For Kandinsky, it was this 'further removed consonance' that he found in Schoenberg's free use of tone outside the normal tonality and harmony laws of the time, and the use of dissonance, that he found to have an analogous and mirror application in painting. Schoenberg's new music epitomised the example of the artist working through the material of their chosen means of expression and which results in a change of form. After this concert, Kandinsky painted 'Impression III, 1911' (see Figure 5).

3.4.4   CONCLUSION: KANDINSKY'S NEW LANGUAGE FOR PAINTING FROM MUSIC – SOUNDS

At both a theoretical and formal level of analysis, music provided a language for Kandinsky to use in relation to explaining analogous processes and activities in his own approach to painting. Painting did not seem to have the words to describe the new techniques and new purposes and

effects of painting and particularly painting moving more towards full abstraction. Thus Kandinsky resorted to, and often used the word 'sound' or 'sounds' to explain the autonomous and related significance of a form and its colour and its placement in the painting. For want of a better language for painting, the word sound captured for Kandinsky the purity of the effect of the pictorial element. It conjured up a freedom for the pictorial form, characteristic of abstract painting in art.

3.5 EXPLORING COLOUR MUSIC IN PAINTING

From the point of view of an emerging art form, colour-music came to be associated with the performance-based art of coloured light made mobile in colour-music inventions (see chapter 2 section 2.3). Colour, however, in the new content in painting that emerged in cubist, impressionist, post-impressionist and abstractionist approaches, had a new role to play in expressing sensational contents in painting that were not bound to representational forms or objects. In this, such abstract art pointed to the expressiveness and autonomy of the picture as an object in its own right. Here, however, music played its role both as a model of quantity and quality where sensations of harmony can be generated with colour, as much as it can with sounds, and where mathematical laws underpinned the principles of music harmony. By association, colour could now be seen and interpreted as having similar quantifiable, mathematical underpinnings. Consonant colour harmony was of value but, increasingly, dissonance and atonal music represented a new type of colour in music, in which tones were freed from tonality to exist as independent objects, so too in painting, colours were being conceived as independent, resonant and affective objects and elements in a painting that could contribute to the expressiveness and the overall whole of the painting. Kandinsky used the term 'sounds' to denote such resonance and affective and expressive power of an arrangement of form and colour as its own autonomous but related object in a painting. Colour took on other functions in painting, and became both its method, subject-matter and content. The link with music was not just in relation to music scales and corresponding colour wheels, but to colours themselves being integrated with the forms created in the painting as well as with the structure of the whole painting, comparable to formal structures in music, e.g., the fugue (see section 3.5.4).

3.5.1 METHODS OF MEASURING TIME IN TERMS OF COLOUR

Rhythm in music articulates time. In painting, the equivalence to rhythm was sought not only in the forms, lines and composition of pictorial elements but also in colour itself. Colour, once understood as vibration, created a perceptual effect of extension. Colours in relation to each other added to perceptual effects. Several colour theorists examined these perceptual effects, including Johannes Itten, who was also a practicing artist. Itten based his paintings on 'mathematical

proportions and rhythmical divisions' of colour and form (Düchting, 2004, 21). The rhythmic aspect of colour was sought in colour's own tonality, that is, in how colour can be arranged in a tonal manner. The graded steps in a singular hue between its lightest and darkest values could create both a tonal and a rhythmic effect. Thus, this encouraged many painters to investigate the science of colour, the colour theories of the time, in conjunction with developing techniques around colour in their painting. Klee, for instance, specifically used a proportionate approach to grades of colour in his colour studies and explains to us that '[A]part from the structural composition, I studied the tonal values found in nature by adding layer upon layer of a thin black watercolour wash. Each layer has to be thoroughly dry. This produces a mathematically proportioned light to dark ratio' (Klee quoted in Düchting, 2004, 18). Klee, however, was also seeking the expressive qualities in the material of colour and the pictorial means to do this. Like Kandinsky, Klee favoured colour to have an autonomous role in a painting, but in order to do that, he sought the structure of the painting — its composition — to facilitate the temporal element of the use of colour. As Düchting points out about Klee's use of colour, when '[A]pplied to a fixed structure, colour is capable of making its presence unfold in pure sound' (2004, 23). When colour is arranged according to contrasts and harmony, within a structure, the use of colour in this regard creates its own structural features. Colour, then, could be extended through an analogy of the keys of the music scale, and so, could be graded proportionately in a dark to light ratio. It could also be used as an expressive temporal element, when it was used in tandem with a pictorial structural element.

3.5.2 SYNCHROMY

The painters Stanton Macdonald-Wright (1890–1973) and Morgan Russell (1886–1953) devised a painting style they named 'Synchromism' that was based on a musical approach to colour and in an analogy between visual art and music. Both painters wrote about their ideas (Russell, 1913; Macdonald-Wright, 1924). They had wanted to use the term 'Symphony' to describe their style, but Russell chose 'synchromy' to emphasize the colour aspect. As a formal device, nonetheless, musical symphonic form and the approach to musical material in a symphony structure has been translated and applied into their own version and structure for colour.

In the statement they made for their first exhibition of 'Synchromism', held in Munich in 1913, Macdonald-Wright and Russell compared colour with music, telling us how music and its tones exalted them. 'Yet colour is just as capable as music of providing us with the highest ecstasies and delights' (quoted in Vergo, 2010, 191). Both painters describe colours in musical terms, for example, Russell talks of principal colours, tonics, tonic dominants and oppositions, with pictures being painting in a particular 'key' with a 'central tonality' (Vergo, 2010, 193); and Macdonald-Wright devised a chromatic colour to music tone scale, and then used this colour scale

as the basis for building up a harmonisation of colour. Like Russell, he uses musical language and concepts to apply to his systematic approach to colour, talking of colour 'keys', colour tonalities, chords, scales and applies inversions, transpositions and modulations in the manner of the 'pliability of a music instrument' (Russell in Vergo, 2010, 195) in 'Oriental Synchromy in Blue-Green,' (Macdonald-Wright 1918) (see Figure 27).

Figure 27: Synchromist Paintings L-R: 'Synchromy in Orange: To Form', Morgan Russell, 1913-1914 c Estate of Morgan Russell; 'Synchromy', Morgan Russell, 1914, The Museum of Fine Arts, Houston, museum purchase; 'Oriental Synchromy in Blue-Green', Stanton Macdonald-Wright, 1918; 'Arm Organisation', Stanton Macdonald-Wright, 1914, The Museum of Fine Arts, Houston, museum purchase.

3.5.3 SIMULTANEITY

Robert and Sonia Delaunay studied the colour theories of Michel Eugène Chevreul and were particularly interested in his simultaneous contrast theory. They also studied Seurat's use of colour in painting. The Delaunays were interested in the relationship between colour, light and musical time and how we perceive things simultaneously (Maur, 1999, 51). They sought, through using colour contrasts, 'to release the dynamic effects of colour and elicit a sense of optical motion' (ibid., 53). The simultaneity of proportions of colours and their contrasts created a harmony and rhythm. In their experiments with colour, they developed the principle of '*simultanéisme*' (simultaneity), which Delaunay defines as,

> The movement of hearing is successive, a kind of mechanism; its law is the time of mechanical clocks… The eye is our most highly developed sense; it is most closely linked with our brain, our consciousness. It conveys the idea of the vital motion of the universe, and this motion means simultaneity. (Quoted in Maur, 1999, 53)

Guillaume Apollinaire, the critic and poet, coined the term 'Orphism' to describe the Delaunays' use of colour (Appollinaire, 1913). Appollinaire also declared this type of art to be a form of pure painting (Maur, 1999, 53). Using a musical analogy, Delaunay considers that pure painting and colour construction are in a particular key, in the same way that a piece of music is written in a key (Kuspit, 1974–75, 114) (see Figure 28).
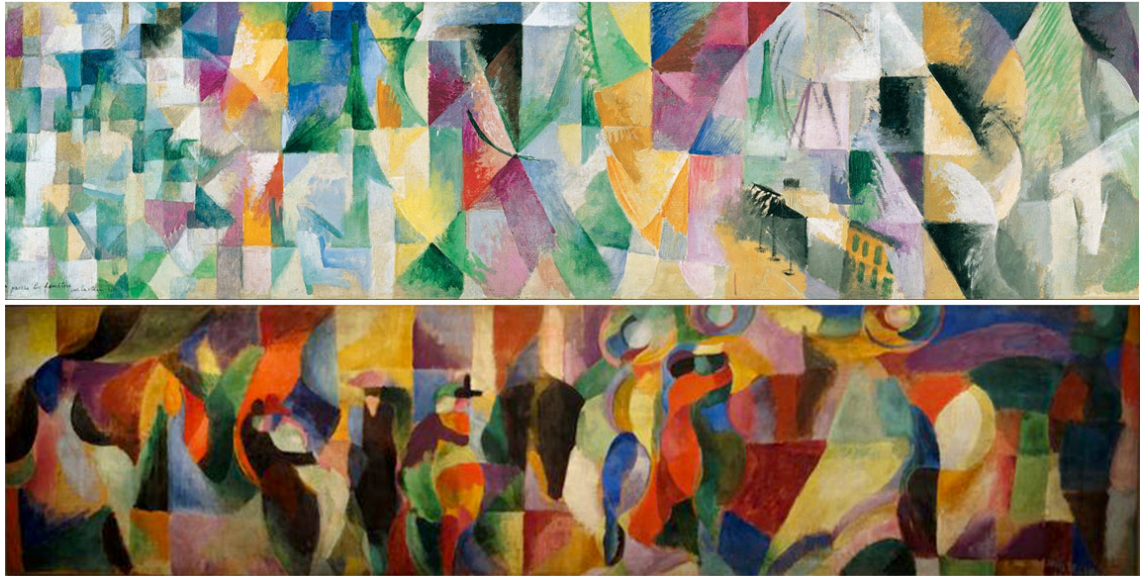
Figure 28 Top-Bottom: Robert Delaunay, '*Les fenêtres sur la ville* (Windows Overlooking the City)', 1912, From the collection of Museum Folkwang; Sonia Delaunay, '*Bal Bullier,* 1913, Paris, collection of the Pompidou Center, Mnam / Cci Purchasing of the State, 1954.

3.5.4 FUGUES IN COLOUR

The fugue was a popular method used amongst painters of nineteenth to early twentieth century to translate a musical form into a pictorial translation. Painters used their own pictorial interpretation of the fugue to structure and create content, or, as tentatively suggested by musicologist Cintia Cristiá, they used the 'pictorial fugue as a genre' (2012). For example, Paul Klee, Wassily Kandinsky, František Kupka, Cuirlionis, and Otto Runge all created pictorial translations of the fugue, in some of their works. The basis of the fugue in music is the technique of polyphony, where the same theme is given to different voices or parts at various pitches. The parts begin in succession and through the course of the work, the harmonic, melodic and rhythmic contours of each part can intertwine. Parts can be reversed and varied.

František Kupka (1871–1957) used a visual interpretation of the musical form of the fugue. Kupka used colour as the themes. He demonstrates this, for example, in his painting 'Amorphia - Fugue in Two Colours' (1912) (see Figure 29).

> Based on the principle of polyphony and fugal variation Kupka lets two voices or parts, in red and blue, appear in succession, in interweaves, divergences and inversions, thus creating a 'fugue in colours' (Maur, 1999, 46)

Klee, too, used a pictorial translation of the fugue in several of his paintings. Klee had written about Robert Delaunay's scroll-like horizontal format paintings and observed a temporality and a sense of a musical time lapse in the format. He noted that 'Delaunay has attempted to shift the accent in art to the temporal, based on the example of the fugue, by choosing a format so long it cannot be taken in at a glance' (Klee, 1917, in Maur, 1999, 54–56). It takes time, in other words, to see and appreciated the work. Klee, likewise, used a fugue structure in many of his own

paintings to create what he called an 'artfully ordered movement reminiscent of the structured division of tones we find in musical scales' (Klee, 1956, 490). The movement is articulated through the movement from white or paler colours, to black or darker colours. The subdivisions from darker to paler colours, as well as the subdivisions of larger forms to smaller forms acting within the one unit, creates a musical scale-like effect. Each unit of geometrically subdivided proportions of forms and colours creates a contrasting and a variation effect. Klee was after a soft tonal effect in which the forms would (seem to) subtly blend into the background as the darker colours blend into the dark of the background. This experience of the sense of movement, therefore, is based on differentiations of the tonal change from light to dark. Klee also sees these movements as being a form of transition from leaping, striding and gliding with both vague and defined limits. The gradations of tones and shape sizes adds to this movement gradations. The progressions then between tones and shapes are based on a form of progression of a series of integers, changing exponentially (see Figure 29).
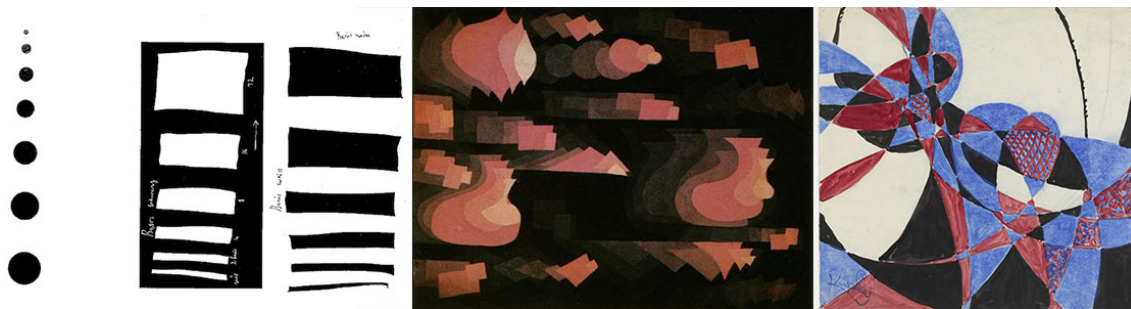
Figure 29 Paul Klee. L-R: Drawings from Klee's notebooks. 'Progression of the series of integers. On a black base. Sole active medium: White (Note: Intervals must increase progressively). On a white base. Sole active medium: Black' (Klee, Notebooks Volume 2 The nature of nature, 1970, translated Heinz Nordon, 1973, 361); '*Fugue in Red*', 1921; 'Green Orange Gradation with Black Half-*Moon*', 1922. Busch-Reisinger Museum, Harvard.

Klee explains the manner of how movement operates in this structural approach:

> The natural state of a movement from white to black — revert once more to this subject — is unarticulated rather than unordered. It is ordered in contrast to chaos, when light and dark are not yet sundered. It is ordered in the natural sense of a fine flow from one pole to the other. This (movement) range of tension is infinite subtlety. The particles closest to one another are scarcely distinct. It is not possible to orient oneself definitely. A locale cannot be sharply fixed (confirmed), everything solid is gently but surely swept along by the flow, the fine current. The naturalistic movement from white to black constitutes the finest ordering of movement. The main loci may be approximately determined as near-white, near-black and neutral grey regions. (ibid., 9)

One of these paintings 'Fugue in Red'(1921) is a watercolour painting that consists of a graduated tone of colours from pink to deep-red ordered in a chromatic arrangement from light to dark. There is repetition and variation amongst the colours and chromatic arrangements and all together

it suggests a rhythmic motif for each group of themes. Klee describes the painting as a '[r]hythmic articulation combined with tonal movement in the realm of colour' (ibid., 490), and explains that:

> The repetitive factor characteristic of structures is here the concept of increase or decrease which is repeated at every step. If the naturally ordered movement perceived with the ears instead of the eyes is comparable to the movements of natural tones, the artfully ordered movement is reminiscent of the structured division of tones we find in musical scales. (ibid.)

In his analysis and interpretation of the phenomenon of music in Klee's 'Fugue in Red', Will Grohmann identifies and suggests that the four shapes (jug, kidney, circle and rectangle) are analogous to musical themes and replies:

> [w]e might see theme, reply, theme in the third, and reply in the fourth part. The changing pitch would then lie in the changing character of the forms, the development of the theme in the development of colour…A logical gradation of colour plays itself out in logically interrelated shapes. (Grohmann, 1954 in Maur, 1999, 55)

Like many of the artists mentioned in this chapter, Klee was also drawn to the structural aspects of music scales. The music scale represented a harmonic and ordered arrangement of tones into a whole, where the parts contribute to the harmonious whole. Klee interpreted the divisions of the chromatic music scale as being a form of articulation. He states in his notebook:

> In music, accordingly, the quarter-tone scale or the 'chromatic' half-tone scale would be closer to natural differences in pitch than the more artificial major and minor scales…consider the various cases of exact articulation. We may at once establish with certainty that scales, where divided into small intervals or large, of equal size or sub-divided, all belongs to the sphere of structural articulation. (Klee, 1923, 377)

3.5.5   THE MUSICALISTS

The Association of Musical Artists (*L'Association des 'artistes musicalistes'*), also known as the 'Musicalist Painters' (*les Peintres Musicalistes*) were a group of painters founded in 1932 in Paris by the painters Henri Valensi, Charles Blanc-Gatti, Gustave Bourgogne and Vittorio Straquadaini. The group were interested in the translation of music into painting. They published a manifesto (1932) and also organised twenty-three *Salons Musicalistes* exhibitions (1909–1957). They were also involved in inventing colour organs and making films.

Henry Valensi, in analogy to the emotional impact of music and with reference to the music's tones, used colour and form to create vibrations and emotional affects. They also were concerned with the arrangement of colour and form in the space of the painting, and so, arranged colours and forms analogously to how a musician organises sounds. Henri Valensi created paintings that explore visual forms of the musical structures of symphonies and fugues. Each colour representing a sentiment and emotion similar to the sentiment and emotion of music. For example, this can be seen in the three 1935 symphony paintings: 'Symphonie bleue,' 'Symphonie en jaune (étude n°1)', and 'Symphonie en vert.' (see Figure 30).

Figure 30 Henri Valensi paintings, all 1935. L-R: 'Symphonie bleue'; 'Symphonie en jaune (étude n°1)', and Symphonie en vert'.

The painter Charles Blanc-Gatti was also a trained musician and played violin with an amateur orchestra. He was also a theorist, influenced by both science and artistic ideas and wrote regularly throughout his life on the correspondence between music and colours and is author of *Des sons et des couleurs* (1934). His first text was published in 1931, where he wrote about the correspondence between music and painting. This text accompanied a special music concert held in the *Salla d'Jena* in which his paintings were exhibited alongside the concert. The paintings themselves, also, illustrated his subjective experience of the music being played and he was also inspired by the music of composers from Bach to Stravinsky (Junod, 1998). Blanc-Gatti enjoyed a friendship with the music composer Olivier Messiaen. Messiaen writes of Blanc-Gatti's form of coloured hearing synaesthesia, that is, where hearing sounds produces the phenomenon of coloured visions. Blanc-Gatti gave to Messiaen a gift an album of pastel paintings that were painted as a result of his coloured hearing synaesthetic experiences that were generated in response to his listening to Messiaen's music *Nativité du Seigneur*. Author translates Messiaen's description of the visual elements of their painting and their connection to Messiaen's music.

> For organ: a thin, yellow, undulating flame is lost in a night of profound, leisurely blue tainted with green (this is '*La Vierge et l'Enfant*'); charcoal blue, hemmed with royal blue clouds, standing black forms (towers, town, trees, who knows what else…), the flight of mauve wings, a low light that rises (these are '*les Bergers*'); golden cones, the blue-green of very black night, blue sapphire on the first plane (these are '*Les Enfants de Dieu*'); two luminous, chiselled rays, issued from an invisible spring, somewhere very high; a very clear, gray night, very dark blue-green; the blue patches of cobalt touch each other and lose themselves on the far away horizon (these are '*les Mages*'). These were the colours that Blanc-Gatti saw when hearing Messiaen's organ music. (Baggech, 1998, 87)

For Blanc-Gatti, musical sound had a correspondence in colour that was particular to his synaesthetic experience. The chromatic range of the spectrum corresponds to the seven octaves of the piano, however for the notes of the scale at different octaves, different shades or tints of the original colour for the first octave will be triggered. The bass sounds, creating warmer tones of a colour and the higher sounds creating paler version of the colour. Blanc-Gatti coloured hearing also responded to the timbre of the sound, so a music instrument can change the colour of the

note, for example, the following timbres had particular colour correspondences, the oboe created a green colour, the harp, a green-gold the flute, a blue (Hortusmusicae.blogspot.com, 2012).

3.6 CONCLUSION

That 'The Association of Musical Artists' did not refer to any society of musical composers, but to a group of 'Musicalist Painters', indicates the extent to which the correspondence between musician and painter in the realm of artistic composition had emerged. By the 1930s then, what this all seem to point to, for many in painting, was a new art in the forming of 'visual music'. Yet the focus was on the static canvas of the painting. With the advent and advancement of audio-visual film technology and light projection on screens in the cinema, in the early decades of the twentieth century, 'visual music' was to take itself on another journey, and one that was, yet again, into an unchartered territory, but one still focused on continuing the idea of a 'visual music' itself. The following chapter examines this development.

Chapter 4   THE VISUAL MUSIC OF FILM

4.1   INTRODUCTION

At the turn of the twentieth century, the invention of new film-making technologies that enabled the recording and playback of successive photographic images to produce the illusion of continuous motion facilitated not only the growth of cinema as an entertainment industry but also the growth of new experiments with artistic forms using the film medium. A new type of artist emerged who approached the film medium in an analogous way to the approach to painting by the abstract painter. The term non-objective and absolute was also applied to these film works. The screen area, replacing the painters canvas, could act as a window into a new world, a new world of 'abstract film'. Today, in the historical analysis of these works, these films are usually examined as avant-garde or experimental film. At the time of their making, however, they were often called 'absolute films' or 'non-objective films' or sound animations. These film art works were further characterised to have musical qualities and characteristics, which was also the case with many abstract paintings.   Many of the early films were silent but were conceived of as having either an affinity to music or were in their true form, best projected with accompanying music. Today, nonetheless, these films can be viewed retrospectively as works of 'visual music' (McDonnell, 2002, 2004, 2007) or, indeed, as 'visual music films' (Mollaghan, 2015). Although some of these early films were not constructed closely to a specific piece of music, they bear resemblance in their visual content to the tightly integrated moving images of contemporary visual music work today that use similar cinematic techniques and processes in the production of the visual component of the art work.   The main difference between these early works and contemporary works is that today, most if not all of the visual music work in the cinematic idiom has a particular piece of music involved in the process of making and presenting the work. The assessment of these historical films as visual music films, then, is transacted more from today's perspective of a vibrant and sophisticated practice in integrated moving image and music works.

However, the phrase 'visual music' did begin to be used regularly in the discourse from the early to mid-twentieth century onwards with these new film art works and there were several authors who used the phrase visual music to describe new films. This chapter examines the significance of these early experimental film works for their contribution to an understanding of both a visual music expression and a visual music art. The examination of the critics and commentators that used the term visual music will focus on drawing out to what works were they referring and what was their understanding of a visual music. It is noteworthy to mention that many of the comments by both artists and critics in terms of these film works refer to the

emergence of a new art. Nomenclature for the description of this new art may have been different, but the overarching common aspect of this observation was that the new art unified both the art of and the expression of music and visual art and that the medium of film facilitating this unity. The chapter begins with an examination of the incidences of the use of the phrase visual music by commentators who began to acknowledge the new possibilities of a combined music and visual expression in the medium of film (4.2).

The chapter then goes onto examine in more detail the early film experiments that took place in Europe in the 1920s, where the non-objective content of the film images were akin to the non-objective content of abstract painting (4.3). The medium of film provided new aesthetic possibilities using the new material substances of light and time afforded by the film technology. Parallel to a non-objective content sought in film images, is those filmmakers and collectives interested in exploring what was known at the time as the 'music of the images', where the cinematographic recorded image was the fundamental unit for an exploration of rhythm and tempo and the basis for a non-objective content but that also utilised cinematic techniques to create the art work

In the mid to late twentieth century, a growing awareness of a visual music approach to film took place in California from the mid to late twentieth century. The German avant-garde filmmaker and inventor, Oskar Fischinger, who was also involved in the experiments with non-objective content in film in Germany moved to California in 1938. His whole film oeuvre, from his film output in Germany to his film output in the US, as well as his inventions to create abstract imagery for film and experiments with a mobile colour, had a lasting and prominent effect on filmmakers in the US and in California in particular. Many artists who worked with film were themselves accomplished technicians and had the skills to work with cinematographic images and technologies of film. Thus section 4.4 examines those artists who were also technicians. These artists were considered unique in their mix of skills, arts, talents and competencies. The content of the imagery for these early film experiments were typically abstract, non-objective and non-representational. During this period, however, the recording of sound onto the optical part of the soundtrack that could then be played back through the film projector enabled inventors and scientists to explore the possibilities of synthetic sound by means of film. In an uncanny similarity to the influence of the colour-tone analogies on the building of colour organs, the optical soundtrack of the film medium and the shapes on the soundtrack that enabled light to read the information and play it back through a speaker facilitated many explorations with the shape of sound as a source of both the sound on the optical soundtrack playing simultaneously with the same shape as the content of the visual forms of the frame. The prolific output of the various Soviet research groups and schools under the directorship of Bulat M. Galeyev will also be

examined here. The chapter concludes by evaluating three artists at work on making sound visible as non-objective content for film: Ralph K. Potter, Mary Ellen Bute and John Whitney.

The overall question that this chapter raises and addresses, therefore, is to what extent did the authors and commentators, at the time of the composition of these films, consider themselves to be engaged in integrating a conception of music, a specific music composition or a musical expression alongside the crafting of the moving image through the medium of film and advancing 'abstract painting' in the direction of 'absolute film'? In other words, is there any evidence to justify the claims that these films were deliberately conceived at the time of their making amongst the artists and commentators as having a visual music quality, or as being a 'visual music' film, or films engaged in the emergence of a new art (of visual music)? Is the term 'visual music' the best way to account for the prominent relationship between the expression of music and the expression of pictorial elements in these films?

4.2   FILM A NEW MEDIUM FOR A NEW ART

It is without doubt that painters were interested in the new medium of film to explore further the plasticity of the visual elements in the painting, such as, the vibratory nature of colour, or to explore further the dynamic interplay between forms and colours, which occupied the attention of many abstract painters. Cubist painters, too, who were interested in the presentation of multiple spatial and temporal views of an object, could now work with a successive presentation of an object from multiple spatial and temporal views in time. Dadaist artists, interested in the depiction of ordinary objects in different contexts and settings (e.g. Duchamp, (in)famous 'Fountain', 1917), could explore such objects in the frame of the film and explore the non-linearity of time made available with film. Painters operating in the abstract and non-objective mode of expression could also create non-objective films. For this last group of artists, film could solve some problems that were emerging in the non-objective painting for some painters. For example, Viking Eggeling and Hans Richter turned to experimenting with the medium of film for the purposes of elaborating on the articulated movement that they explored and achieved in their large-scale horizontal 'scroll paintings' (Richter, 1952, 81). Richter writes in 1952 about their discovery of film in 1919:

> After each of us in 1919 had finished his first scroll, we began to understand that we had gotten more than we asked for: the necessity to release this accumulated 'energy' into actual movement! Never during our collaboration had we dreamt of that. But there it was. And movement implied film! (ibid.)

Painters interested in a mobile colour also saw in film a general solution to the problem of the mechanisation of mobile colour that previously relied upon unique, one-off custom-built devices because the film medium facilitated the standardization of technologies and techniques for

moving image work. There were other artists who saw in film the immense possibilities for combining a music expression with a non-objective pictorial art expression — that was already being explored in abstract painting — but through the moving images of film works. Artists, then, who were interested in solving temporal musical problems in the non-objective imagery of painting saw the potential of film to address this time element of pictorial forms (in visual music painting).

4.2.1   THE AFFINITY OF FILMIC EXPRESSION WITH MUSIC

Some of the earliest experiments in the medium of film that explored a non-objective content with a music-led expression have alas been lost. For example, the Italian Futurists Bruno Corra (1892–1976) and Arnaldo Ginna (1890–1982) made three abstract films, which are now presumed lost, but were discussed in 1911 by Corra in *Musica Cromatica*. Maria Teresa Arfini, nonetheless, provides a brief outline of these films.

> They painted directly on to the filmstrip … Their first film, *Accordo di colore*, in which they attempted to animate a divisionist painting by Giovanni Segantini, *Riposo all'ombra*, was followed by three other films: *Studio di effetti tra quattro colori, Canto di primavera*, a cinematic transposition of the homonymous song without words by Felix Mendelssohn Bartholdy, and *Les fleurs*, taken from Mallarmé's poem of the same name. The films have been lost. (Arfini, 2013, 213)

From 1921 to 1922 Viking Eggeling (1880–1925) worked on a film entitled 'Horizontal Vertical Orchestra'; but that is also believed to be lost (O'Konor, 1971, 51). Louise O'Konor states that 'music had great importance for Eggeling, and all his later, abstract works were created as he was studying musical problems; they are conceived in analogy with music'(ibid., 40).

In this early period of cinema history, the films of filmmakers who were involved in artist-led endeavours that explored the potential of the relationships between music and fine art cinematographic imagery were, at the time, referred to as 'absolute films', and later as 'abstract films'. These films are representative of some of today's canon of works belonging to a visual music history. Many writings on visual music refer to the works of these artist-filmmakers. The most famous among these are: Walter Ruttmann, Viking Eggeling, Hans Richter, Oskar Fischinger, Norman McLaren, Len Lye, Mary Ellen Bute, and John Whitney. According to Walter Schobert, what Ruttmann, Eggeling and Richter all had in common was their desire to 'seek new means and forms of expression' (1989, 12) and to work with time. Thus the 'productions of all three men do concentrate on what is essential in film: movement and light' (ibid.). This, however, is true of all artists named above following a 'visual music' line of expression. A common ground between the three filmmakers and the others, then, is their emphasis also on music: 'There is also common ground in an affinity to music, an infinity which

is already evident in the titles of their first films: *Lichtspiel Opus I, Opus II, Diagonal-Sinfonie, Rhythmus 23*' (ibid.).

Elder explains that the first filmmakers that explored abstract forms in film literally bypassed the 'camera image' that rendered a realistic-photographic image. They went about the task of using the 'camera image' to construct instead purely artistic forms. Thus,

> The makers of Absolute Film proposed to reconfigure film so as to highlight the film's innermost dynamics — thereby they would release cinematic form from representation. Light and time, they insisted, were the cinema's true materials — the artists engaged in the creation of the Absolute Film shared an interest in light and time with makers of light sculptures and *Lichtspiele*. These works were as immaterial as music. That something as immaterial as coloured light came to represent an ideal medium for artists in the nineteenth and twentieth centuries must be taken as evidence of the important role that music — and the cinema— had assumed in thinking about the arts. (Elder, 2007, 22)

An artist, then, that was equally comfortable working with ideas from visual art, music and film arising from the techniques of film could advance and explore ideas of both visual art and music hitherto not entirely possible. Thus, in an often-quoted text, Ruttmann anticipates that,

> This new art-form will give rise to a totally new kind of artist, one whose existence has only been latent up to now, one who will more or less occupy a middle ground between painting and music… Cinematography will be the technique of presentation. (Ruttmann, 1919, in Schobert ed., 1989, 102)

This new art-form, arising from the film medium, enabled a temporal dimension to the exploration of visual events in a medium that also enabled a new type of artist, or, perhaps, more accurately stated, a new type of visual music artist or artist-filmmaker-musician.

4.2.2   WALTER RUTTMANN AND THE 'ARTIST-MUSICIAN' BY MEANS OF CINEMATOGRAPHY

Walter Ruttmann (1887–1941) was one of the earliest filmmakers to explore an abstract visual art and a music expression in the film-medium. He studied painting and music at the Academy of Fine Arts in Munich (Moritz, 2004, 4) and then proceeded to work with film in order to create images moving in time (ibid.). He set up a company to produce 'drawn films' in 1920 and patented an 'animation stand for making cinematographic images' (Goergen, 2012, 42). Ruttmann was one of the first filmmakers to successfully make an abstract film. His film 'Lichtspiel Opus 1' (see Figure 31) was first shown in Frankfurt and Berlin in 1921. For this film, Ruttmann commissioned his friend, the music composer Max Butting, to compose a score for a string quartet to accompany the film. Goergen notes how the music was introduced to accompany the film: 'At the screening, the film images and the music alternated. First there was a musical introduction, then the first part of the film with the corresponding music, then again a musical section without film, and so on (ibid., 43). Ruttmann's technique for the visuals of this piece consisted of a frame-by-frame camera recording of a succession of brushstrokes. Moritz explains that he achieved this

by 'filming single frames as he took each brushstroke while painting on layers of glass (or wiping away some of the wet oil paint between shots)' (Moritz, 2004, 4).
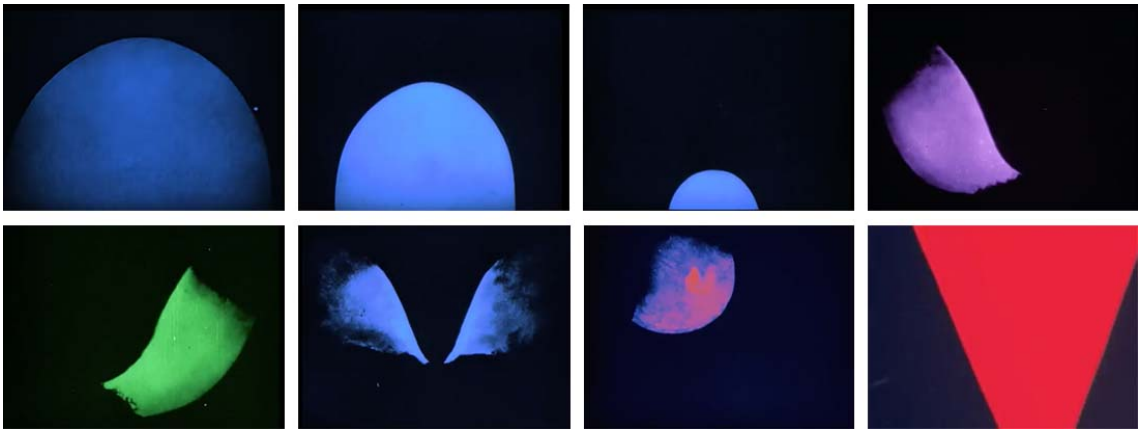
Figure 31 Frames from Ruttman's '*Lichtspiel Opus 1*', 1921. Source: author frame captures.

Ruttmann completed three further abstract content films, 'Opus II', 'Opus III', 'Opus IV'. The ideas, however, that drove the creation of Ruttmann's four 'Opus' films were expressed much earlier. In an unpublished letter, believed to have been written between 1913–1917 (Ruttmann, 1913–1917 in Schobert, 1989, 8), Ruttmann discusses abstract qualities that could be explored by film. In this text he emphasizes the artistic and creative possibilities of the new cinematic art and urges for the cinematic arts to look beyond reproduction and the representation of literature, the grotesque, or the staging of drama, and work instead with cinema's appeal to our eye. He calls for the new cinema art to be a self-contained art, stressing the point that the 'content of every film drama is conveyed to us through the eye and can therefore become an artistic experience only if it has been conceived *optically*' (ibid., 6). For Ruttmann, the cinema art is a visual art and is thus closely related to the laws of painting and dance. He explains why:

> [Cinematography] uses the following means of expression: forms; surfaces; brightness and darknesses with all their inherent moods; but above all the movement of these optical phenomena, the temporal development of one form out of the other. It is visual art with the novelty that the root of the artistry cannot be found in a final result, but in the temporal growth of one revelation out of the other. The main task of the creator of films lies therefore in the work's total *optical* composition, which for its part also makes quite specific demands in the treatment of the individual links. And just about everything that up to now has been rejected as unessential is essential for the aesthetic value of the work. For example, the conscious imparting of a certain expression by having a dark section of film follow a bright one; a crescendo of the plot through an intensifying in the sequence of individual sections of film, through a progressive shortening, lengthening, darkening or brightening of these sections, through the sudden introduction of an occurrence with a completely different optical character, through the development out of a resting mass to restless, wild movement, through a pictorially composed unity between human beings and the forms of nature which surround them — and through a thousand related possibilities of changes between light and dark, between motionlessness and movement. (ibid., 7–8)

One can see very well pre-figured here, in the content of his first abstract film '*Lichtspiel Opus 1*' the idea of the transformative progression of shapes and forms, the working with the darkness of the background contrasted with the shapes themselves, and the focus on the tonality of colour within the forms,. This work, in other words, is the realisation of the 'main task' that Ruttmann had set earlier for 'the creator of films' that lie in the work's 'total *optical* composition, which also makes quite specific demands in the treatment of individual links' (ibid.).

4.2.3 BERNHARD DIEBOLD ON FILM AND THE AESTHETIC POSSIBILITY OF A NEW ART

Art critics came to predict the potential of film for a new type of abstract image in which the material of painting — such as colour and form — could be made more mobile. The art critic Bernhard Diebold (1886–1945), based in Germany, foresaw cinema's potential for a new art, what he described as a '*kinetic cinematic art*' (Schobert, 1989, 14). He wrote about this new art, realisable through the medium of film, as being about 'ornaments in temporal motion' (ibid., 100) that the films were dealing with 'optical and spatial phenomenon in temporal succession' (ibid., 100). Diebold is also noteworthy for his encouragement and promotion of experiments in the new medium of film for new artistic ends and content.

In his newspaper review, published in the *Frankfurter Zeitung* on 2 April, 1921, of a preview screening of a new film by Walter Ruttmann that Diebold had attended the previous day at the *Ufa-Theater im Schwan*, Frankfurt, Germany, he calls this piece 'A New Art: The Visual Music of Film' (Diebold, 1921, in Blower, trans., 2016). At the time of this preview, Ruttmann's film was untitled, and it was retrospectively titled '*Lichtspiel Opus*' (Ruttmann, 1921). In this review, Diebold refers to Ruttmann's film as 'Photodrama, Opus 1' (ibid., 50) and uses the phrase 'visual music' in the context of predicting a new art. He writes, '[P]ainting and music are wed. The boundaries laid out in Lessing's Laocoon have become blurred. There is *visual music* [author emphasis]' (Diebold, 1921, 51). In Diebold's estimation, then, Ruttmann's film represented both an artistic and technical innovation in realizing the beginnings of the kinetic cinematic art that he had envisaged. Its content comprised abstract content (shapes, forms and colours) set both in motion and in succession. Diebold had been calling for such a film since 1916, describing this type of film then as 'Absolute Film' (Blower, 2016, 47). Diebold is so enthusiastic to share his views in this article about the potential of this new art of cinema in its kinetic, temporal and spatial dimensions, to explore motion and movement that it is worth quoting in full that context where the phrase 'visual music' is used. He writes:

> Besides dancers and rockets we now have the instrument of film, an apparatus that has been so thoroughly defiled by banality that its new players will be looked upon with scepticism from the outset. But the new art of movement has absolutely nothing to do with cinema in the conventional sense. Certain woodwind instruments can be made to imitate animal noises, though they are also quite capable of serious music. The same goes for film: the new art has nothing to do with the old craft of filmmaking.

A grand piano, an orchestra, paintbrush, chisel, and stylus serve both high art and kitsch alike. Until now film has been little more than the applied art of photography, a substitute for the novel, a stand-in for theatre. As a vehicle for photography it was nothing but naturalism, and no amount of stylistic retouching could change that. But now the artist paints his film. He no longer obeys the naturalisms of the actors, the landscapes, horses, donkeys, palms and authentic plasterboard buildings. As a creator of movement he obeys his own will, his own style. *Like a musician* [my emphasis] he gives expression to his soul in ornaments that move in time. The urge for movement in expressionist painting, the confused, frenzied cinematic mess of a thousand allusions in a futurist picture, the utter impossibility of capturing a temporal sequence of antecedents or associations within one contiguous space; in the new film art these things find fulfilment and are redeemed from space into time. Painting and music are wed. The boundaries laid out in Lessing's Laocoon have become blurred. There is *visual music* [author emphasis, es gibt eine *Augenmusik*] …The birth of film from the spirit of music is a done deed [*Tat*]; film now bears the torch of culture. (Diebold, 1921, 51)

Diebold observes the genuine synthesis of painting and music that is not syncretic, but productive of a new art, 'a done deed', albeit a 'fulfilment' of the desires of modernist abstract painters. He also notes that, like 'dance, the new film art cannot do without audible music' (ibid.) and praises the efforts of 'the painter Ruttmann' to make plans for a music accompaniment to be shown in a few weeks' time for the public screening of the premiere of the film. In this 1921 review, Diebold informs his reader about this planned music accompaniment:

The public premiere of this novel creation is to be held in Berlin a few weeks from now, where a specially composed score by Max Butting will provide rhythmic and melodic emphasis. (ibid.)

Diebold, nevertheless, was well aware of the fact that this new art was in its embryonic stages of development and he predicts, in an analogy with music, that this art will improve when the 'primitivism of its geometric shapes will be exceeded someday by grander forms of expression, just as mathematical counterpoint emerged from the absoluteness of music' (ibid.). He thus proposes 'absolute dance' as a temporary name for this new art, but he acknowledges that this new art will need a suitable name:

What are the implications of this for aesthetics? In future we will require a new name for a new artform that will stand alongside literature, music, the visual arts, and architecture. For the time being at least it would perhaps be best to call it 'absolute dance'. (ibid., 50)

The 'dance' that Diebold is metaphorically referring to is of course the dance to music of the motions of the painted ornaments '*set* (*bewegte*) in motion' (ibid.) in this new film art, without any objective reference implied in those ornaments. This is why he cautions that although 'superficially this art appears to use the expressive means of the painter, for it appeals to the eye via hand-painted creations' (ibid.), it is no longer like previous painting because it does not follow 'the laws of all previous pictorial art' (ibid.). The 'sense of this new art (*der Sinn der neuen Kunst*)', rather, is 'moving painting' (ibid.). Thus this new artist — for whom he coins the term

'Kinarch', abbreviating and splicing together the two Greek words, kinesis (movement) and arche (ordering principle) — has a new artistic vision because 'the creative imagination of this modern artist is primarily concerned not with fixed forms but with movement' (ibid.). In this regard, the Kinarch's 'vision is much more closely related to that of the musician and dancer (who give sensual form to movement in time) than to the atemporal spatial suspension attending the painter's mode of perception' (ibid.). In other words, the visual music artist needs to work musically with the visuals in this creation and performance (visualisation) of this new form of 'absolute dance' or 'painting set in motion'. Diebold was an active supporter of this new expressive art with film, and encouraged young artists to become involved. For this screening, he brought along with him the young Oskar Fischinger. Later, Fischinger would become one of the most innovative abstract filmmakers of his day, working with a variety of ideas in relation to the fusion of images and music, and pioneering a visual music approach to art. Diebold's encouragement was highly influential, then, on the young Fischinger (Dicker, in Blower, 2016, 48).

4.2.4 THEO VAN DOESBURG ON FORMATIVE ART AND THE VISUAL MUSIC IN EARLY FILM

Theo van Doesburg (1883–1931) was a Dutch artist, author and founding member of the *De Stijl* group, set up in Holland in 1917. He persuaded the painter Piet Mondrian to join this group. The group had links with Germany and the Bauhaus, and the Russian artist El Lissitsky. In the *De Stijl* manifesto, written in 1918 and published in 1922 in the *De Stijl* Journal, van Doesburg calls for an acknowledgement of the new plastic art and artistic expression in which there is 'a balance between the universal and the individual' (*De Stijl*: Manitesto 1, 1918, in Harrison & Woods, 1992, 278–79). They believed that the artists of the day had the same consciousness and therefore were opposed to a 'domination of individual despotism' (ibid., 279).

In an article on 'Principles of Neo-Plastic Art' published in 1925, van Doesburg discusses the different aesthetic laws at work in a painting as well as the principles behind the setting up of the *De Stijl* group. In particular, he discusses the various currents of artistic expression, and distinguishes between two types of aesthetic ideas at work in the activity of an artist and in the work of art, namely, the aesthetic-naturalistic approach and the formative approach. By the aesthetic-naturalistic approach, he means painting that reproduces a content that is 'in a high degree true to life', yet the painting differs from nature and does not follow the laws of nature but aesthetic laws that are fixed laws. For example, he explains this in relation to the way light is configured in a painting:

> Stress has clearly been laid upon attitudes and relationships. Everything has obviously been carefully pondered. Everything is governed by fixed *laws*. Even the light, uniformly strong over the whole canvas, differs from natural light. (Doesburg, 1925a, in Harrison & Woods, 1992, 279)

A painter who works with natural forms, then, 'uses natural forms only as a means of attaining his artistic aim' (ibid., 280). These laws are harmony laws:

> The aim is: to create a harmonious whole in which the equilibrium of the whole, an aesthetic unity, is achieved by means of multiple exchanges and by cancelling out the positions and postures of the figures, the areas of space and masses and lines of movement in the picture (by relationships) … Neither colour nor form appears in its pure state as colour and form. Rather colour and form are used to assist in producing an illusion of some other thing, e.g., leaves, glass, limbs, silk, stone. (ibid., 279)

What he calls the formative artist, on the other hand, uses painterly means instead of naturalistic forms to express their own 'aesthetic experience of reality' (ibid., 280). These painterly means create their own forms as they arise out of colours, forms, lines and planes, what he calls, 'purifying the formative means' (ibid., 280):

> The aim of the formative artist is simply this: to give form to his aesthetic experience of reality or, one might also say, his creative experience of the fundamental essence of things. The visual artist can leave the repetition of stories, fairy-tales, etc., to poets and writers. The only way in which visual art can be developed and deployed is by revaluing and purifying the formative means. Arms, legs, trees, and landscapes are not unequivocally painterly means. Painterly means are: colours, forms, lines, and planes. (ibid., 280)

Van Doesburg goes onto explain how art is expression (rather than representation) and that artists use their aesthetic experience of reality as the basis for their work in art. These experiences are expressed in the art work. Thus, '[F]ormative (visual) art is formative expression with formative means' (van Doesburg, 1925b, in Lund *et al*., 1968, trans, 36). By comparison, the art of music is expression with musical means, but the 'content of all arts is the same. [Thus] Only modes and means of expression are different' (ibid., 14). Van Doesburg elaborates:

> Visual art, for example, is the exclusively plastic expression of the aesthetic experience (using space, volume, colour), music the exclusively phonetic expression of the aesthetic experience (using time and sound), etc. (ibid., 14)

Standish Dyer Lawder (1967) informs us how van Doesburg first became interested in abstract film and in the early film experiments of the painters Viking Eggeling and Hans Ricther. Van Doesburg had read a newspaper article on both of the painters' experimental film work by one of the most prominent critics of the modernist movement at the time, Dr Adolf Behne (Lawder, 1967, 7). In reading this article, Van Doesburg recognised in the work of Hans Ricther and Viking Eggeling an affinity with his own artistic ideas about painting and arranged to visit Richter. He then wrote an article on their film experiment projects for the 'De Stijl' pamphlet in 1921. In this article, he compares the open field of light in the potential of abstract film to be analogous to the dynamic expressionism of music. It is in this report that he uses the phrase 'visual music' to describe the essence of their experiments and their plans for an abstract film. Lawder quotes van Doesburg's text, which provides the context for the use of the visual music phrase:

> Hans Richter and Viking Eggeling did not come to abstract film totally unexpectedly. The notion of conquering the static character of painting by the dynamic character of film already existed in the minds of many modern artists who have wanted to solve problems of visual arts with the help of a well-developed film technique, to bring together the dynamic and static in an aesthetic way. However, satisfactory results were not found, nor did the attempt to express the dramatic content of a decadent ideology in the so-called expressionistic film (with its laid-on tragedy) provide a solution to speak for the new era. I could add many other compromises but these have nothing to do with abstract film form, a form which has introduced a new era of possibilities for dynamic expression. It is generally known that the Futurists sought dynamic effects in their paintings, but, because their art remained static, these effects remained only suggestive... It is helpful to compare abstract film-making with visual music, because, the whole composition develops visually, in its open field of light, in a manner more or less analogous to music. The spectator sees the composition (already worked out by the artist in a 'score') come into being, attain a clearly defined form, and then disappear again into the field of light, from which a new composition of totally different structure is built up again. This abstract dynamic plasticism is mechanically realized, and will be accompanied by musical compositions in which the instrumentation as well as the content would have to be totally new. (ibid., 57)

For van Doesburg, the artists Richter and Eggeling had 'found the basis for dynamic plasticism' (ibid., 58). He felt that they had not yet arrived at the purity of form that would be required, and that they had to overcome technical difficulties at the time. He noted, however, that the challenges were not just to do with technology but also with how, exactly, to work out sufficiently and precisely the drawings, their timings and the proportions of colour. Van Doesburg conceived of such timings, proportions and plasticity of the visual composition 'into the field of light' in analogy to how music compositions and its instrumentation and dynamics unfolds. Yet he recognises that both the content and the instrumentation of this 'dynamic plasticism' would require a radically new form of artistic visual music expression in the way the artist expresses musically the content in the visual music piece and the way the music must accompany expressively and interactively over time that visual music content.

4.3   THE NON-OBJECTIVE FILM

At the beginning of the twentieth century, abstract painting had established processes in art that enabled a freedom of expression in working with non-objective imagery and in articulating forms and objects to express the artists' ideas. The early non-objective filmmakers were also painters engaged in the painting of non-objective imagery, and so, brought with them into the realm of their films that interest in the non-objective content of painting. Here, however, the film image was capable of exploring the interrelationship of a pliable and plastic abstract imagery in the space of the frame of the image in and over time. The most well-known early non-objective films were made in Germany and referred to as 'Absolute film'. These continued on the exploration of absolute and abstract values in the medium of film, but in new ways, for it was the medium itself, film projection, in its creative use as an art form, that was now being called upon to be independent of all other arts forms and to become an art-form *sui generis*. As Elder sums it up,

> Discarding objects, freeing visual form from any correspondence to the natural object, changed painting, as it allowed painted forms to become pure plastic elements that the artist could freely shape. It also offered filmmakers real advantages: it allowed them to develop pure plastic relations among the visual elements of an Absolute Film, to treat visual elements as forms interacting in contrapuntal relations. (Elder, 2008, 165).

4.3.1 THE ABSOLUTE FILM

'Absolute film' was a term that came to be associated with the film works of several German-based filmmakers operating in Germany in the 1920s. This term, however, was also a term associated with the art of film itself as an autonomous independent art that had its own intrinsic cinematic means, its own artistic language and its own cinematic techniques, and its own kind of art to make. It is typically associated with a film content comprising abstract imagery content in a similar manner to how abstract painting composed imagery of abstract, non-objective content. It was understood as a film category that explained the illusionary reality of the film; that is to say, as a man-made reality. It was of course a concrete and real reality, but one that belonged to the film reality due to purely cinematographic material processes. It thus denoted film's independence as a self-contained art. In this, it again was similar to the developments in abstract painting that also sought to decree to the abstract painting the status of an autonomous object. Concepts such as pure, non-objective, concrete, plastic, and formal elements were applied to both painting and film content. The painter Malevich also used the term 'absolute' to describe the abstract content and meaningfulness of his painting contents. Absolute was a term also applied to music, for example the critic Hanslick correlated instrumental music with absolute music and 'insisted that music, without the aid of a sung text or verbal cues, was entirely self-sufficient' (Evan Bonds, 2014, 7). In absolute film, just as in music, the element of time and movement that renders rhythm, melody in music is made available to images that could craft autonomous visual elements of colours and forms, and thus make rhythmic and movement changes in the transformations of the pictorial elements analogously to how a composer or musician can transform sound. The use of a line, or a shape, or a colour in an absolute film is there for its own value and its movement value (ter Braak, 1931, 14).

It is understandable, then, why absolute film came to be associated with a music of images or a 'visible music', due to this analogous structuring and combining of image material in a musical manner. As the Dutch modernist author Dr Menno ter Braak (1902–1940) remarks in his 1931 essay on '*De Absolute Film* (The Absolute Film)' (1931 – reproduced in 1980),

> Onder absolute film verstaat men gewoonlijk een filmkategorie, die de waarde van het instrument film zoekt in een soort zichtbare muziek; men pleegt deze kategorie dan te stellen tegenover de film, die met begrijpelijke symbolen, met verstandelijk te overwegen problemen, hoofdzakelijk met menschen en menschelijke psychologie werkt. (ter Braak, 1931)

English translation of quote:

Absolute film is usually understood to mean a film category that seeks the value of the instrument film in a kind of visible music; this category is then set against the film, which, with intelligible symbols, with intellectually contemplable problems, mainly works with people and human psychology.

The three foremost filmmakers associated with the earliest absolute film idea were first painters: Ruttmann, Eggeling, Richter. Later, these films have come to be known as being part of the 1920s German Avant-Garde film. They are also currently claimed by the visual music community of scholars, curators, educators and practitioners as being films belonging to a visual music history.

4.3.2   *DER ABSOLUTE FILM* (THE ABSOLUTE FILM) MATINEE, 1925

On 3 May 1925, the UFA-Theatre on Kurfürstendamm (*Universum-Film Aktiengesellschaft)* in Berlin, screened a matinée film called '*Der absolute Film'* ('The Absolute Film') (see Figure 32).
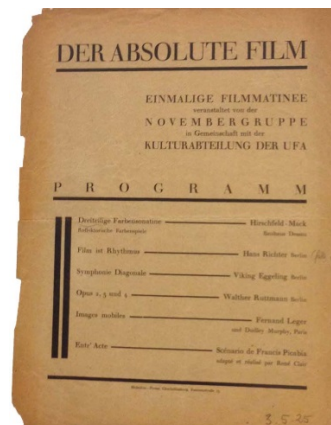
Figure 32 Programme for the public showing of '*Der Absolute Film*' (The Absolute Film), May 3, 1925 (Leitner & Nitschke (eds.), 1989,13) or (Source: Dickerman, 2012, 346)

The matinée was repeated at the Kestner-Gesellschaft in Hanover on 21 May 1925 and, in the following year, at the Bauhaus, Deassau, on 21 March 1926 (Kaes, 2012, 347). The event organiser was Edgar Beyfub, who was director of UFA's *Kulturfilmabteilung* (Culture Film Department)*.* Others involved in organising the matinée were the members of the *Novembergruppe* (November art group), a group that comprised expressionist painters, playwrights, composers, architects and poets, interested in bringing together ideas from cubism, futurism, Dadaism and impressionism (Elder, 2008, 163).

The works presented were: A live multimedia performance of a kinetic light show by the Bauhaus artist Ludwig Hirschfeld-Mack, Dessau (Bauhaus), entitled *Dreiteilige Farbensonatine* (Three Colour Sonatinas) using the *Reflektorische Farbenspiele* (ColourPlay instrument). Five films were screened after this performance: Hans Richter's, *Film ist Rhythmus* (Film is Rhythm later known as *Rhythm 21.* Anton Kaes explains that this film was not actually ready for this first

screening but was part of the screening a week later in the second matinee (2012, 346)); Viking Eggeling's *Symphonie Diagonale* (Diagonal Symphony) (1921–24); Walther Ruttmann's *Opus 2, 3 and 4* (1921–25); Fernand Léger und Dudley Murphy's *Images mobiles,* 1924 (now known *as Un Ballet Mécanique*); *Entr'acte*, for which the credits were *Scénario de Francis Picabia adapté et réalisé par René Clair (*The film scenario by Francis Picabia, adapted and directed by René Clair). (Grohmann, 1928, 39; Monoskop.org, 2016; O'Konor 1971, 53).

After this matinée, however, the 'absolute film' movement declined in Germany (Elder, 2008, 164), and neither Richter nor Ruttmann made another non-objective film thereafter. They both rather moved towards experimenting with a realist style in their films and like most others focused on working with the photographic image, the real object and the use of editing and montage filmmaking techniques. These films produced were considered more 'objective' rather than 'non-objective', even if the objects were being re-contextualised in the space and time of the film. Richter did create films using such objects and real photographic images in his films; but he used them as if he was arranging the elements in his non-objective painting and films. As Elder describes Richter's film *Filmstudie* (1926):

> *Filmstudie* investigates the thresholds between the two artistic modes [of objective and non-objective artistic representation], highlighting some of the features that separate the two and minimizing others. Richter employs devices (e.g., multiple exposures and negative images) that draw attention to the technical specifity of photography; he then fuses these with graphic elements. (Elder, 2008, 164)

Oskar Fischinger, who was familiar with Ruttmann's non-objective films and who went on to make abstract films himself, did carry on in this artistic mode of abstract film-making in Germany and when he moved to the United States in 1938, bringing with him, according to Elder, the abstract film movement to the United States (Elder, 2008, 164). Several factors, nonetheless, may have contributed to the lack of further development of non-objective film in Germany around this time, such as, for instance, the political situation in Germany forced a turning away from modern abstract art, as such art was deemed '*degenerate art'* (*Entartete Kunst*), an (in)famous term adopted in the 1920s by the *Nazi* Party in relation to such art practices. Modern abstract art, was eventually censored and banned together with 'degenerate (atonal or jazz) music'. Rather, what was focused on in film experimentation were the cinematic techniques of montage and editing. These techniques could also facilitate the musical and rhythmical editing of shots, but did not use abstract content.

4.3.3   HANS RICHTER – *UNIVERSELLE SPRACHE* AND FORM EVOKES FEELING

Hans Richter (1888–1976) was a German painter, filmmaker and actively involved in several art movements and groups, such as, the Zurich Dada group, Constructivism, and *De Stijl*. He also was involved with the journal 'G'. Music was an important part of his conception of art and he

cites music as being what led him to the arts in his writings (Richter, 1997). Richter started out drawing and painting and then worked with film. He became interested in exploring what Malcolm Turvey describes as a 'structured form of abstraction through which a rhythmical effect could be produced across his picture surfaces' (2003, 17). Richter used the picture surface as a fundamental formal unit in his paintings and early films. He was influenced by Viking Eggeling's approach to musical form in painting, after meeting him in 1918 (Richter, 1997, 62) and Richter was led by Eggeling to explore a language of form in his own work. Richter elaborates on his and Eggeling's understanding of a language of forms that underpinned their works of art in a pamphlet that he and Eggeling published in 1920 titled *Universelle Sprache* (Universal Language) (Turvey, 2003, 18), arguing that all human beings could understand, at a perceptual level, the forms they explored in their films and this is what they sought in their films:

> [*Universelle Sprache*] elaborated our thesis that the abstract form offers the possibility of a language above and beyond all national language frontiers. The basis for such a language would lie in the identical form perception in all human beings and would offer the promise of a universal art as it had never existed before. (Richter, 1965, in Turvey, 2003, 26–27)

Richter declares that like Eggeling, 'he had arrived at his theory by way of music, and always explained it in musical terms' (Richter, 1997, 62). In their abstract paintings and abstract films, both Richter and Eggeling began to investigate the possibilities of finding a universal language based on perceptual geometrical forms and patterns with their rhythms and movements. This universal language they sought was one that was hoped to be a bridge between mysticism and rationalism. '*Kontrast-Analogie*' (contrast-analogy) was a formal principle that Eggeling had developed and applied to forms, and one that Richter adopted in his 'Rhythm' films. Richter created three abstract films, employing elementary geometrical figures in motion in the early 1920s titled 'Rhythm 21' (1921), 'Rhythm 23' (1923), and 'Rhythm 25' (1924) (see Figure 33).

For Richter, form building relied on '*Kontrast-Analogie*' (contrast-analogy) – the development of contrasts. By articulating such contrasts, an artistic unity can be created. Richter explains in 1964: 'Form could be placed in context only by its opposite and could be brought to life only by the establishment of an inner relationship between the two opposites. This was the only way to create a unity, that is to say, an artistic whole' (Richter, 1997, 64). These contrasts in the film can be between the position of the object, its size, its darkness and lightness, and its movements. In 'Rhythm 21', the basic elements of the film are white squares and rectangles on a black background. The squares advance, recede, and move position. They also change position in terms of the foreground and background element, where the positive image is replaced with its negative, effected through a jump cut edit, resulting in a white square on a black background suddenly changing to the opposite of a black square on a white background.
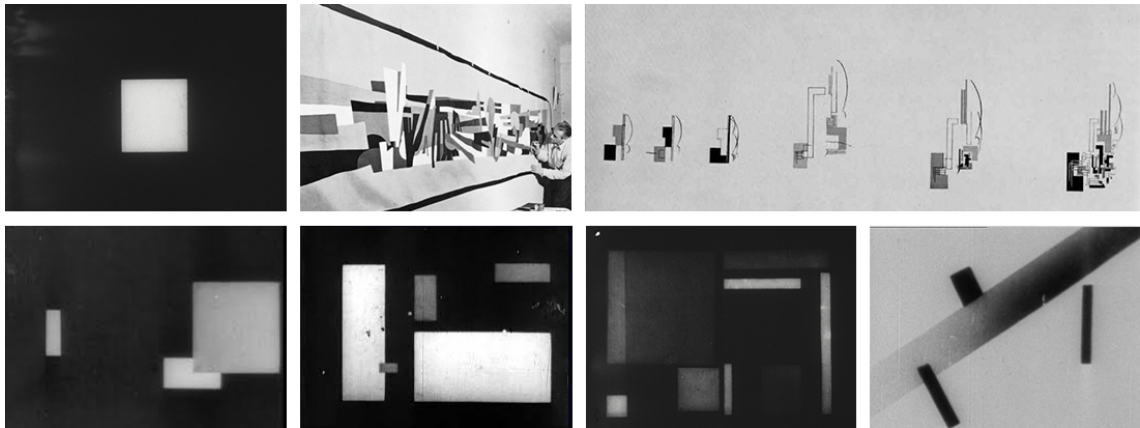
Figure 33 Hans Richter. L-R-Top: Frame from film '*Rhythms 21*' (screened 1925 at '*Der Absolute Film*' matinee), Hans Richter with a scroll painting, Scroll painting, *Preladium* (Prelude), ink scroll on paper, 1919. L-R-Bottom: Frames from ''Rhythm 21'.

By articulating these contrasts, Richter believed that these could evoke feelings in the spectator and that the feelings are evoked through the forms. Therefore, as Elder explains Richter's view,

> [T]hrough its form, an artwork elicits and resolves tension. The sort of tensions appropriate for artworks to modulate are tensions that arise from creating and resolving contrast between features essential to that medium. Every frame is a distribution of light and dark, and filmmaking is essentially the art of modulating the distribution of light. Thus, it is appropriate for film form to modulate tension by varying contrasts amongst dark and light areas ... (Elder, 2007, 26)

Richter, like Eggeling, was influenced by the analogy of form to music and applied principles of music to his filmmaking (ibid.), for example, employing a contrapuntal rhythm with his abstract forms.

Standish D. Lawder (1975) remarks about Richter's 'Rhythm 21', that the area of the movie screen is a surface of which the forms are 'part of a totally self-contained kinetic composition of pure plastic forms', elaborating that the movie screen has become a,

> direct substitute for the painter's canvas, as a rectangular surface on which a kinetic organization of purely plastic forms was composed. For normally, the movie screen is perceived as a kind of window, more or less arbitrarily circumscribed, and behind which an illusion of space appears; in *Rhythmus 21*, by contrast, it is a planar surface activated by the forms upon it. (Lawder, 1975, quoted in Graf, *et al.* 2007, 49–40)

4.3.4 VIKING EGGELING – '*GENERALBASS DER MALEREI'* AND '*KONTRAST-ANALOGIE*'

Viking Eggeling (1880–1924) was an artist and filmmaker. He was born in Sweden and moved to Germany as a teenager, and then moved to Milan where he studied art at night classes. When he lived in Paris he was influenced by Cubism. He started to work on what he called a theory of 'universal language' from c. 1915–1917, which was a theory of harmony for painting, and this resulted in an articulation of a form language (Monoskop.org, 2016b). This idea consumed him and he crafted many hundreds of study drawings exploring a language of forms consisting of

various forms of harmonious relationships (O'Konor, 1971, 40). Eventually, he translated this form language into large scroll drawings. It was these scroll drawings that eventually acted as a type of script for his work in film later. Eggeling met Richter in 1918 and both recognised that they were working along similar lines in their approach to form in painting. Richter describes seeing a drawing by Eggeling for the first time at this meeting. 'Here, in its highest perfection, was a level of visual organization comparable with counterpoint in music: a kind of controlled freedom or emancipated discipline, a system within which chance could be given a comprehensible meaning' (Richter, 1997, 62). By the time Eggeling met Richter, Eggeling had already developed an advanced theory of painting called *Generalbass der Malerei* (the elements or 'groundbass' of painting) that he shared with Richter at their first meeting. Richter recounts Eggelings theory:

> As his starting-point, Eggeling had taken the most elementary pictorial element, the line, and he was working on what he called its 'orchestration' (a concept first used by Gauguin in speaking of colour). This was the interplay of relationships between lines which he had arranged (as I had done with positive and negative surfaces), in contrapuntal pairs of opposites, within an all -embracing system based on the mutual attraction and repulsion of paired forms. This he called *'Generalbass der Malerei'*. (Richter, 1997, 63)

After Eggeling's meeting with Richter, he worked alongside him for several years. In Berlin they worked on the scroll drawing idea of developing a form language, and Eggeling joined the *Novembergruppe* (November Group). Both Eggeling and Richter then started to work on the expression and articulation of universal pictorial language together. Elder explains:

> Eggeling and Richter's *Universelle Sprache* was a grammar for combining forms into pairs of opposites based on mutual attraction and repulsion. The constellation of opposing pairs would create a form of counterpoint. The theory of the *Universelle Sprache* proposed that polarities between opposites were the elemental relations from which forms were created: positive and negative; black and white; above and below; curved and straight; empty and filled; intersecting and not intersecting; horizontal and vertical; parallel and counterpoint; simple and complicated; dark on light and light on dark; single and multiple; internally linked and separated. It was a language whose elements, then, were not individual forms but which were significant in their relationship to one another. (Elder, 2007, 31)

Eggeling and Richter moved from focusing on form-building to working on what Richter described as the 'principle governing relationships' (Richter, 1997, 64). Form could be brought to life 'only by the establishment of an inner relationship between the two opposites. This was the only way to create a unity, that is to say, an artistic whole' (Elder, 2007, 31).

Eggeling was introduced to the idea of film as art in the 1920's and was influenced by the Constructivist aesthetics of the time. Neither Eggeling nor Richter, however, were familiar with the technicalities of film, but this did not stop them from working with the new medium for creating a form language of their own. Eggeling continued to explore his form and relationship language in the film medium and Richter changed his approach and writes that he, 'restricted

[himself] to trying to articulate time in various tempi and rhythms' (Richter, 1997, 197). They managed to secure funding from the *Universum-Film* A.G. (UFA) in Berlin to produce their films. Eggeling worked on his first film '*Horizontal-Vertikal-Messe I-III*' ('Horizontal-vertical Orchestra'), now presumed lost, and it was based on his scroll painting of the same name. With the help of Erna Niemeyer, Eggeling finally finished a film with which he was happy, his '*Symphonie Diagonale*' ('Diagonal Symphony') in 1925 (see Figure 34).
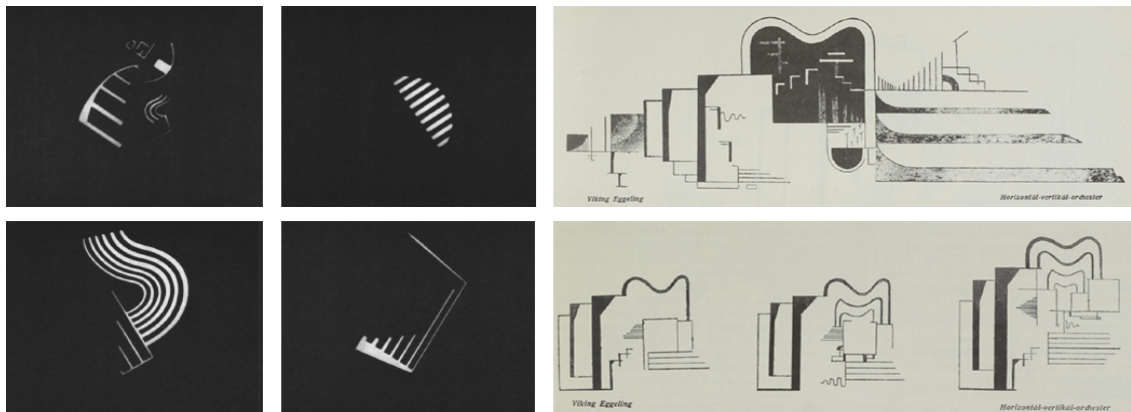
Figure 34 Viking Eggeling. L-R-Top: Two frames from film '*Diagonal Symphony*' and Scroll painting Horizontal Vertical. L-R-Bottom: Two frames from film '*Diagonal Symphony*' and Scroll painting Horizontal Vertical

Eggeling approached his art and film experiments from both a practical and theoretical point of view and wrote in two journals, the *MA* in Hungary and *De Stijl* in Germany. Eggeling evolved a theory of visual dynamics for film. Louise O'Konor conducted extensive research into Eggeling's work and posthumously known writing, which are mostly written in fragments (O'Konor, 1971, 75). O'Konor explains that in his writings, Eggeling's central concerns were 'centred on questions regarding composition, ethics and artistic integrity' (ibid.)

In the 'Theoretical presentations of the art of movement' that was published in the *MA* journal in 1921 (ibid., 75), Eggeling articulates his theory of visual dynamics for film that was related to music dynamics. He relates formative evolutions and revolutions of the abstract forms in analogous fashion to how music sounds to our ears (Eggeling, 1921 in O'Konor, 1971, 90). The action of the forms creates tensions and resolutions that are similar to music. O'Konor observes that the 'principle of polarity plays an extremely important role as one of the basic tenets underlying Eggeling's creative work' (ibid., 76). For Eggeling, the composition of these forms is determined, artistically, from following and engaging the principle of polarity — this requires the artist to use and deal with proportion, rhythm, number, intensity, sound and time to create contrasting and analogous relationships between forms. For Eggeling, this building and contrasting of forms was akin to creating and assembling an alphabet (ibid., 76). This is why

Eggeling understood art not to be a subjective phenomenon but to be an individual performance of a universal organic language (ibid.).

4.3.5   MONTAGE AND *CINÉMA PUR* – THE MUSIC OF IMAGES

In Elder's assessment, the three German-based filmmakers, Ruttmann, Eggeling and Richter, who had screened their non-objective abstract films at the Absolute film matinée in Berlin (see section 4.3.2), 'had overlooked one formidable potential of the medium: montage' (Elder, 2008, 164). There were, however, two other films screened at the '*Der Absolute Film*' matinée that did not explore an abstract imagery content in the film image, but had experimented nevertheless with the new medium of film and its potential as an integrated artistic expression of images, sound and music. These were, Léger and Dudley Murphy's '*Images mobiles*' (1923-24) — now known *as Ballet mécanique* (1924) and for which a music score of the same title was composed by George Antheil — and Clair and Picabia*'s Entr'acte*, for which Erik Satie scored the music. These two films by the French artists screened at this matinée did make use of montage as a means of expression in the films.   Montage was a new artistic technique and means of expression made possible with the new medium of film. As film consisted of a sequence of photographic frames, played back at the correct speed, to give the illusion of a continuity of motion, in montage the sorting, assembling and organising of these image sequences enabled time itself to be re-arranged. This technique was explored in a comprehensive manner by a group of Soviet filmmakers, who are known commonly as the Soviet montage filmmakers. With montage, then, frames of the film can be re-arranged and juxtaposed images in time to create new rhythms and dynamics and new types of relationships between images. For example, images could be played backwards, or the natural order of a recorded sequence could be re-arranged through the techniques of cutting and editing the film strip.   Montage also facilitated a more musical approach to working with images in time where the juxtaposition of the objects and images in time creates new meanings and new associations as a result of the temporal relationships between the images. In this regard, the montage artists who collaborated and created these films were interested in a pure cinema by which the language of cinema could be used to create a true cinematic art that explored its own means and materials, just as music did and as painters and abstract painters were beginning to do. In France, a popular term to describe the film work of experimental filmmakers in the 1920s was '*cinéma pur*'.   Henri Chomette (1896–1941) 'coined the term *cinéma pur* to refer to a cinema that maintained modernist aspirations, one that focused on the pure elements of film, such as light, movement, tonality, and rhythm' (Elder, 2013, 392). Here the cinematic means were used for artistic goals. Thus in their desire to produce a pure cinematic experience, these artists, Kaes remarks, were opposed to following a linear narrative in their film compositions and instead,

> They were pursuing the goals of 'pure cinema' by following the rhythmic structures
> of music and poetry rather than the causal logic of a linear narrative, they produced

> sensations in the viewer through strictly filmic means, such as slow and fast motion, surprising camera angles, distorted close-ups, rapidly cut whip pans, and breakneck traveling shots. The filmmakers used images from the visible world as material for new formal arrangements that could only exist on-screen. (Kaes, 2012, 347)

In this regard, we could say that the independence of the image and the objects photographed are comparable to the independence of tones in an atonal music composition, or the use of new sounds in music such as noises from noise machines or noises from machinery.

The films *Entr'acte* and *Ballet mécanique* then, were made as a result of a shared collaboration and conversation between artists, cinematographers, and music composers. The films not being typically narrative-driven films were striving to explore the integrated art and integrated media approach to exploring artistic ideas. In this collaboration, new voices contributed to the final form of the work, such as, for instance, the camera operator and the director.

4.1.1.1   René Clair and Francis Picabia's '*Entr'acte*'

Entr'acte, for which the credits were *Scénario de Francis Picabia adapté et réalisé par René Clair* (The film scenario by Francis Picabia, adapted and directed by René Clair), was a film that was originally conceived as being part of a Picabia's Ballet *Relâche* for the *Ballets Suédois* ballet company. The composer Erik Satie (1866–1925) composed the score both for the Ballet and for the film. The ballet performance was intended to be a Dada work, and so included several provocations in the style of Dada art, such as, lights being shone on audiences eyes and dancers changing their costumes on stage. Picabia conceived of the Ballet as being an 'Instantaneist ballet' (Elder, 2013, 185), which refers to the present moment and the moment of sensation and a concept of perpetual movement. Picabia had the idea for a film to be played in the intermission of the two acts of the ballet performance. He collaborated with Clair to make the film '*Entr'acte*'. Picabia wanted to deliberately use the film medium in this instance during the intermission as he saw the potential of film to 'heighten the dramatic effect of dance – for film can move us as rapidly as thought' (ibid., 186). Picabia declares what he sees as the possibilities of cinema:

> The cinema must not be an imitation, but an evocative invention as rapid as the thought of our brain, which has the ability to transport us from Cuba to Bécon-les-Bruyères, to make us jump on a spirited horse or from the top of the Eiffel Tower . . . while we eat radishes! (Picabia in Elder, 2013, 186)

Thus in Picabia's view, 'the purpose of art is not to create clear ideas but, rather, to create strong and delicious sensations' (ibid., 185). The use of a film in the ballet in itself was also considered to be provocative in the style of Dada art. Clair was an accomplished filmmaker and he used several techniques to explore the scenario suggested by Picabia for the film. The film is notable for its handling of movement as an aesthetic quality. Elder provides a succinct description of the power of movement explored in the film:

> The film as a whole is very much a film of movement, which, Clair recognized, is the very basis of cinematic lyricism. Indeed, the film generates its effects primarily through the ways it handles movement. The use of various speeds — of both the shooting and the cutting — sometimes converts the subject matter into almost pure (almost non-referential) figures, thus emphasizing the cinema's dynamic properties. This cutting also organizes the shapes, speeds, and directions of motion into a highly choreographed ensemble. (ibid., 198)

The overall result or effect of this compilation and composition of moving images, using montage techniques, overlaid images, speeded up, slowed down, backwards and forwards, and a compatible musical score, projected onto a visual screen, distinguishes '*Entr'acte*' as its own unique artistic achievement, from the Ballet equally yet differently concerned with movement in act on stage, in the 'intermission' space (c. 20 mins) between acts on stage.

4.1.1.2   FERNAND LEGER AND DUDLEY MURPHY'S '*IMAGES MOBILES*'

That the title of this work as first named '*Images mobile*' (mobile images) screened at the '*Der Absolute Film'* matinée (see section 4.3.1) reflects aptly the type of imagery and juxtaposition of images in the film. Subsequently, it was re-named as *Ballet mécanique*.

The painter Fernand Léger and the cinematographer Dudley Murphy collaborated on the film *Ballet mécanique,* 1923–24. The artist Man Ray was also involved in the early conception and planning of the film but not in its production. The film is an example of an artist collaborative effort around artist-led themes in the medium of film. The artistic ideas were linked to cubist, surrealist and dada art concerns. The title of the film came from an artwork by the artist Francis Picabia that had been published in the 391 pamphlet in 1917 (Picabia, ed. 1917). The music composer George Antheil was commissioned to score the music for the film. Unfortunately, the film was released without the music. There were attempts to put the two together but there were difficulties. Antheil promoted the music part as a solo concert work, with the title *Ballet mécanique*, and it was premiered as a solo work in 1926. It was an innovative score, consisting of xylophones, siren, electric bells, player pianos, and airplane propellers. In 1935, Antheil did accompany the score with the film. The score was also performed with the film in the 1990s, and a 1952 version of Antheil's score was put together with the film as a soundtrack and premiered in 2001 by Paul Lehrman. That film was then made available for the Unseen Cinema DVD version of the film (*Ballet mécanique*, 1924).

Léger made an interesting observation about how the medium of film should be used: 'A cinematic concept [should find] its own methods. As long as the film is based on fiction or the theater, it will be nothing' (Léger in Elder, 2013, 194). Léger also wrote an article about what he had learned from his involvement with film 'A New Realism – the Object' (1926), where he suggests that, in film, the photographed object needs to be treated in isolation. He recognised that the photograph had within it the 'element of interpretation in it' and yet also had its own plasticity in terms of how it is framed and photographed. An object could be photographed at a distance or

close-up, or only a fragment of an object could be photographed. Plasticity also occurs in terms of the choice of images in succession. When making these images mobile through stop motion capture, or by what we call today frame-by-frame animation, further new effects are achieveable through the medium of film. Léger in 1926 explains this new role for the object in film.

> Every effort in the line of spectacle or moving-picture, should be concentrated on bringing out the values of the object — even at the expense of the subject and of every other so-called photographic element of interpretation, whatever it may be. All current cinema is romantic, literary, historical expressionist, etc. Let us forget all this and consider, if you please: A pipe — a chair — a hand — an eye — a typewriter — a hat — a foot, etc., etc. Let us consider these things for what they can contribute to the screen just as they are – in isolation — their value enhanced by every known means … The technique emphasized is to isolate the object or the fragment of an object and present it on the screen in close-ups of the largest possible scale. Enormous enlargement of an object or a fragment gives it a personality it never had before and in this way it can become a vehicle of entirely new lyric and elastic power. I maintain that before the invention of the moving-picture no one knew the possibilities latent in a foot — a hand — a hat. These objects were, of course, known to be useful — they were seen, but never looked at. On the screen they can be looked at — they can be discovered — and they are found to possess plastic and dramatic beauty when properly presented … I propose to apply this formula to the screen and to study the plastic possibilities latent in the enlarged fragment, projected (close up) on the screen, specialized, seen and studied from every point of view both in movement and immobile. (Léger in Elder, 2008, 165)

Léger was not the only one who explored the artistic possibilities of the photographed natural object through the medium of film. The German filmmaker Laszlo Moholy-Nagy (1925) also explored the expressive possibilities of presenting the photographed object and discussed this in his writing in *Malerei, Fotographie, Film* (Painting, Photography, Film). He focused on exploring rhythm, light, shadow, various framing angles and views of a scene, often distorting the viewing angle of the scene. The camera was not just a mechanical tool for the recording and reproducing of photographic images because it had its own expressive possibilities for visual art making.

4.3.6   STANDISH LAWDER ON '*BALLET MÉCANIQUE*' AS VISUAL MUSIC

The images in the films *Entr'acte* and *Ballet mécanique* were photographed images that comprised recognisable objects in short live-action scenes. One, therefore, could not say the films were abstract; nor could one easily argue that they were non-objective. The objects, however, had a new role to play in these films as they were isolated from their usual contexts. The object was treated as an object in itself devoid of the meanings normally attributed to it in its natural contexts. In other words, the objects were being treated as if they were abstract forms in a non-objective film. By isolating and re-contextualising these objects from their normal contexts, they were being used in the film to create new meanings or as objects for a different scenario.

These films explored the cinematic potential for ordering and sequencing images in time and the dynamic and rhythmic effects that such sequencing can create. They worked with camera recorded images of live action scenes and juxtaposed the shots from these recordings to create new meanings, focusing more on the arrangement, sequence, duration and rhythmic timings of recorded images. The meanings, at times, emerged not in the content of the images but in the editing, rhythm, pacing and timing of the images. *Ballet mécanique* is often referred to as a cubist film (Lawder, 1967, 4) on account of the similarities in the shot compositions that juxtapose and present multiple points of view at one time, and in superimposed shots playing simultaneously. Standish Lawder (1967), who conducted research into the study of film in the early period from 1896 to 1925, argues that the cinema that developed during this early 1920s period was a form of modern art. He also makes the case that *Ballet mécanique,* through it utilisation of a modern art filmic expression, contributed to a notion developed in the 1920s among critics and commentators that film was a type of visual music (ibid., 175). Lawder explains:

> Léger was concerned with rhythm for its own sake, as a kind of *visual music* [my emphasis]. His system of rhythm was almost purely sensuous and had no explicit meaning outside the film. This is why almost every image in Léger's film has a bold but relatively self-contained design, for each image was to have maximum visual impact, each must strike our eye as, in music, the sound of percussion instruments is apprehended by the ear. Only in this way does the rhythm of images become forceful enough to become, in fact, the content of the film…In Léger's montage, the rhythm, by and large, is the meaning. (ibid., 327)

In Lawder's use the term, 'visual music' refers to the rhythmic sequencing of cinematographic shots in time establishing its own artistic meaning, impact and effect in this experience (reflective of the meaning of life as experienced in such disconnected yet connected manner). This film embraced the particular cinematic techniques pertaining to filmmaking, but explored them in non-narrative ways and explored the techniques in themselves for a more formal result. The visual music in this film can be attributed as much to the collaborative effort of various types of artists from different art domains, such as the painter Fernand Léger, the filmmaker Dudley Murphy, and the composer George Antheil. This collaboration enabled a rich painterly, filmic and musical expression, using nonetheless the new language of cinema and its own unique techniques to bear upon the work. Lawder points to the films of Germaine Dulac as an example of filmmaking that follows in the footsteps of *Ballet mécanique*, utilising this type of film grammar as well, and explains that Dulac developed a theory of visualised music for film (ibid., 175).

4.3.7 Lászlo Moholy-Nagy – Sound film composition

László Moholy-Nagy (1895-1946), the Hungarian filmmaker and artist based in Germany and was associated with the Bauhaus in Berlin, worked mainly with visual art and film. From the 1920s Moholy-Nagy, was also interested in the power of the early sound recording technologies

of the gramophone and subsequently optical sound film for the 'technological extensions of music' (Patteson, 2016, 86). Moholy-Nagy was particularly interested in the potential for sound recording technologies to be 'experimental instruments' (ibid.). Moholy-Nagy drew a distinction between two methods for working with the sound recording mediums. The first consisted of manipulating an existing acoustic recording, and drawing on cinematic methods such as the techniques of montage to re-arrange and manipulate sounds. Thomas Patteson quotes Moholy-Nagy:

> Just as the optical film possesses the possibility of capturing an object from different perspectives—from above and below, from the side and from the front, foreshortened—something similar must happen with sound. There must be different "angles of hearing" to correspond to the various "angles of view." To this can be added acoustic close-ups, slow motion, time lapse, distortion, washes—in short, all the means of a "tone montage." (Moholy-Nagy , 1932 quoted in Patteson, 2016, 98)

Another approach for using sound recording technologies for music material was the direct inscription method. This method facilitated the creation of entirely new sonic phenomena constructed into 'a deliberately artificial work conceived on the basis of the technological medium and its formative potential' (Patteson, 2016, 83). However, as Patteson observes, such recording media 'lacked the visual and tangible characteristics of traditional musical tools' (ibid., 84). Moholy-Nagy was interested in creating that tangible visual for the inscription method and experimented with it, initially for the gramophone record in the early 1920s and then the optical sound film towards the end of that decade when the optical sound film technology emerged. He called for 'a methodical study of the correlations between inscriptions and their sonic effects in order to establish a "scratch-writing alphabet" (ibid., 88) or as Moholy-Nagy named it as an "opto-acoustic alphabet" (Moholy-Nagy quoted in Patteson, 107). Moholy-Nagy proposed that optical shapes could be created and organised into a precomposed plan and these shapes would be converted into sound via the optical sound film. The shapes would be photographically transferred to the sound track of the film for this purpose. Robert Beyer put forward similar theories for 'experimental sound-film composition' (Patteson, 2016, 99) envisaging a music production for film based on the technology basis of optical sound film.

Moholy-Nagy along with other filmmakers and authors such as Oskar Fischinger and Rudlof Pfenninger inscribed acoustic phenomena directly onto the film strip using various types of graphical shapes and patterns. Experiments were also conducted with synchronising these sound shapes with the optical part of the film. Moholy-Nagy created a film in 1933 that used all manner of shapes, symbols and letters of the alphabet onto both the optical and sound track, titled, '*Tönendes* ABC (Sound ABC)'. As Patteson surmises: 'The optical track and the sound track of Moholy-Nagy's film were identical, allowing viewers to witness the graphical correlate of the sounds as they heard them' (Patteson, 2016, 113).

Béla Balázs (1884–1949), born Herbert Bauer, was a Hungarian film critic, film theorist, playwright, screenwriter and director. He spent some time in Berlin from 1926, where he was involved with theatre productions and film projects, and also published several books and writings on film theory. In 1924 he published in German *Der sichtbare Mensch oder die Kultur des Films*, which was translated by Rodney Livingstone into English *Visible Man, or the Culture of Film*, published in 2010 (Carter, ed., 2010). Balázs deploys several musical metaphors to explain the new aesthetic potential of film as a new language of art. He refers to a music of language that he sees as being available to all languages. The music of language, nonetheless, does not possess an acoustical musicality; it is a type of interiority that is inherent in all art forms. Thus, he argues,

> Every language has a musical component and every word its own melody. But the music of language, although similar acoustically to actual music, possesses no inner musicality. It has the atmosphere of concepts and helps to enhance the process of rational discrimination. However, music is not just an acoustic matter; it is a separate sphere of the soul. And indeed, facial expressions and gestures are themselves no mere optical matter. I was speaking of dancers. But the film actor does not dance. Nevertheless, he is not dependent on words and plays no part in the rational world of concepts. There appears to be a third realm between the speaker's world of gestures and the decorative expressive movements of the dancer, and this realm has its own form of interiority. The gestural language of film is as far removed from the linguistic gestures of theatre as it is from dance. (Balázs, 1924 in Carter, ed., 2010, 91)

For Balázs, then, the gestural language of film (as an art-form) is more akin to the interiority of the soul of music as it is 'not dependent on words and plays no part in the rational world of concepts'. He compares, inversely, the individual voices of polyphony in music as it is heard in the general sound to the use of the close-up technique in cinema as a method of teaching us how 'to read the score of the polyphony of life':

> But the magnifying glass of the cinematograph brings us closer to the individual cells of life, it allows us to feel the texture and substance of life in its concrete detail. It shows you what your hand is doing, though normally you take no notice when it strokes someone or hits out at them. You live in it and pay no attention to it. The magnifying glass of the film camera will show you your shadow on the wall, something you live with without noticing, and it will show you the adventures and the ultimate fate of the cigar in your unsuspecting hand, and the secret — because unheeded — life of all the things that accompany you on your way and that taken together make up the events of your life. You have observed life much as a bad musician observes an orchestral piece. He hears only the leading melody and the rest of it merges into a general sound. Through its closeups a good film will teach you to read the score of the polyphony of life, the individual voices of all things which go to make up the great symphony. (ibid., 103)

The 'bad musician' in the performance of an orchestral score, only pay heeds to the main voice, unaware of the individual voices and instrument that concretely, that is to say, 'taken together', go to make up that experiencing of the sound of the orchestra in the first place. So, too, analogously, and inversely, in the interpreting of the meaning of life on the screen, 'a good film'

will make us see the polyphony of life's events that go to make up the 'substance of life in concrete detail' by going more, and not less, into the 'unheeded' yet 'accompanying' detail of that whole life as experienced. This is why Balázs refers to the succession and simultaneity of the use of cinematic techniques (such as close-ups etc.,) to show the different types of facial expressions more closely than was possible in theatre or in a portrait or in everyday face-to-face brief encounters. Rather than acting as a mirror to reality, then, the cinema acts as a magnifying glass directed at the unhidden yet constitutive parts of one's whole life experiences in all its concreteness and complexity. In this sense, this art-form is capable of being more true or real to life than any form of the representational arts. Like music, nonetheless, he compares the display of the emotions in this simultaneous and successive presentation of facial expressions as being like the chords and polyphony of music.

> In general, facial expressions are more 'polyphonic' than language. The succession of words resembles the successive notes of a melody. But a face can display the most varied emotions simultaneously, like a chord, and the relationships between these different emotions is what creates the rich amalgam of harmonies and modulations. These are the chords of feeling whose essence is in fact their simultaneity. Such simultaneity cannot be expressed in words. (ibid., 100)

From these writings, one can ascertain the richness of music and its components as having a resonance with the language of cinema and that this language pointed to a form of musicality (that was not an acoustic musicality) of cinematic language. It was, however, in a book on film theory that he published, twenty years or so later, in 1948, *Filmkultúra*, that Balázs uses the phrase 'visual music' three times, each with a slightly different conceptions and meanings and contexts. The book was translated into English by Edith Bone, posthumously in 1952, as *Theory of the Film*; *Character and Growth of a New Art* (Balázs, 1948, in Bone trans., 1952).

In the chapter on 'Editing' and in the section on 'Musical and Decorative Rhythm in Cutting', he uses the 'visual music' phrase to describe the rhythmic effect of montage editing as being both parallel and independent of the dramatic content. Here, he compares the content and the arrangement of shots through editing and assembling in time to musical structures and languages, such editing, in this instance, being compared to a 'good symphonic structure' and musical rhythm is decorative. This conception of visual music, then, has to do with the arrangement and editing of shots in a film and is less about an abstract style and approach to the content of the shot. Indeed, this arrangement of shots is a type of *formal* visual music in relation to the structure of the film and is not about its content, as Balázs explains:

> An important artistic part may be played by a kind of editing which has little to do with the dramaturgic aspect of the contents of the film. It does not increase the tension of sequences, does not express internal, emotional storms. It has merely formal, musical, decorative significance. But this is a great deal. Shots of landscapes, buildings, interiors can by cutting be given a certain irrational interrelation, like melodies in a good symphonic structure. Such musical or decorative rhythm may play an important part if combined with dramatic content. But it is dwarfed into

nothingness if the attempt is made to separate it and endow it with independent life. The avant-gardistes and futurists made the mistake of thinking that such rhythms can become independent artistic means of expression of a special kind. Experiments in this direction led to abstractions such as were already mentioned in connection with symbolic angles and cutting. The shots in themselves lose their primary significance when they serve as material for rhythmic effects. What have the subtle changes and forms of rhythm in Walter Ruttmann's Berlin in common with the trams shown in the film? What have the shots of Montmartre streets in *Cavalcanti's Rien que les heures* in common with the legato-staccato of his cutting? From the viewpoint of rhythm these features are merely carriers of light and shadow, of form and movement. They are no longer objects at all. The *visual music* [author emphasis] of the montage is played in a separate sphere that is parallel to the content. (ibid., 133)

In a later chapter on 'Formalism of the Avant-garde', in a section entitled 'Abstract Film', he provides a more precise description of the abstract formal visual elements of the abstract film, referring to them as a visual music and acknowledging that such a phrase was one that was in common use by those who supported abstract films.

The striving for a 'pure style' finally purged the film of every vestige of life, just as logic carried to its final conclusions makes nonsense of all human thinking. Eggeling, a Swedish painter invented the abstract film as long ago as 1917. Abstract shapes, circles, squares, waves, gratings, moving and changing outlines dissolved into each other, no longer depicting any object existing in reality and not resembling any natural object. They existed in themselves and for themselves and if they signified anything at all, they signified only themselves. What we saw were not the forms of life, but the liberated life of shapes, the dance, the rhythm, the mobile ornamentality of lines, planes and solids. Such a dance of shapes, which its adherents like to call *visual music* [my emphasis], could easily be linked with musical rhythms. There was no clash with the resistance of the laws of living reality, if circles and squares were made to move in perfect time with the rhythm of some piece of music. They were the creatures of the director and he could do what he liked with them. This great ease, and especially the utterly complete, residueless, precise solutions it permitted, would in themselves have sufficed to destroy all artistic credit of such a playing with form. There was nothing here of the redemption of the chaotic material of life by forcing it into shape at the cost of a struggle, as a result of which even the most perfect form still retains a little of the raw tang of life. (ibid., 182)

Later, he questions the validity of the use of the phrase 'visual music' in depicting the expression of emotion in the use of abstract imagery in film, particularly in reference to film sub-titles. He argues that this is a misunderstanding of the meaning of abstraction and declares the use of visual music in this context as a false analogy with music. He understands 'abstract' to be 'a correlative concept' that has meaning in relation to the 'concrete' (of properties existing together) from which it is an abstraction, but there is no shape in a piece of music from which to abstract the emotion (ibid., 183). Thus, Balázs argues that:

For the sake of the completeness of epistemological analysis it is to be mentioned that the theoreticians who described this sort of abstract art [film sub-titles] as '*visual music* [my emphasis]' merely because it is not a presentation but a direct expression of emotion, were quite mistaken. They were mistaken, because 'abstract' is a correlative concept. It has meaning and content only when contrasted with the concrete from which it is an abstraction. For instance: the apple is spherical. The abstraction of this natural shape is a circle. But of what natural shape is music the abstraction. (ibid., 183)

Most painter-filmmakers quickly realized that the medium of film brought with it its own medium-specific techniques, challenges and possibilities. The more successful filmmakers, nonetheless, who experimented with abstract content, were the ones who were able to work with the unique possibilities of the new medium of film and to adapt to its new operative and instrumental means. A new class of artist began to emerge at this time, comprising those who were able to work or invent techniques to master and overcome the technical challenges of the film medium and new mediums as well as being able to exploit the integration of images and sound in film.

4.4.1   OSKAR FISCHINGER – VISUAL MUSIC IS BORN

Oskar Fischinger (1900–1967) was a filmmaker, painter, apprentice organ-builder, draftsman, and colour organ inventor. He built and designed many artefacts and devices for both experimenting and creating his films, and many have written about his historical contribution and pioneering efforts in the field of visual music (Moritz, 1974, 2004, Keefer, 2013, Mollaghan, 2015, Abbado, 2017 and many more). Fischinger, indeed, in contemporary discourse, is often referred to as the 'father of visual music' (Keefer, n.d.); first of all, on account of his virtuosity and skill in visual music expression, but also because of other broader types of relationship between music and image in his other inventions. A succession of filmmaker artists and scholars from the 1950s onwards acknowledge the influence of his ideas and works in their own practice. The efforts of the scholar William Moritz, the Iota Center, Fischinger Trust, and the recent Centre for Visual Music's curation of Fischinger's works at international art galleries and screenings have done much to give exposure to Fischinger's work. Keefer explains that Fischinger used various phrases such as '*optick music'* and '*augenmusick*' (Keefer, 2013, 164) to describe his work. He also used the term 'visual music'.

Fischinger met the critic Bernhard Diebold (see section 4.2.3) between 1919–21 when he was a member of the association of The Friends of Literature Club (Moritz, 2004, 3). Diebold admired a dynamics graph image that Fischinger had presented in a lecture at one of the club meetings and encouraged Fischinger to expand on the graph to focus on creating a visual music with the film medium (Moritz, 2004, 7). Moritz explains:

> As part of the Friends of Literature club's Shakespeare cycle, Oskar prepared a lecture on Twelfth Night [Was Ihr Wollt!] on 12 December. Instead of merely giving a talk of his analysis, Oskar drew five graphic charts which picture the dynamics of the dramatic action in abstract form; reading from let to right following a flow of lines, sometimes undulating gently, sometimes colliding thick and dark against a vertical barrier, sometimes swirling into a vortrex, sometimes breaking inot several parallel configurations. At the lecture, Diebold encourages Oskar to shoot these graphs on to film so that the time element could be built in – and suggested that they should become

abstract visual music, their own work of art, quite independent from the Shakespeare model that inspired them (ibid. 5-7).

Fischinger was also introduced to the absolute film work of Walter Ruttmann by Diebold when he accompanied Diebold to a private screening of Ruttmann's first abstract film *Lichtspiel Opus 1* in Frankfurt in 1921 (Goergen, 2013, 42). Fischinger spent some time perfecting methods for creating controlled and predictable abstract imagery. For this, he turned to designing his own inventions. One of these inventions was the 'Wax Machine', described by Moritz as follows:

> The 'Wax Machine' synchronized the blade of a guillotine cutting machine (the kind used to make ultra-thin slices of ham or cheese in a deli), with the shutter of a movie camera. Every time the machine made a slice, the camera would shoot one frame of the fresh surface exposed by the last cut. The resulting film showed a time-lapse cross-section moving through the wax block which, according to whatever configuration had been modelled into the wax, might depict representational or abstract movements .. [Rudolf Scheneider further explains] …If you began slicing away a hard-boiled egg starting at one end, you would see at first a white circle getting larger, then a yellow dot in its centre would begin to grow larger and larger until only a thing white line remained around the circumference of the large yellow circle, then the yellow circle would begin to shrink again, and the white circle to increase, until the yellow became a dot again and disappeared, leaving the pure white circle which in turn would grow smaller. (Moritz, 2004, 7)

Ruttmann purchased a licensing agreement for one of Fischinger's wax-slicing machines and he experimented with this device to create special effects and used it specifically for the 'Sorcerer's magic conjuring of the flying horse in the opening sequence' (ibid., 9) of Lotte Reiniger's 1926 film *Die Abenteuer des Prinzen* Achmed (The Adventures of Prince Achmed). Ruttmann moved away from working with non-objective content in film and instead developed a successful career in film effects and production. Arfini (2013) notes the significance of Fischinger's work in abstract film and says, that Fischinger took up where Ruttmann left off by investigating further the relationships between 'musical and visual formal organisation' (219) While Fischinger gained animation and special effect work in commercial animation film production companies in Munich and Berlin from 1927-35 (ibid., 44) he continued to spend time creating his own abstract films. In 1926, Fischinger was invited by the composer Alexander László to contribute some abstract films for László's *Die Farblichtmusik* (Colour-Light Music) performances using László's *Sonchromatoscope* colour organ projection system (see chapter 2 section 2.4.4.2). From 1926, Fischinger also went onto create film imagery for his own *Raumlichtkunst* (Space-Light-Art) multiple screen projection performances (Moritz, 2004, 12).

4.1.1.3 FISCHINGER'S STUDIE FILMS

Fischinger crafted a series of fourteen 'black-and-white musical-visual partnership' (Moritz, 2004, 210) between 1929 to 1934, that are known as his *Studie* films. These films used charcoal animation drawing techniques in which charcoal drawings on white paper are filmed and the positive/ negative image is inverted (Arfini, 2013, 219) reversing the drawings to white figures in

black background. For the later *Studie* films Fischinger's brother Hans also assisted with the productions. Moritz accounts for the state of play of these *Studies* and documents through his research, excavation and preservation work in relation to the details of the *Studie* films (ibid., 210-219) and particular pieces of music that played a part in the making of these films. Though as Moritz notes that these films also seem good when seen silent (ibid., 210) Except for *Studie Nr. 1*, for which Moritz could not ascertain what music it was intended for (ibid, 210), Moritz gives account of the music that was intended or was the basis for the animation of each of the other *Studie* films. The music that Fischinger used to set his animations too ranged from Spanish fandangos to Hungarian foxtrtos and Brahm's Hungarian Dances. These *Studie* film also traversed the transition from silent film to film with sound and the emergence of technologies and processes for synchronising sound with film. The sound-on-disc technique in which sound was recorded on a separate phonograph record and synchronised to the film projector was used in some of the Studie films, Three of the *Studie* films, *Studie Nr. 2*, ca 1930, *Studie Nr.3*, 1930, *Studie Nr. 4*, 1930, consisted of visual elements synchronized to recordings of music by the Gramophone company Electrola. The optical sound-on-film technique in which the sound is recorded onto optical soundtrack of the film was used in *Studie Nr. 13*, The music for this *Studie* was Beethoven's 'Coriolan Overture' (ibid., 219).

What is of significance of the visual content of the films is their formal study of shapes, lines and movements and that these were constructed and conceived in tandem with a specific music piece. It was not always easy for Fischinger to afford the music rights for the use of the music recordings that his films were based on, for example he had difficulties securing such rights for the music for *Studie Nr. 8* (1931) (ibid., 37). The *Studies* series of films were incredibly innovative for their visual music integrated expression. In them, Fischinger explored many formal ideas, where each study investigated one or other of these ideas. Fischinger writes in 1930 about his intentions for working with subsequent *Studie* films:

> This time it will not, as hitherto, be music that is transposed into pictorial form; that was just the beginning, a makeshift effort. Now I am going to start exploring in greater depth the mathematical order and optical laws of the absolute image. Since these laws are in keeping with acoustics, the result will be a space-music. The process — set out in a precise timetable — will involve tracing musical values and curves on graph paper. Then, at every phase of the work, I will play the relevant phrase. It is my aim to make absolute film theatre-worthy. For I am firmly convinced that there is still much that is new and beautiful to be discovered in this area. (Fischinger, 1930 in Goergen, 2013, 44-45)

Fischinger's *Studies* series of films were well received at the time, both in Germany and internationally, inviting such appraisals as: 'the forms in these films are revelations; sound and images have melded into a single, eternal entity' (Eisener, 1932 in Goergen, 2013, 46).

Thus, as Arfini notes:

The new technology of the soundtrack stimulated a stricter synaesthetic relationship between moving images and music. Fischinger attempted to create a 'visual music' perfectly correspondent to the music synchronized to it, from a formal and synaesthetic standpoint. (Arfini, 2013, 219)

4.1.1.4 VISUAL MUSIC IS BORN

Fischinger moved to the United States in 1936. According to Elder, '[W]hen Fischinger and his wife Elfriede moved to the United States in 1936, the abstract film moved with them, and became known in artist circles through the support of Hilla Rebay' (Elder, 2008, 164). Fischinger initially worked for Paramount Pictures, and MGM, and designed an animation sequence for Disney's *Fantasia* (1940) (Guildemond *et al*. 2013, 10). He created several films in the US, and had some support from the Museum of Non-Objective Painting, now called the Guggenheim Museum, to make his film 'Motion Painting No. 1' (1947). Keefer, however, provides evidence for Fischinger using the term 'visual music' too to describe his work. In the 'Foreward to the Invitation Preview of the Representative Work of Oskar Fischinger' in 1948, for example, he appeals to this phrase to explain how his painting ['Motion Painting No. 1'] designated a deep feeling similar to the kind one might get with good music. Fischinger states:

> In Motion Painting Number One, for the first time, visual music was born, creating that deep, emotional, almost pleasurable feeling (as we know it) that we get from good music. (Fischinger in Weinberg, 1948 in Keefer, 2013, 166)

In the same Forward by Weinberg, Fischinger shares his views on 'films potential to achieve properly musical effects' (Keefer, 2013, 165), noting that in this art,

> This art emphasizes the effect of music. It is to music what wings are to birds. Figures and forms have a definite effect on the consciousness. When they are in colour the effect is emphasised. The staccato movement of rows of geometrical figures on the screen will get the same reaction from a person as the staccato sounds from a musical instrument. (ibid.)

Later, in an unpublished and undated typescript of an interview Fischinger had with Bert Reisfeld (c. 1950), Keefer draws our attention to Fischinger's intentions and expectations in his work to configure movement and create a visual music. Fischinger explains:

> What always interested me about film was the possibility to draw and paint movement, configure movement, develop graphic lines, dots and shapes in movement, exhibit them, change them, give them expression, let them voice feelings, give them their own life, let them entertain, so to speak. I managed with the help of Trickfilm Technik [sic] to give my thoughts expression and give life to lines. On thousands of white paper I drew lines, which changed from paper to paper and then in film on the screen resulted in a fluid overall movement … I expected through incessant work and study … to bring graphic concerts to the screen. In other words, I wanted to create visual music … I believe that I've been successful in considerably contributing to the creation of a new art form, of which developmental possibilities today are still completely overlooked. The meaning will most likely be able to be for the first time fully and entirely captured by later generations. (Fischinger interview with Reisfeld, c. 1950, in Keefer, 2013, 166)

Fischinger's work had far-reaching influences on the developments of abstract film in America. William Moritz notes that he was responsible for the development of a California visual music scene, influencing Jordan Belson (1926–2011), who went onto create the Vortex concerts with sound artist Henry Jacobs (1924–2015) and Harry Smith (1923–1991). As Walter Schobert (2003) remarks, in today's terminology, we would call this visual and music expressiveness and unity in his work a visual music.

> Unlike the other pioneers, Fischinger consistently based his work on sound, … His contribution to the avant-garde can be summarized as the repeated attempts to provide the adequate cinematic forms for standard popular or classical music, to transpose music into movement, form and colour: in current terminology he sought to create 'visual music.' Thus Fischinger was the forefather of a movement which spawned the productions of the Whitney brothers and other members of the American West-Coast avant-garde, as well as today's video clips and computer animations. (Schobert, 2003, 237)

Indeed William Moritz (1941–2004) had framed much of his discussion of Fischinger's work and others, as being that of a 'visual music'.

4.4.2 WILLIAM MORITZ AND CALIFORNIAN VISUAL MUSIC

William Moritz (1941–2004) was a film historian, filmmaker, curator, critic and author who wrote extensively about animation, film and visual music. He has contributed extensively to the field of visual music and used the term 'visual music' many times in his writings to describe various works in the film medium by several authors. Moritz taught film and animation at several Colleges in the US, including CalArts in Los Angeles, California. He was actively involved in the preservation and promotion of films, and was a member of several filmmaker clubs and groups. He is also one of the founding members of the Center for Visual Music (CVM), which holds his research collection.

Moritz wrote a biography on the filmmaker Oskar Fischinger, which he entitled *Optical Poetry. The Life and Work of Oskar Fischinger* (Moritz, 2004). This was the result of over thirty year's research with the Fischinger estate (Keefer, 2013). Moritz had been long aware of Fischinger and other filmmakers work in his writings about visual music and experimental film, and had drawn attention earlier to Fischinger as being 'the foremost influence on the development of visual music in California' (Moritz, 1996, 224). Through his research into Fischinger's life's work in film, colour music, painting and technical devices to create abstract imagery and colour performances, Moritz documents for us Fischinger's beliefs from the time of his early period of artistic activity in Germany, where Fischinger 'purposely refused to paint since he believed that kinetic abstraction — visual music — would be the art of the future' (Moritz, 1996, 225) to Fischingers work in the US. Fischinger, who was proficient in many mediums, was well placed to observe and notice the changes in art from medium to medium, and yet to notice the salient

and general feature of this new art. Moritz notes that Fischinger's earliest abstract films were synchronized to 'phonograph records and live musical accompaniments' (Moritz, 1977, 25/65).

Moritz situates Fischinger's films in the context of the emergence of the European 1920s film outputs that explored a non-objective content in film (Moritz, 1998). When Fischinger moved to America from Germany in 1936, and subsequently developed his career and art practice there, Moritz identifies Fischinger as a significant influence on other US based artists and filmmakers at the time, remarking that,

> Fischinger's presence in California fostered a school of colour music, which included three young men, Harry Smith, Jordan Belson and James Whitney, who knew Fischinger and each other, each of whom forged a personal style and created a dazzling body of work rich in intricate visual nuance and spiritual expression (Moritz, 1998).

Moritz also identifies what he calls a 'Californian visual music school of filmmaking' and credits Fischinger as being 'the foremost influence on the development of visual music in California' (Moritz, 1996, 224). He credits this school of 'visual music' as being one of the 'finest achievements of modernist California' (ibid., 223). The great masters that Moritz associates with this California visual music school are, Oskar Fischinger, Harry Smith, James Whitney and Jordan Belson (Moritz, 1998b). Moritz wrote monograph articles about the prominent filmmakers in the region in this genre accounting for their approaches and activities pertaining to experimental filmmaking.

Moritz's studies, of course, took him beyond the locality of California. He also researched and wrote about a number of film topics, such as, for example, the historical precursors to visual music in the colour organ and colour music traditions, absolute film, modernist art, integral cinema, and non-objective film. In his discussion of visual music, Moritz includes several other artists, inventors and filmmakers, both historical and contemporaries of his time, including: Viking Eggeling (1880–1925), Dudley Murphy (1897–1968), Norman McLaren (1914–1987), Len Lye (1901–1980), Hy Hirsh (1911–1961), Sara Petty (b. 1947), Larry Cuba (b. 1950), MTV rock videos, the colour organ inventors, Mary Hallock-Greenewalt (1871–1950), Thomas Wilfred (1889–1968), Charles Dockum (1904–1977) and Charles Blanc-Gatti (1890–1966).

Moritz's major contribution, then, is that he demarcated the field of visual music by bringing forth the connection between the European avant-garde filmmaking of the 1920s and 1930s and the film practices in California in the mid twentieth century, to which Oskar Fischinger belonged. The growth of an abstract filmmaking practice that, like Fischinger, engaged with the non-objective content of film in creating films that worked well with either a synchronised sound track or as a projective backdrop for music performance, he attributed to Fischinger's influence.

In his 'Non-Objective Film: The Second Generation' (1979), Moritz uses the visual music phrase to describe filmmakers who follow the style and approach of Viking Eggeling, which he calls the 'Eggeling tradition of classicist visual music'. By this, he meant a peculiarly European visual music whose origin lies in the film work of Eggeling. Moritz's demarcation of the early film by Eggeling has had considerable influence on subsequent histories of visual music since, as we look to that period of European film containing works by Eggeling and Eggeling's contemporary filmmakers as being the precursor and pioneering artists for a visual music and, in particular, for the beginnings of a visual music film art. The term 'visual music', however, was not a term used by Eggeling or by those early filmmakers to describe their films. As an origin of a particular type of filmic art, such as what visual music came to be associated with, it is nonetheless quite fitting to identify an Eggeling tradition. The European artists and filmmakers whom he suggests follow this Eggeling tradition of classicist visual music are: Blanc-Gatti, Robert Breer, the Conrads, Peter Kubelka, Paul Sharits. In this article, however, he also points to the film 'First Fig', 1974 by American filmmaker Larry Cuba, who at that time had used computer programming to produce films on a computer as being part of this Eggeling style of content. Cuba's work is described as using computer programming 'which allow simple geometric forms to modulate, overlap and interlace in clear and complete sequences that unfold at a generally serene tempo, delighting by the purity of their mathematical cadence' (Moritz, 1979). The author has also seen some of Cuba's work screened and was likewise struck by the elegance and precision of Cuba's forms and modulations of forms across the screen space and their modulations and changes and also compared them to Eggeling's forms in his 1925 film *Diagonale Symphonie* (Diagonal Symphony).

Moritz often compares these European films, sometimes unfavourably, to what he perceives to be the better film work by Fischinger or the American visual music filmmakers. He presents, for example, a succinct statement on the visual music connection in the Swiss painter Blanc-Gatti's art works, whom he considers to follow the Eggeling and thus classicist visual music, but whose film '*Chromophonie*' he describes as being 'based on the principle that each tone of music ought to have a single, consistent colour in the spectrum'. He then goes onto criticise the film's poverty of movement and remarks that Blanc-Gatti was unable to deal with the depths that are in music, compared to Fischinger, because:

> His [Blanc-Gatti's] animation, tightly synchronized to a gladiators' march, closely resembles Fischinger's Art Deco designs for *Allegretto* (which the Swiss artist could not have seen), but the insufficiency of Blanc-Gatti's theoretical assumption is mirrored in the film's poverty of movement: a stylized trumpet may emit a ray-wedge of red, but after that it often has nothing else to do. Music has depths Blanc-Gatti was unable to deal with, but his film is amusing and interesting none the less. (Moritz, 1979)

Moritz also describes the movements of the dots in James Whitney's 'Yantra' (1957) and 'Lapis' (1966) films as a visual music:

> The repeated accelerating flickers between black and white or solid colour frames photo-kinetically induce an alpha meditative state. Into the climax of these generative alternations of spectral opposites, the dots enter and enact movements which are as carefully 'choreographed' in the sense of purely visual 'music' as had been the imagery in the FILM EXERCISES, including variations, inversions, harmonic and contrapuntal balances and imbalances, etc. (Moritz, 1977b)

The surface of the cinema screen is described as being the space from which the exposition and evolution of the material processes as a result of James Whitney working the emulsion of the film to create flickers, transparent backgrounds and scratches:

> The screen is scrupulously sustained as a flat expository surface, and a reflexive consciousness of the film material process is maintained by the use of flickers, transparent/white backgrounds, scratches, and solarized, step-printed episodes, in which the hand-wrought, irregular textures also recall (for those familiar with this background information) both James' expertise as a raku potter and the Alchemical processes of transmuting elements, in this case the coloured chemicals of the film emulsion by the 'solar' Fire. (ibid.)

Moritz takes into account of the influence of several art cinema clubs operating in Los Angeles, from the 1940s onwards, that helped to foster and promote creative and experimental film showings and dissemination as well as inspire artists and filmmakers to take up cinema as an art. The Art in Cinema festivals, organised by Frank Stauffacher, began in 1946 and ran until 1950. John and James Whitney's films were shown, as were Oskar Fischinger's. These screenings were to have considerable influence in inspiring two painters to become involved in abstract filmmaking, such as Jordan Belson and Harry Smith. Moritz is one of the most significant authors in the twentieth century to utilise the term 'visual music' frequently in his writings and is one of the first to point to the field as a distinct activity of practice.

4.4.3 LEN LYE – COMPOSING MOTION IN THE FINE ART FILM

Another filmmaker who like Fischinger worked with a range of mediums, devices and techniques to realise his art is the New Zealand born artist Len Lye (1901–1980). Lye was also based in London, UK (1926–1944) and New York, US (1944–1980). The overarching feature of all his artwork was his interest in exploring movement in art (Horrocks, 2010, 67). He created paintings, animations, kinetic sculptures and abstract films. Lye also wrote both poetry and formal essays on art and film-making. In each of these art forms, the idea of movement and motion were at the core of his work. Roger Horrocks explains how Lye's idea about motion was linked to the changing pattern of light in nature and with Lye's interest in Impressionism in painting:

> His idea linked up with the Impressionists and their interest in the changing patterns of light and the uniqueness of every moment; and it could also be related back to English Romantic writers such as Wordsworth with their sense of 'a motion and a

spirit' that permeated nature. But Lye's approach went a step further by focusing on specific patterns of movement. (ibid.)

Drawing motion was a problem to be solved, and such was Lye's interest in motion, that he spent some time developing movement notations from sketching everyday activities (ibid.). In an article entitled 'The Art That Moves', reprinted in an edited volume of Lye's selected writings *Figures of Motion* (Curnow & Horrocks, 1984), Lye designates kinetic art as a new category of art (ibid., 78), conceiving it as a cross between painting and sculpture. The important aspect of this art for Lye was the 'kinesthesia' of the felt motion and our sense of motion in the body. He refers to this bodily aspect of motion as being the 'gifts of the Muse of Motion' (ibid., 79) and compares this art of motion in kinetic art to be equivalent to the aesthetic qualities of sound in music. Referring to these art works as compositions, he notes that 'in kinetic art, we have begun to compose motion' and we 'project our bodily sense of motion beyond the aesthetics of dance by composing three-dimensional motion sculpture, and by editing the sequential composition of motion in the fine art film' (ibid., 78). From our bodily experience of motion, he goes onto explain that:

> This kind of kinetic imagery can now be transposed into formal figures of motion by the kinetic artist. He does this in a similar vein to the composer transposing sound into musical figures. (ibid., 79)

With each abstract film that he made, he worked on developing skills to synchronise images to music. He was especially interested in working with Jazz music and dance music. His films comprised moving abstract forms and they suggest a form of dancer-less dance (Perrott, 2013, 5) in which the line and its movements is akin to the body making marks and patterns with its movement. Lisa Perrott describes his use of the formal element of the line:

> Particular elements of the abstract mark-making (such as lines, points and patterns) are choreographed in rhythmic interplay with the dance sound track. Recognising the gestural qualities and potential bodily affect of mark-making, Lye describe this dance of abstract forms as a 'sensory ballet'. (ibid.)

For example, the film, *Swinging the Lambeth Walk* (1939) was set to the popular dance titled, 'Lambeth Walk'. Lye combined several different jazz versions of the music (Lenlyefoundation.com, 2018). Horrock's describes the kinetic effect of Lye's use of line in the imagery for this film and his treatment of the line in association with the music instruments and rhythms in the soundtrack, remarking that Lye 'learned to do many things with it [the line], such as make it sway, wriggle, jump or glide' (Horricks, in Perrott, 2013, 6). This use of 'the line' also evoked 'the vibration of a twanged string', with 'vigorous' movements, and 'twangs and stomps' (ibid.). The film was synchronised to the music, by using direct painting on film techniques in combination with an optical printer to create layers of imagery and colour mattes (see Figure 35).

Figure 35 Len Lye, *Swinging the Lambeth Walk*, (1939), frames from the film.

Lye co-authored with Laura Riding, the essay 'Film-making' (Lye & Riding, 1935). The essay deals with two main standpoints in relation to the role of movement in film which are: movement can be conceived of as a language and movement could be conceived of as a medium.

4.1.1.5   MOVEMENT AS LANGUAGE

Lye and Riding write that the 'language of cinema is movement' (ibid., 40). In film, movement is the most significant meaningful aspect of form, but there is problem here because to think in terms of a shape of a form is to take something that is already fixed in its truth or literal meaning, and not a product of its movement. Thus Lye and Riding suggest that it is of importance to think of shape as having arisen in the film as a result of an after-life of a movement. Therefore, 'the result of movement is form' (ibid., 39).

For Lye and Riding, then, the meaning of form is to provide 'life-signs', and not 'truth signs', and since they consider movement is a language of life, to conceive of form as movement is to conceive of form as life, not truth.   In this regard, they are wary of making movement a literary language because '[M]ovement is unpremeditated being; it is the uncritical expression of life' (ibid.). It 'is [rather] strictly the language of life' (ibid.).

4.1.1.6   MOVEMENT AS A MEDIUM

When it comes to identifying the significance of movement, Lye and Riding draw our attention to the fact that once we recognize or take pleasure or dissatisfaction in the marks of a physical shape, that shape is already the 'mental after-life' of the shape and meanings have already been attributed to the movement.   Thus the significance of movement for people is not the 'post-physical significances' of the movement, but that people are 'movement-conscious' because they are 'more sensitive to physical immediacies' (ibid., 40).   The mind is what gives the shape, but the movement has come before the shape.   They conclude, therefore, that '[M]ovement is the

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simple compulsion to live' (ibid.). The movement is a life-manifestation. Life-manifestations can make pleasure or displeasure, but once we get to pleasure/displeasure, we are at the stage of meanings' (ibid.). This life-manifestation characteristic of movement can be used as a criteria for the judgement of a movement. So the question arises: 'Does the movement result in 'a variety of life-manifestations?' (ibid.). The authors note that there is not a tradition of physical judgement to guide us into a discussion of movement. So, the authors have to rely on what they call a self-conscious description of the terminology for judging movement.

The authors talk about movement self-consciously and in an effort to find an appropriate terminology, they make some descriptive statements: form in movement design is the total effect of the design; the physical immediacy of movement is found in the body; consciousness of movement, or a sense of movement is the receptive, passive 'sensing of the vibration pattern' (ibid., 41), and movement precedes consciousness just as physical precedes mental. From a natural science standpoint, nothing physical such as light, colour, sound, atoms, exist in a static state; rendering movement where movement is time. Film is a good medium for 'the isolation of movement' (ibid.) as it provides a record of time, and so, sound and movement 'are equal in *timing* [as] they can be balanced with accents and silences in film' (ibid., 41/42, my emphasis). Lye and Riding's theories on the role of movement and film are quite extraordinary, and since the elements of time and motion are at work in much visual music work, their idea of 'movement as form' is a noteworthy one for contemporary practitioners and theorists on visual music.

4.4.4   NORMAN MCLAREN – THE MEASURE OF MUSIC IN EXPERIMENTAL FILM

A filmmaker that followed in some of Lye's footsteps as both had worked for the same UK General Post Office (GPO) Film Unit, albeit at different times, and both were interested in the aesthetic and technical aspects of motion in film, is that of Norman McLaren (1914–1987). McLaren was an experimental filmmaker and animator. He studied art at the Glasgow School of Fine Arts, and it was while at college he started to work with film. He made educational films at the GPO and became acquainted with the work of Len Lye while working there. He moved to the United States in 1939 and started to work on educational films at the National Film Board (NFB) of Canada in 1941. The NFB enabled a significant amount of creative freedom; so, it was here that McLaren was able to experiment with techniques in animation and abstract film and, alongside his work for NFB, became recognised as an animation and experimental film artist (Sexton, n.d.). It was in his position in the NFB where he had access to resources that he perfected his techniques and experiments with animation, sound and experimental film. McLaren had an immense interest in the connection between animation, experimental film and music, and explored a number of methods for creating images and sounds by means of animation and the camera.

McLaren had substantial knowledge of musicianship. He learned music theory, piano and violin as a child. Later, he developed a keen interest in the structure and composition of music, in jazz, popular music, folk music and classical music (McLaren, 1968 in McWilliams, 1991, 29). He lamented, nonetheless, of his lack of further knowledge about music so that he could compose music, as he would have liked to have made more music for his films. He did, nevertheless, perfect some direct sound on film and synthetic sound techniques by film that he used to 'make' music for some of his films, for example, in the films 'Synchromy' (1971), 'Mosaic' (1965), and 'A Chairy Tale' (1957). McLaren also worked in close collaboration with musicians and music composers, such as the music composer Maurice Blackburn in the films 'Begone Dull Care' (1949), 'A Phantasy' (1952), 'Blinkity Blank' (1955), 'Lines-Vertical' (1960) and 'Pas De Deux' (1967). McLaren also worked in collaboration with other filmmakers, animators, and skilled camera personnel, musicians, composers and cinematographers at NFB. In particular, he worked regularly with Evelyn Lambert and Grant Munro and worked as an animator for Mary Ellen Bute's films 'Spook Sport' (1939) and 'Tarantalla' (1940).

4.1.1.7 MUSIC AS SCRIPT FOR FILM

McLaren was interested in the experimental short film 'which doesn't use words' (McLaren, 1974). Many of his films are crafted from an interplay between evolving a new or old technique and evolving the subject-matter for the film. This technique and subject matter influence the final film. In the National Film Board of Canada., & Learning Corporation of America documentary 'The Eye hears, the ear sees' (1971), McLaren is interviewed about the techniques he uses in his films. McLaren explains that it important to him that there is a technical challenge as it can trigger him off, where he has to investigate the technique first – and then find the subject matter. Several films that were technique led are discussed. He conducted early experiments with removing the emulsion from 35 mm film and painting directly onto it. He was not aware of Lye's work at this time but did come to get to know his work later. For this first direct film experiment, he explains the excitement this created for him: 'I got dancing colours and shapes when it was projected, and I was very excited by this … It was an interpretation of the spirit of the music' (ibid.). For another film, 'La Poulettte Grise' (1947), he thought of a technique of using a series of dissolves of varying stages of a pastel drawing in order to solve the problem of the workload that would entail for creating an animation for a slow piece of music. For the film 'Blinkity Blank' (1955), he discovered that if he left 10 frames blank between drawing shapes, that there was still a continuity of action, even if the shape was changing form and moving position, the relationship showed up even if there were blank frames. In this way, he describes his process as being improvisational: 'I always leave as much room as possible for improvisation during the movie-making process; have never used a script; only keep a skeletal idea of the whole film in my head' (McLaren, 1974).

Although McLaren says he does not use a script, the planning and meticulous processes that he evolves are apparent in each film he made. Regardless of technique or subject matter, however, music for McLaren was a central concern in his filmmaking. He explains that for many films, he does not explore a theme, but this is not the case when music is the starting point for the film, what he calls 'when music is the growing point' (ibid.). Here, the theme (music theme) comes before the technique. In this case, it is music that guides him in the making of the animated images and the combining of the motion of music and images. He writes:

> when my excitement about a particular piece of music propels me into trying to convey the spirt of that music on the screen, by means of shapes, forms, colours and especially movement. To me, the most powerful common denominator between abstractions on the screen and music on the soundtrack is their motion. (ibid.)

And even later when he turns from away from direct, animated and abstract films, and to 'live-action subjects with human interest' (ibid.), McLaren informs us that 'I still feel the need to keep exploring the as yet untouched technical possibilities of the movie and optical cameras. And, I shall still feel the need to have an over-riding concern with the music of the film' (ibid.). Being both a visual artist and musician before he worked with film, McLaren is well placed to make the following observation that, '[I]f a person's a static artist and a musician, the chances that he or she will be an animator is much higher, because he's [or she's] interested in motion' (McLaren, 1968, in McWilliams, ed., 1991, 29). His musicianship, nevertheless, enabled him to see that for him animation is the same kind of thing as music. Thus,

> [T]he whole flux and flow of what's happening [in music]. Music is organised in terms of small phrases, bigger phrases, sentences, whole movements and so on. To my mind, animation is the same kind of thing. (ibid.)

Holly Rogers concludes that McLaren's approach to the relationship between music and image was to explore a crafting of that music and image simultaneously.

> McLaren's interest was not in the seamless accompaniment of moving image with music, nor in the gap that opens up when the visual and the sonic are placed in clashing formations. Rather, he was fascinated by the ways in which music and image could be created simultaneously, the ways in which they could generate each other and coexist onscreen. (Rogers, 2014, 70)

In this regard, what McLaren was trying to achieve could be called improvised visual music on the film screen. His concern for improvisation — arguably emanating from his experience of jazz music — appears to have carried over both in his visuals and music in a non-syncretic fashion as a visual music artist and in a visual music art form. This is clearly fully realised in his collaboration with the jazz musician Oscar Peterson in his film 'Begone Dull Care' (1949) (see, following section).

When music was the starting point for his films, McLaren developed meticulous methods to examine the music for his film. Music was used as a form of script, as it were, in the preparation for the visual part of the film. One of his methods was to record the soundtrack and then to examine the soundtrack on the filmstrip, taking note of beats and phrases and using the frame counter of the film to measure the distances and durations of beats and phrases, and other music events, translating these into how many frames. He explains this method used for analysing the soundtrack of the film 'Boogie-Doodle' (1940), before he created the visuals for the film.

> The soundtracks were recorded prior to the visuals. For synchronization, the soundtrack was then threaded on the sound head of a moviola with blank leader on the picture head. With both running interlocked (often at slower than normal speed) the musical beats, phrases and sentences, were tapped out on the blank leader with grease pencil. The leader was then run through a frame-counter and the distances in terms of frames between grease pencil marks measured as an accumulating total, from which the number of frames between each beat could be derived. These measurements were written down on a 'dope-sheet' which provided all information necessary for synchronization (where needed) of the visuals with the sound. This is, of course, one of the usual standard practices for synchronizing animation to pre-recorded sound track. (McLaren, 1985 in McWilliams, 1991, 59)

Because McLaren was measuring the music events in terms of frames and setting up a script via a 'dope-sheet' to mark the necessary synchronisation of the film, he was able, in a very precise way, to use the music as the temporal structure for the film.

In the film 'Begone Dull Care' (1949), McLaren worked closely with the famous jazz pianist Oskar Peterson, who played double bass and percussion for four days in evolving the musical structure and details for the film. Again, in this film, a very precise method was used by McLaren to examine the music and to use the music as a script for the film (see Figure 36).

> The music was measured, note by note, phrase by phrase. The measurements were transferred to a 'dope-sheet' which charted the music on paper. The measurements were numbered, and these numbers were marked on the 35 mm celluloid, between the sprocket and along the edge of the film. (McLaren, 1949 in McWilliams, 1991, 82)
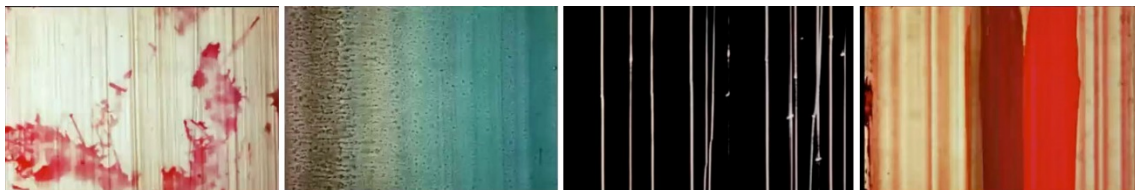
Figure 36 Norman McLaren, 'Begone Dull Care' (1949), frames from the film.

McLaren made his own synthetic sound music for some of this films to accompany his animated films. McLaren was familiar with the synthetic sound on film experiments that took place in

Germany and Russia in the early part of the twentieth century and wrote an short essay on the topic, titled 'A Brief Summary of the Early History of Animated Sound on Film' (1952). In this writing McLaren refers to authors who foresaw that there could be a direct writing of sound such as Moholy-Nagy and Ernest Toch. He also mentions that he read the papers of the experiments done in Russia at the Scientific Experimental Film Institute in Leningrad by A.M. Avxaamov in 1930, which was later continued by G.M. Rimsky-Korsakoff and E.A. Shcolpo. He mentioned too the work carried out in Moscow by B.A. Yankovsky and N.Voinov. The work by the German electrical engineer Rudolf Rfenninger was also discusses and mentions Rfenninger's documentary film made in the 1930s titled '*Toenende Handschrift'*. Oskar Fischingers photographing of geometric shapes onto the soundtrack is mentioned as too is the experiments of English filmmaker Jack Elliot in 1933 ending with the Canadian support for developing a system of animated sound that McLaren himself was working on.

McLaren produced optical and synthetic sound by various methods, but all involved the shooting of various shapes onto the soundtrack of the film so as, when played back by the projector, the sound is synthesised. McLaren writes of one of his methods of animating sound with the assistance of Evelyn Lambart, by what he calls the card method in 1952.

> Around 1950, Evelyn Lambart and I worked out a method of shooting soundtrack optically on film, without using a microphone or regular sound system, but with the use of an animation camera. We called it 'animated sound,' because it was shot frame by frame, onto the soundtrack area at the edge of the picture. (McLaren, 1984 in McWilliams, 1991, 91)

Using shapes and stripes of varying heights, widths, and edges, he was able to build a library of pitches with the cards and to control pitch and volume. For example, to synthesise a square wave sound, he used hard-edged stripes. This method enabled McLaren to create synthetic pitches and various timbres, but mainly creating sinewave and square wave sounds. McLaren describes the library of cards:

> For pitch control we used a set of 72 cards, each having stripes or striations, and each representing a semi-tone in a chromatic scale of six octaves. The more stripes the higher the note, the fewer the stripes, the deeper the note. Our first set of cards (with which the music for Neighbours was made) had soft-edge undulating stripes, corresponding roughly sine-wave sound. A later set of cards had simple hardedge black-and-white stripes, corresponding acoustically to square-wave sound. It is with the square-wave cards that I shot the music for Synchromy. (ibid.)

Volume was controlled by varying the width of the soundtrack and interacting with the shutter of the animation camera, thus facilitating different amounts of light to affect the width of the track and thus affect the volume of the sound (see Figure 37).
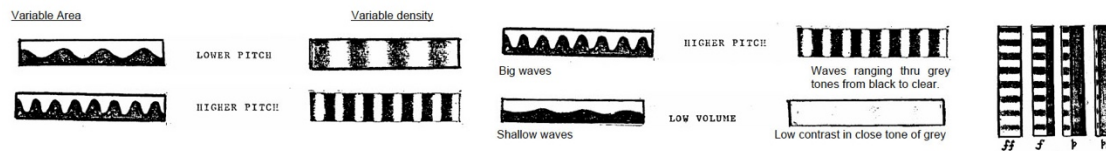
Figure 37 Norman McLaren - Animated Sound - Card Method in Variable area or Variable density optical sound track: L-R: The Pitch – Lower Pitch and Higher Pitch on Variable area or Variable density optical sound track (McLaren, 1952 in NFB, 2006, 62); The Volume – Big waves in Variable area or waves ranging through grey tones from black to clear in Variable density (ibid.); 'Volume control narrowing the width of the track by a black mask or shutter placed above the card' (ibid., 65)

McLaren explains:

> The volume was controlled by varying the width of the soundtrack. A moveable shutter controlled this width. If the shutter was almost closed, the extremely narrow band of striations would give a pianissimo note. If the shutter was wide open, the broad band of stripes would give fortissimo. All intermediate degrees of volume were possible by regulating the position of the shutter, which was calibrated in decibels. (ibid.)

McLaren also used envelopes and more complex shapes for the purposes of affecting the tone quality and timbre of his animated synthetic sounds (McLaren, 1952 in NFB, 2006, 63-69). McLaren used 'animated sound' methods in the music for the film 'Synchromy' (1971). He explains that, after creating the synthetic sound track by means of the animated sound card method, he used the same shapes that were used to create the sounds to make the visual part of the film. This ensured that they represented exactly the same shape on the soundtrack that was generating the music.

4.4.5   HENRI VALENSI – MUSICALIST CINEPAINTING

In many respects, the abstract painter's concerns with concepts of rhythm, chromatic sequences of colour, the autonomy of line and form, dynamics, simultaneous colours and forms, speed and musical forms, such as, polyphony and fugue 'were basically directed towards opening visual art to time' (Maur, 1999, 44, Elder, 2008, 4). Within the arrival and development of the film medium, these concepts were still explored but with a new dimension of time that was made available through film technology and new artistic uses of concepts such as movement and transformation. By creating images with film or video, one was no longer involved with paint and painting in its physical conditioning of a canvas, material surface, and paint, in a painting, but one could still be involved with painting in a metaphorical sense, as when Ruttmann, for example, described his experiments with film as being a form of 'painting with light' in his manifesto 'Painting with Light (1919). Henri Valensi (1883–1960) was a painter who was interested in the connections between colours and musical tones. He made a film '*La Symphonie Printanière* (Spring Symphony)' in 1959-60, which was based on an earlier canvas he painted in 1932. He called this

form of art '*cinepeinture* (cinepainting)'. He first explored movement in this painting and then, over the period of nearly thirty years, made this film-painting of 64,000 coloured sketches (cinepainting, n.d.) on transparent celluloid frames (see Figure 8).

Valensi conceived of an artistic approach in painting and doctrine called 'Musicalism', and along with Charles Blanc-Gatti, Gustave Bourgogne and Vittorio Straquadaini, founded the Association of Musical Artists in 1932. One of the central tenets of these 'musical artists' was their view of colour as vibration and that the painters' task was to seek to arrange colours and shapes in the space of the canvas in an analogous way to how a composer arranges sound material in a music composition or a musician might express the sound material.

It is interesting to note that in a similar vein to some of the early colour organ inventors, who were also painters, several painters also explored the possibilities of the instrument of film to extend the experiment with non-objective art. Eggeling and Richter moved from exploring musical ideas and structures in large scale horizontal and vertical scroll paintings (see Figure 38) into the temporal rendition of articulated movement of non-objective forms in the film medium. There are many more as we will come across in this chapter, but it would seem to be the case that the art movements in operation at the time, such as Cubism, Dadaism, Divisionism, Surrealism, Synchromism and Futurism were as much an influence on the artist-filmmaker as they were on the painter.
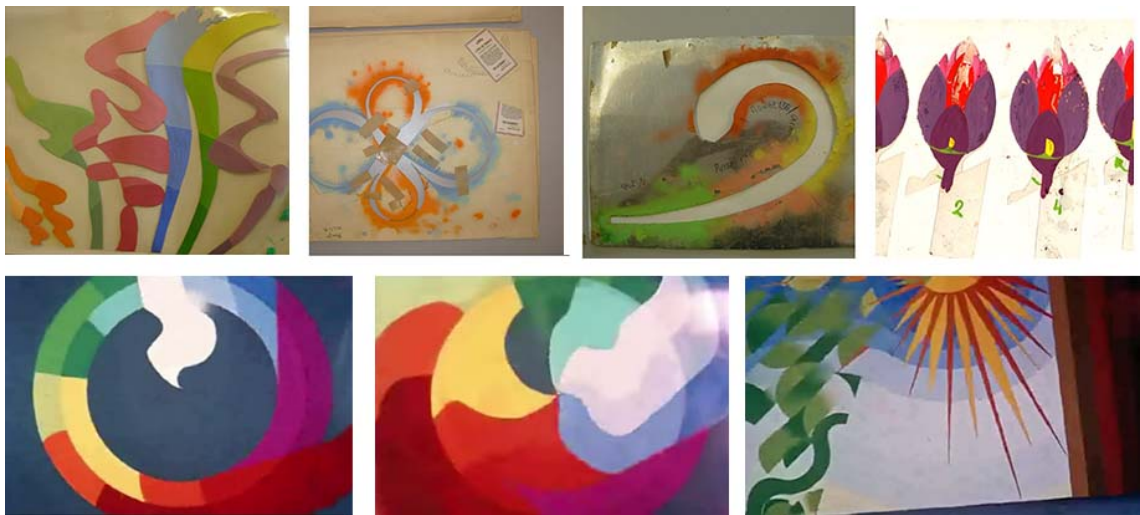
Figure 38 Top row: Celluloids from Valensi's cinepainting 'Spring Symphony', 1959 (cinepainting, n.d.) Bottom row: Frames from Valensi' cinepainting film 'Spring Symphony' 1959.

4.4.6   The Soviet school of light-music film

A significant contribution to the development of abstract film, colour music, and the building of instruments to explore music, light and colour as well as visual music took place in the Soviet Union spearheaded by the work and of Bulat M. Galeyev. One could argue that this contribution entails the designation of a Soviet school of light-music film and visual music.

4.1.1.10   Bulat M. Galeyev

Bulat M. Galeyev (1940–2009) was a physicist, researcher, artist, filmmaker and a promoter of the art-science community in the Soviet Union. He was also involved with the international community dedicated to the connections between art, music, science and technology. In 1962 Galeyev founded the SKB 'Prometei' group in Kazan.   It initially started out as an amateur student group and became a research institute named 'Prometheus' in the Kazan Aviation Institute, in the Soviet Union. It was commonly known as either the 'Prometei' group or the 'Prometei' institute. It was a research group collective comprising engineers, artists and musicians. Galeyev was head of the group from 1964–1995. The 'Prometei' group was inspired by other previous artists work on music, light, synaesthesia and colour music, and the synthesis of music and the visual arts, such as, by the Lithuanian artist/composer Mikhail Matyushin, whom, Galeyev regarded as a '"pioneer of musical painting," who possessed a unique combination of musical and artistic talents' (Galeyev, 1995). They also were inspired by the painter Wassily Kandinsky and the Russian composer Scriabin who was an advocate of a 'universal art' and who had intended to extend his ideas about the synthesis of visual art and music into 'combining together music, light, speech, gesture and architecture' (Galeyev, n.d). The group continued on the traditions from these artists but also did not want to limit themselves to light-music only, exploring and experimenting with multiple possibilities for the interconnections between music, colour, and art in their art experiments, research and work. The institute took its name from the Scriabin's light-musical composition *Prometheus: The Poem of Fire* (1910) (see chapter 2 section 2.4.4.1).

4.1.1.11   The advancement of visual music research and practice

Galeyev not only wrote a great deal on their activities abut also presented the work of the group in its historical contexts of the developments in abstract painting and early colour music instruments as well as early film experimental works. He uses the phrase 'visual music' and 'visible music' amongst the many other varieties of phrases, such as, 'audio-visual music' (Galeyev, 1976), to describe his and others experiments and work with exploring correlations between images and music. In 1988, he refers to what he calls a revival in 'visual music' (Galeyev, 1988b) in an article, entitled, 'At the sources of the idea of "visual music" in Russia'. In this article, he overviews the history of visual music in relation to Newton's colour-tone analogy, Castel's colour organ invention, Pythagoras's discovery of the numerical proportions

of the musical scale, to the work of Kepler and the link with the revival of the idea of the music of the spheres and various other historical authors. He includes, in this overview, several contributions from Russia of historical sources on discourses on science, referring in particular to speeches presented at a public meeting held by the Imperial Academy of Sciences in 1742, and continuing on in writings for a period of years afterwards (by Mr Kraft, I. Weitbrecht, M.V. Lomonosov, L.Eiler) where scientists 'subjected Castel's "*musique oculaire*" to a thorough analysis' (Galeyev, 1988b). Galeyev makes the point that this history for visual music in the colour organ and colour-tone comparisons until the end of the nineteenth century was 'a matter dealing only with the idea of visual music (and not with the art itself)' (ibid). He references other historical authors whose writings were translated into Russian and who also contributed to ideas about visual music, such as, the German writer K. Eckartshausen's 'The Key to the Mysteries of Nature' and the Italian theatre artist P. Gonzaga. Galeyev concludes that the current practice of music-kinetic art in the work he and his colleagues at 'Prometei' were conducting was evidence of a real possibility of the advancement of ideas about visual music.

> It becomes evident that the laws of 'audio-visual harmony' should be sought not in the sphere of physical extra-human analogies, but on the basis of comparison of the physiological, psychological and, ultimately, aesthetic influence of light and colour (which correspondingly characterizes the notions of 'audio-visual unity' and 'audio-visual harmony' as a gnosiological category). And it is here that real possibilities exist for the advancement of the ideas of 'visual music', as manifest in the current practice of the so-called music-kinetic art (Galeyev, 1988b)

Vera Koshkina, in her review of Galeyev's work, refers to the translation of this term as visual music. Regardless of which term is used, they both point to similar things, a new art in which a visual image and music are combined, either in a kinetic installation, through a customised invention, or by device, or through film works and performances of images with music. Koshkina refers to the concerts that the 'Prometie' group organised as 'visual music performances' (Koshkina, 2018, 198).

4.1.1.12 MUSIC-KINETIC-ART MEDIUMS

The 'Prometei' group conducted research, publications and creative activities in relation to the new art which they called 'music-kinetic art' and investigated the various manifestations and possibilities for a music-kinetic art medium. They approached their work as being that of 'solving topical problems of a true "experimental aesthetics" (more precisely, "aesthetics", tested by experiment)' (Galeyev, n.d.). They also held 'Light-Music' conferences and festivals and experimented with multimedia open air performances, for example, in their show 'Magic Garden' shown at Sabantue holiday in June 1991' (ibid.). They also investigated 'synthesising architecture and light' and experimented with *son et lumière* presentations for the exterior of buildings (Galeyev, 1988, 390). A studio and a music-kinetic art museum was established in Kazan in 1979. In an article which Galeyev wrote in 1976 and published in the *Leonardo* Journal, entitled

'Music-Kinetic Art Medium: On the Work of the Group "Prometei" (SKB), Kazan, U.S.S.R.', he explains the objectives of the group:

> The main objective of the group is to search for ways of developing the relatively new aesthetic reality of the medium in which kinetic art with electric light is correlated with the various qualities and thematic aspects of music. The group has continued the development of ideas of the Russian and Soviet school of music-kinetic art or 'light-music art' originated by the musical composers A. Scriabin and V. Shtcherbatchev and the artists V. Baranov-Rossine, G. Gidoni and others (Galeyev, 1977, 177)

This group, nonetheless, were well aware of the fact that this art had several names both inside and outside the Soviet Union, such as, colour music, colour organ productions. The group preferred the terms 'audio-visual music or light-music' (ibid, 177). They also noted that there was a problem for describing the medium for this art. They set about investigating what mediums could serve this enquiry into music-kinetic art, by analysing it from several points of view. They experimented with several mediums and several forms of presentation of their mediums, from building and designing 'electro-mechanical devices for producing kinetic images of changing colour' (ibid, 177) for light-music performances, to presenting their light projects through architecture and buildings. The activities of the institute and the writings and work of members of the institute have been documented on the institute's website (Galeyev, n.d.) and acts as a research archive for the activities and, in particular, the work by Galeyev. The activities in which they were involved are organised into useful categories that serve to demonstrate the multiplicity of forms and mediums that their work on the synthesis of visual art and music brought them. The categories are: Light concerts; light-music videos; light-music films; light architecture; applied light-music; electronics, sound and space activities; slide and music films; laser experiments; computer art experiments; video art experiments; conferences; international activities; synaesthesia and colour hearing (Galeyev, n.d.).

Galeyev refers to the overall art practice in which the group were involved as 'music-kinetic-art medium' (Galeyev, 1976) and the devices that were invented as being 'decorative music-kinetic devices'. It is, nevertheless, most interesting that the group used many terms to describe their activities and researches, such as: *instrumental choreography*, referring to the projection of images onto a translucent or opaque screen of a non-figurative kind and that have a close connection with the music (ibid, 177); the concerts are also sometimes named by him as 'music-kinetic art concerts', 'lumia-music concerts' and 'lumia-music films' (Galeyev, 1988).

'Prometei' produced its first performance of light and music in 1962, using one of its own inventions, a light music instrument they named '*Prometheus-1*'. In this performance, they were interested in exploring 'the correlation between individual qualities of music such as pitch, key, timbre and harmony with kinetic images' (ibid, 177). They describe the process.

Electric light as projected through filters controlled by a manually operated keyboard to project areas of coloured light on an opaque screen in accordance with the special light projection score prepared by Scriabin for the music that he composed. ... The keyboard, or colour organ, for controlling the projection of uniform areas of colour on a translucent screen had the designation 'Prometei 1'. (Galeyev, 1976, 178)

A description of the 'Prometei 1' instrument's operation is provided on their archive website.

Behind semi-transparent screen, 30x6 m size, more than 1000 seven-coloured 15 W electric bulbs had been arranged. Each colour channel was operated by the control panel, using 3 kW transformers. (Prometheus.kai.ru, n.d.)

Further 'Prometei' and other instruments were constructed, and each were designed to explore visual and music correlations in different forms and for different functions. Some were for live performance of images with music, others were standalone devices for home use, others were for video art (see Figure 39 for examples of the devices and activities of the 'Prometei' group).

For later instrument and performances, Galeyev explains what correlations were explored between images and music:

Two other instruments, 'Prometei 2' (1962) and 'Crystal' were constructed with the correlation of: (1) light brightness with music volume of loudness, (2) hues with timbre and chords, (3) structures of images with metre or rhythm and (4) spatial character of drawings with melody. (Galeyev, 1976, 178)
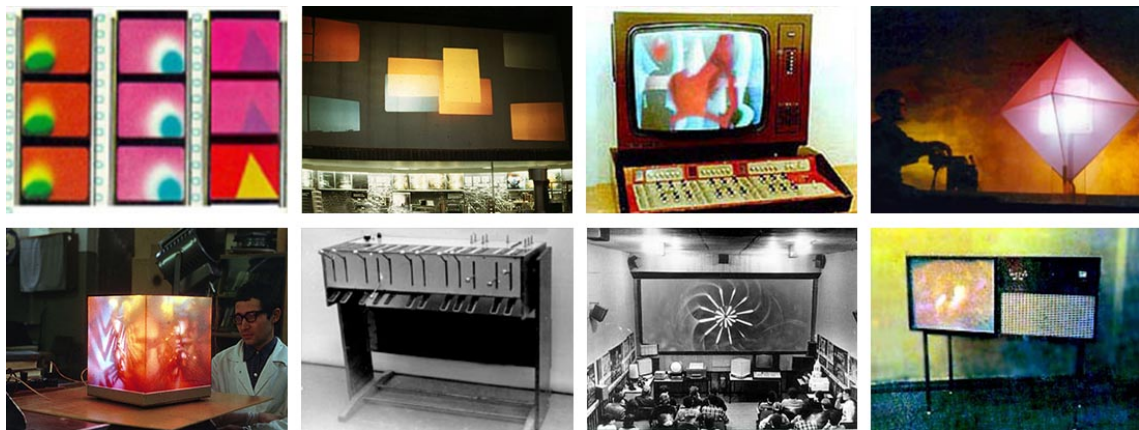
Figure 39 Bulat M. Galeyev and music-kinetic art activities of the Prometei group (Galeyev, n.d.). Top row L–R: Frames from the film 'Prometheus' (1965–66),directed by Galeyev. View of the music-kinetic art instrument 'Crystal' showing image-score operator, image producing device and kinetic picture on a translucent screen, 1965 (Galeyev, 1976, 179), image source (ibid.). Bottom row L–R: Music-kinetic art device '*Yalkyn*' (1972), with a cubic translucent screen (ibid., 181); Control panel of the instrument '*Prometheus-3*'; and a concert using the instrument in 1987 (Galeyev, n.d.); Music-kinetic art device '*Idel*-1' with automatic control, 1971 (Galeyev, 1976, 181).

4.1.1.13 LUMIA-MUSIC FILMS TO BE ACCOMPANIED BY ELECTRONIC MUSIC

Galeyev along with members of the 'Prometei' group were involved in working with other various forms and mediums for creating musical graphics to music or as Galeyev also names 'lumia-

music films to be accompanied by electronic music' (Galeyev, 1988). Films were produced through experimentation with colouring black and white film, but then moved onto using shapes and forms also to accompany the music.

> Initially they recorded the music along with simple colour alterations, as suggested by Skriabin's 'Luce', on a screen. The simplicity of the colour alterations was not a good match for the intricacy of the musical score, and the group decided to add coloured forms to bring greater complexity to the image. Because colour film was not readily available, the group made their first visual music films on black and white film and established a technique of chemically dying the negatives in the course of the development process. (Koshkina, 2018, 206)

Example films directed by Galeyev are: 'Prometheus,' wide-screen light musical film, 1965-1966; 'Eternal movement,' 1969 with music taken from Edward Varese's composition 'Electronic Poem'; 'The Small Tryptich,' 1975; 'Space Sonata,' 1981 with music from a collage of electronic music various composers. They also used other mediums, such as, the presentations of slides with music in studio halls. They did not believe 'there was any objective correspondence between musical tones and colours' (ibid, 206) and they were comfortable with this; but they recognised that their images and the unity of the images with the music came about from experimentation and by manually and mechanically altering colour and shape combinations (Galeyev, n.d.). For example, they welcomed the advent of video as a new technique that allowed them 'to turn from troublesome cinema experiments towards abstract light music videofilms' (ibid.) and both Galeyev and I. Vanechkina directed many of these lightmusic videos together. The list of lightmusic videos are: 'Space Sonata', 1986; 'The Temple' (in the kith style), 1989; 'The Temple' (in the style of Joan Miro), 1989; 'Ballad for Bernt' (in the style of W. Kandinsky), 1989; 'Harmonia Viva' (in the style of Salvidor Dali), 1989; 'Dance of vertical lines', 1990; 'Dance of white vertical line', 1990; 'Frogs symphony', 1991; 'Russian terminator', 1993 (Galeyev, n.d., Lightmusic videos, n.d.) (see Figure 40 for frames from some of these works).
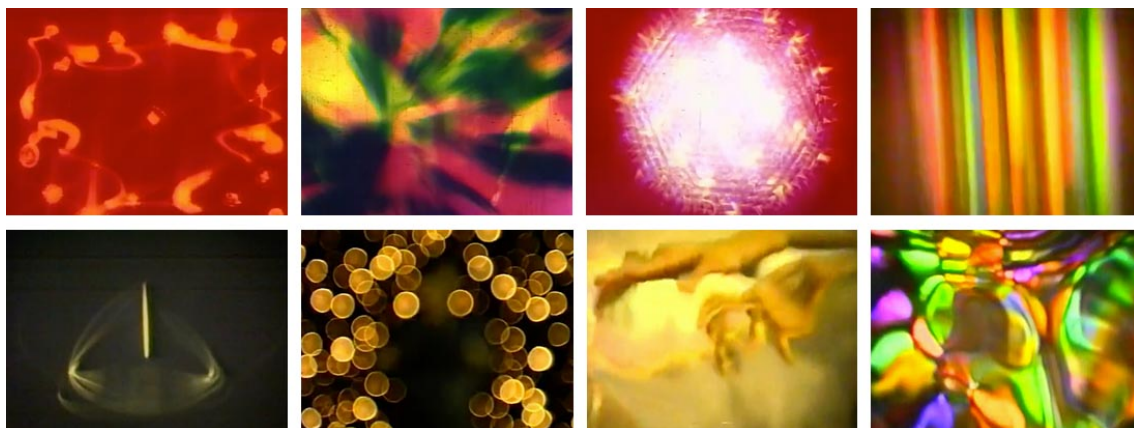
Figure 40 Light-music films and Lightmusic videos produced by the 'Prometei' group. Frames from a selection of works directed by Bulat Galeyev in a solo capacity or in collaboration with Irina Vanechkina. Top-L-R: Light-music films, 'Small tryptich',

'Eternal movement', 'Space sonate', Lightmusic video 'Dance of vertical lines'. Bottom-L-R: Lightmusic videos 'Dance of vertical lines', 'Russian terminator', 'Harmonia Viva' (in the style of Salvador Dali), 'Ballad for Bernt' (in the style of W. Kandinsky).

4.5   MAKING SOUND VISIBLE AS NON-OBJECTIVE CONTENT FOR FILM

4.5.1   RALPH K POTTER 'S 'AUDIVISUAL' MUSIC

Ralph K. Potter (1895–1980) was Director of Transmission Research in the Bell Telephone Laboratories and best known for 'his ways to translated speech, music and other sounds into visible patterns' (Potter, 1947, 66). He noted that a subject of interest to acousticians and phoneticians, especially to those developing solutions in the field of electrical communication, was the 'automatic representation of speech sounds by visible traces or symbols' (Potter, 1945, 463). Potter identified that the problem in this area was how to make the visual interpretation and visual discrimination of the recorded sounds of various phenomenon correlate with 'the auditory sense' (ibid.). In his article on audio-visual music, he raises the question, '[W]ill there ever be a generally accepted music that is both audible and visible?' (Potter, 1947, 66). He notes that there is great potential in the sound movie techniques in, what he calls, 'the experimental effort toward a visible and audible music… Here it has acquired the name "audivisual music"' (ibid.). Potter uses the term 'audivisual music', without the o in audio, to describe 'any combination of abstract and moving colour forms accompanied by a sound-track music' (ibid.). In his short overview of example films in this field, he uses the term 'visuals' as a reference to many of the practicing filmmakers working with this approach to experimental film, where the action in the films are the visuals in the film. He describes the visuals he sees in the films, such as 'black zigzag and white accents…spirals growing…cylinders in groups…waves in rows' (ibid., 67). He notes a problem in terms of developing an audience for audivisual music, suggesting what would make good works for an audience, such as unity in the audivisual composition. He does not think colour or form in a connection with musical features will be understood by audiences but that movement would. Hence, the key characteristic to connect audio and visual is movement. He writes:

> A remaining factor is *movement,* and here the situation is entirely different, for any film animationist knows that movement can perform wonders in audiovisual association. Imagine a wavy line standing motionless on a screen while accompanied by sound music. As long as the line remains stationary it bears no relation to the music. Now, think of it as a wiggly line, set in motion by the animationist and cutting capers to the audible rhythm. Immediately, the line attaches itself to the music, the visible and the audible movements binding the two together. (ibid., 68)

Potter refers to this as an audible-visible association. He makes suggestions for an analysis of movement in both domains of music and visual, for example noting that 'the aurally significant movements in music must occur in two dimensions, pitch and loudness' (ibid.,69) and that when related to visuals on the screen – then 'pitch movements might be related to horizontal motion on

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the screen and loudness, movements to motion toward and away from the observer' (ibid.). He makes similar comparisons between a spot and a tone (ibid.) and tone versus music (ibid.,70). The whole article is geared towards urging the audivisual music to consider what might work for an audience in helping the audience to understand the film. Potter designed an oscillator for Mary Ellen Bute, which she used in her later films. Bute's work will be examined next.

4.5.2 MARY ELLEN BUTE – INTER-COMPOSED RELATIONSHIP OF VISUAL MATERIAL AND MUSIC

Mary Ellen Bute (1904–1983) was an independent US painter and abstract filmmaker who was an active proponent of working with synchronised sound with light and cinematographic forms. Bute devised various methods and techniques for exploring a musical expression in abstract cinematographic imagery. She makes, however, an important distinction between the relationship between music for mainstream film, where music serves a function to assist the character or the plot or the mood of the film, and music in absolute film, where the relationship is more 'inter-composed' and there is a close relationship with the visual material (Bute, 1953).

Bute uses various scientific and mathematical understandings of sound and music. She explores these ideas in her films, using different terms to categorise the content, methods and type of film. By 'absolute film', for example, she means her work that results from interpreting a musical score and musical ideas to springboard her visual composition ideas. 'Expanding Cinema' refers to early film work with the cinematographer and film producer, Ted Nameth (anon, 1936). 'Seeing Sound' films (Starr, 1952) and 'abstronic film', which refers to her work which included abstract imagery and electronic imagery in the content of her film (Bute, 1954).

Some of Bute's earliest techniques for working with musical ideas in her films, involved a method for analysing a music score of which the music was to become a soundtrack for the film. Bute used that analysis as the basis of her visual composition of visual elements in her film. Bute, along with others, also sought to explore the compositional idea of 'one kinetic composition to be realized in the two materials (aural and visual) in such a way that they were inter-dependent and neither the musical composition or the picture would be complete alone' (Bute, 1953). In an article 'Film Music' (1953), Bute explains one such method of kinetic composition that she used as a basis for creating the visuals for her films 'Spook Sport' (1949), 'Colour Rhapsodie' (1948), 'Polka Graph' (1947).

Bute created a compositional graph from an interpretation of the music score using this 'graph pattern of the music as a springboard for the visual interpretation' (Bute, 1953) (see Figure 41 & 42). She also collaborated with many others in the production of her abstract films and in the interpretations of music explored in her films. Around 1929, she was in contact with Thomas Wilfred, the colour organ inventor who set up the Lumia institute of light in New York. From

this contact, she too became interested in also building a colour organ. She collaborated with various individuals involved in mathematics, camera operation, and electronic music, such as, Ted Nemeth (1911-1986), who helped her to produce her films in his studio. She came to know Leon Theremin (1896–1993) when he was based in America, by arranging to be an apprentice in his sound studio so as she could learn about music composition and his demonstrations of the Theremin musical instrument (Haller, ed. 1985). As a result of this, she worked with Theremin for a time on developing a system for the use of electronics to create drawings. They gave a demonstration of their efforts in 1932, entitled 'The perimeters of light and sound and their possible synchronisation' (Bute, 1954). She employed the assistance of the experimental filmmaker Norman McLaren, at a very early stage in his career, for her films 'Spook Sport' (1940) and 'Tarantella' (1940).

Bute also worked with the mathematician, music theorist and artist Joseph Schillinger (1895–1943). It was his knowledge of mathematical composition as applied to the kinetic arts that enabled her to find images and imagery that acted 'as counterparts to compositions in sound' (Bute, 1954). Bute realised that motion picture film could best work to realise such counterparts to sound, in image form. Some of her methods of creating imagery consisted of working with various forms of manipulating light and then cinematographically recording the results and effects of light on and through objects and kinetic sculptures. Betancourt describes these as 'films to be built from careful manipulations of physical objects to achieve chiaroscuro effects in black-and-white' (Betancourt, 2011). Some of these sculptures that she used for her light work were themselves physical representation of some form of mathematical structure, such as, a sculpture, by John Rutherford Boyd (1935), that was shaped like a parabola and through which she recorded and created various manifestations of patterns that arise through light being shone through the structure, in a similar manner to the light play sculptures in Europe from the 1920s. An example film where she used this technique is *Parabola* (1937) (see Figure 43) . Bute conceived of these films as being a 'method for controlling a light source to produce visual compositions in time continuity much as a musician manipulates sound to produce music' (Bute, 1954).

After a screening in New York's Radio City Music Hall of Bute's film 'Synchromy No.2' as a short film before the feature film, an anonymous writer in the *Letters and Art* column of the *Literary Digest* (anon. 1936) remarks that Bute's film was a 'visual music'. In a little more detail, the author explains the visual music at work in her films:

> Behind Miss Bute's models of the mathematical order which exists in music are the esoterically trigonometric investigations of the editorial board of *Scripta Mathematica*, learned journal of Yeshiva College in New York City. The professors work out equations for the scale of the model of the visual music which Miss Bute arranges and Mr. Nemeth photographs.
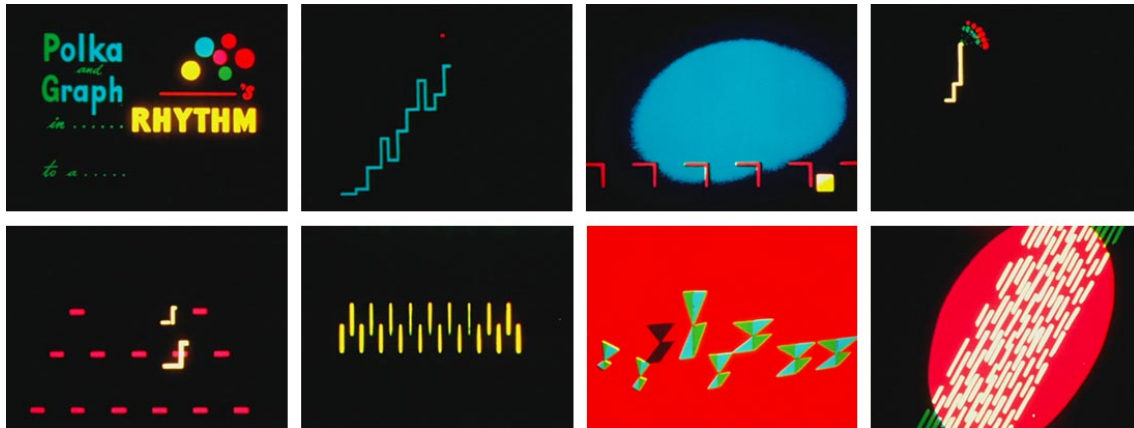
Figure 41 Mary Ellen Bute - frames from the film '*Polka Graph'* (1947)

Figure 42 Mary Ellen Bute's graph pattern (right) of the music (left) as a springboard for the visual interpretation of the music (REF). Transcription of text in the graph: Each small square equals one semitone; horizontally one sixteenth. See Figure 13 for frames from the film '*Polka Graph'* based on this system.

Bute also worked with Dr Ralph Potter of the Bell Telephone Laboratories. He engineered and constructed a version of the oscilloscope, using an electronic circuit, that Bute was able to use to create lissajous curves and various figures and forms produced by the light on the oscilloscope screen (Bute 1954). What excited Bute about figures and forms generated from the oscilloscope were the possibilities for manipulation of both the motions and the tempo of the motions of these forms, whilst synchronising such changes with the music. Her film 'Abstronic' (1952) makes use of such oscilloscope imagery.
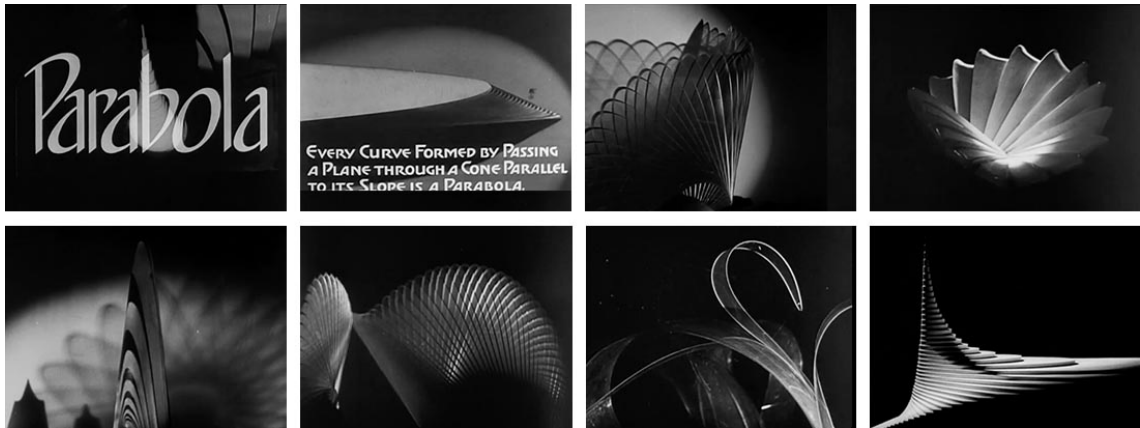
Figure 43 Mary Ellen Bute – frames from the film *'Parabola'* (1936).

4.5.3   JOHN WHITNEY – VISUAL HARMONICS AS PROGRESSIONS OF RESONANT HARMONIC RATIOS

The Whitney brothers John Snr. Whitney (1917–1995) and James Whitney (1921–1982) created both individual abstract films and collaborated on creating test exercises. They invented new equipment, processes and tools to create images and sounds. Of the two, however, it was John Snr. Whitney who was involved more with the technical inventions and innovations in creating imagery for animation films.

Reflecting back over fifty years of his work, John Whitney, in an article written in 1992 and originally published as an essay to accompany a documentary *A Personal Search for the Complementarity of Music and Visual Art* (1992) — and subsequently published in the *Computer Music Journal*, Vol. 18, No.3 (Autumn 1994) under the title 'To Paint on Water: The Audiovisual Duet of Complementarity' — explains the motives and ideas behind their approaches in their work to finding a complementarity for animation/film art and music. He uses the phrase 'visual music' several times and refers specifically to visual-music artists, visual-music composers, visual-music films and a visual music. In this writing, he explains that for fifty years in his own work, he was attempting to find methods to explore the complementarity of music and visual art by creating methods for devising 'real-time composition languages' for 'audiovisual fine art' for the purposes of creating a real-time affinity between music and the visual. He notes that technical innovation has now enabled a chance to explore a 'true visual match with the structures of music' thus following on in the tradition of artists and the earlier filmmakers having belief in the affinity between colour and tone.

> Technical innovation is thus providing the means to begin a fine art for eye and ear. Regrettably, the formal idea of such an extraordinary art remains obscure and is still poorly defined. A lasting faith that colour and tone do possess a 'magical af-finity' inspired many so-called *visual-music* [my emphasis] films. Yet, from avant-garde abstract films to pop musical story-telling, the difficult problem of constructing a true

visual match with the structures of music was scarcely examined. (Whitney, 1994, 46)

He was interested in the development of computer languages for the arts, particularly for a combined music and art.

> Yet, computers are the only instrumentality for creating music interrelated with active colour and graphic design, and though the language of complementarity is still under examined and experimental, it foretells enormous consequences and offers great promise. (ibid.)

As a result of the computer, Whitney believed that it 'would amalgamate the resources for artistic and musical creativity' (ibid.), resulting in the birth of a 'genuine audiovisual art'. Referring to the phrase visual music again, Whitney considered that such developments could 'mark the end of obscurity for so-called visual-music composers and perhaps the end of a dry season for contemporary music'. (ibid., 47)

Whitney's views on the potential and great promise of this new art form, then, depends upon his principle of complementarity. Complementarity, however, is not static or arbitrary or fixed or pre-determined. Rather, he tell us that,

> Complementarity can be lively, rich in colour and texture, free to integrate the painterly image, cinema, and typography, and free to bring abstract design of colour in action into a serious new world of music. (ibid.)

He differentiates his work from earlier visual-music artists who often choose 'to work with existing music, being intent of "illustrating" the "music"' and which he believes results in an animation which is 'perhaps supported by music, but hardly associated in deep structure' (ibid., 47). He explains that a structural complementarity is based on 'some kind of common harmonic foundation' (ibid.). In his and his brother John's practice, they found that their own experiments into the affinity between visual and audio art were ambiguous and more like typical abstract art approaches based on subjective structuring of visuals and music. Like others, they dreamed of a visual music and acknowledge the persistence of an interest in 'the archetypal concept of a "magical affinity" between colour and tone' (ibid.).

> My brother James and I dreamed of a visual music reviving Kandinsky's theories and his interrelated musical aspirations; we sought spiritual, psychic, literal, and orderly structures, perhaps reinforcing synaesthetic cross-perceptions of hearing and sight. (ibid.)

John explains how he observed and discovered a form of visual harmonics in pixel phenomenon, when generating pixel patterns in the computer with the assistance of software programmers. He noted a phenomenon where 'resonant actions of aggregate pixel patterns, generated by computer, resemble the actions of harmony in music.' (ibid.). He describes these as arising from 'harmonic pixel phenomena'. He dealt with this topic in detail in his *Digital Harmony – On the*

Complementarity of Music and Visual Art' (Whitney, 1980). In that study, he discusses the 'differential polar equations', equations and algorithms, with which he was able to work, with the assistance of computer programmers at IBM and in particular Jerry Reed (ibid., 51) in the Pascal programming language to generate what he calls 'visual harmonics'. He was able to attain various types of motions by enabling the programming language to access and activate a cluster of pixels 'overlaid on polar coordinate arrays' (ibid., 47) to create a range of graphic patterns from a selection of numerical variables. In a documentary in 1968, he explains that the programme 'is based on a single polar coordinate equation having about twenty parameters. Using the light pen, numerical values can be chosen and given to any of the parameters of the programme', noting that 'one soon learns to control the graphic possibilities of this new medium' (Experiments in Motion Graphics, 1968). This design in motion is based on 'dynamic graphic patterns of resonance, interference', what he calls 'differential action' (Whitney, 1980, 47). In order to create films from these computer processes, Whitney had to rely on first recording each figure made on the computer frame-by-frame onto black and white film, and then use an optical printer to add colour to the film, before finally using these in his film exercises and experiments (see Figure 44).
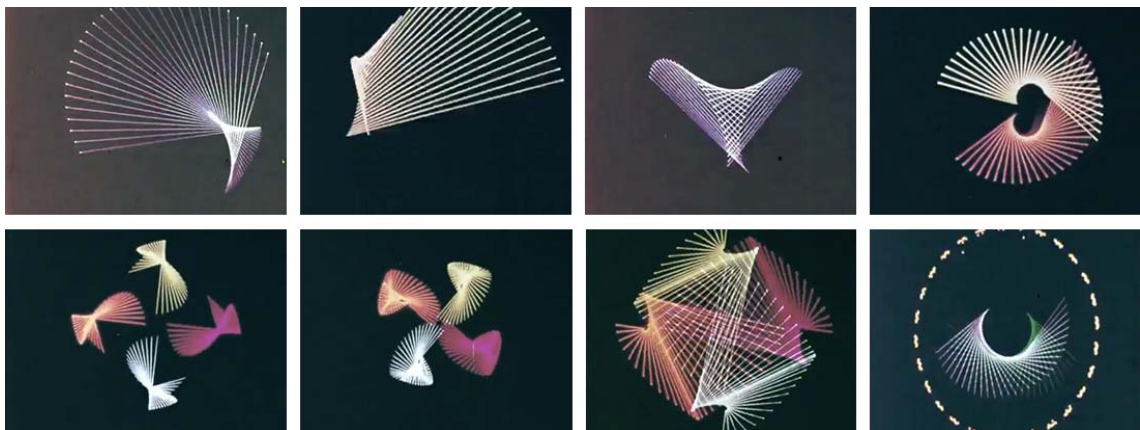
Figure 44 Frames from excerpts in the documentary of John Snr. Whitney's demonstrating his system of generating a multiplicity of graphic patterns of resonance overlaid on polar coordinate arrays with programming, frame capture, filtering and colouring and optical printing. (Experiments in Motion Graphics, 1968)

Whitney discovered that the 'ratios of harmony possess a visible component of resonant tension' (Whitney, 1994, 48), and which he says can be observed in the action of a dancer or a conductor's gestures in relation to music. The computer, he also observes, has an 'incremental power to animate successions of visual ratio, sending dynamic structures to a screen or a loudspeaker' (ibid.) and that '[R]esonant harmonic ratios can generate visible as well as audible architecture, pixel-by-pixel or sine-tone-by-sine-tone' (ibid.). He also calls this process, 'differential digital harmony' and explains:

> The hypothesis I call differential digital harmony derives from the idea that progressions of ratio in visual as well as tonal (chordal) patterns of harmony lie at the heart of our perception of time as aesthetic structure (Zukerkandl 1956). Diverse sequences of ratio patterns in melody and polyphony activate the lively sensations that move, beguile, and inspire us with music's abstract pattern. Within my limited resources for computer film-making, I have been able to demonstrate similar visual experiences with time and tension. (Whitney, 1994, 47)

Like many artists and filmmakers of the twentieth century, Whitney describes a new type of artist — the 'individual artist-composer-poet-author' — whom he predicts will choose the digital realm as a medium of choice (ibid., 49). He notes that even in those art works that utilise the cinematic image, they too are working with a form of harmonic forces because they also embody 'progressions that flow in and out of focus, zoom, fade, or cross-dissolve as forms of punctuation' (ibid., 49). A very far-reaching observation he makes, however, is that computer memory, storage and capability for modifying minutiae details of an image provides 'an evolving creative methodology' to such an extent that where:

> Advances in the speed and capacity of computers and their memories allow a composer to shape and re-shape interactive, dynamic creations in real-time, as if each figure were its own individual audible-in-dialog-with-visible gesture… instant replay from digital memory expands the composer's access to time in the artwork. (ibid., 51)

Having been involved with computer programme generated imagery in its early stages, Whitney also observes the possibilities for connecting the visual figures of computer imagery with the new types of sounds made in the computer and the future potential of computers in forging a complementarity between music and images:

> Differential digital harmony, for example, might be incorporated into 3-D particle animation in a quest for more meaningful visualizations of the spatial dynamics such as we find in classical music structure (Simms 1990). Granular synthesis in the domain of computer music research suggests a similar opportunity (Truax 1990). Might we borrow ideas from sampled-sound granules and 3-D particles, redeploying the sine wave (or grain) and pixel as I have described their critical function in generating the temporal dynamic of harmony? Might digital harmony serve to generate a richer virtual reality? (Whitney, 1994, 51)

In all of this, then, Whitney shows considerable foresight into the vital question of the future, pre-figured possibilities and 'great promise' and 'enormous consequences' for the advancement of a visual music.

4.5.4   JOHN WHITNEY – PENDULUM SOUND

The Whitney brothers experimented with sound as well as images for their abstract films, particularly in the early films. They were attracted to the 'permanent unity' made available in film through the tying together of abstract film and sound. Explaining the attraction to this unity in their article on 'Audio-visual music' (1978), they remark that '[W]e are attracted by the

prospects of an idiom as unified, bi-sensorially, as the sound film can be' (Whitney, 1978, 84). They also explain their ideas about the unity of sound and abstract film in the new abstract film medium, and how being able to compose sound and image at the level of the filmic frame afforded great potential for the integration of image and music. They celebrate what the machine can offer the audiovisual medium. They considered their early films as exercises and their work as part of the development of art, in particular of modern art as explored by Marcel Duchamp in his 'studied exploitation of the mechanisms of chance' and Piet Mondrian's move from representation to a different form of reality explored in his paintings (ibid., 85-86). The Whitney's sought 'a new equilibrium—an equilibrium on a temporal frame as in music' (ibid., 85). They built a device, which they called a pendulum instrument, for the purposes of synthetically creating sound. Their experiments with synthetic sound for their films was triggered by the desire to remove any associations that known music might have as this might interfere with the experience of the abstract film. They were conscious that music itself has its own connotations and associations for the audience, and so, they tried to pick music that was as primitive or 'least common' in order to avoid any form of disunity that might occur from having a music with strong associations and connotations. This is the reason why they turned to finding a method to create their own sounds 'by some means near as possible to the animation process, technically and in spirit' (ibid.). Thus they experimented with a form of visualizing sound which consisted of a set of pendulums that could be set in motion and its motions could be traced and draw patterns emanating from the motions of the pendulum onto the optical part of the sound track. The sound was then generated through the mechanism of the projector playing back the film (see Figure 45).

They describe the process for generating synthetic sound,

> The sound track of all our films to date was created synthetically by the device which came into being as a result of these conclusions. Without attempting to describe it in detail here, its principle resembles less a musical instrument than certain devices used for charting the rise and fall of ocean waves. Pendulums instead of waves create the ebb and flow of movement. This motion is greatly magnified and registered on a narrow space of the motion picture film provided for the sound track. No sound is needed to produce these patterns on the sound track. The patterns themselves generate tones in the sound projector. The instrument has a selection of some thirty pendulums adjusted in frequency relationship to each other so as to form a scale. They can be swung singly or in any combination. (Whitney, 1978, 84)

As they worked with sound for their films, they noted the potential 'for a species of audio-visual performances' for the abstract film medium where composing sound directly onto the film and working with the capability of film to provide one with a fraction of a single motion such as in a single picture frame was possible. They thus concluded from this that such level of access to a fraction of motion, in both a single frame and in a single frame of sound, creates not only immense possibilities for 'a new field of audio-visual rhythmic possibilities' but also, consequently, 'the

sound is easily integrated with the images.' (ibid., 85). Referring to their system of synthetic sound generation onto the optical sound track as an instrument, they explain (ibid.):

> The scale of the instrument is adjustable to any intervals we may choose including quarter tones and smaller. This permits use of graduated ascending or descending tonal series. They correspond in quality of feeling and variability to certain types of image series, such as, for example, an enlarging or diminishing shape, an ascending or descending shape, or a colour series.
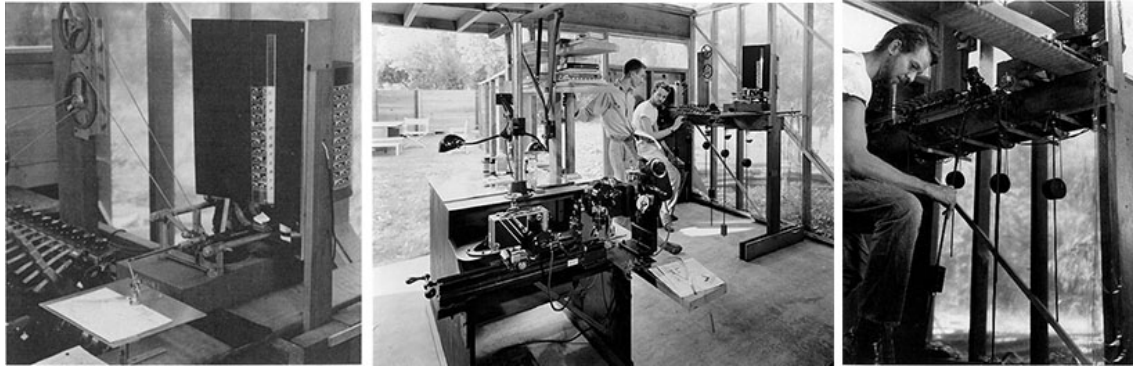
Figure 45 The Whitney brother's pendulum instrument for creating synthetic soundtracks for their early film exercises. (Whitney, 1994, 48); 'James and John Whitney in their film studio in 1947. Their handmade optical printers is shown in the foreground and their pendulum-cycled subsonic musical instrument is in the upper right. (Becker, 1946, in Whitney, 1994, 47); John Whitney, playing the pendulum machine, ca. 1945. (Patterson, 2009, 39)

4.6   CONCLUSIONS

Coupled with the advances in modern art painting, advances in modern technological science of audio-visual phenomena with computer generated or assisted image-making and sound-making devices enabled one platform to realise on 'the canvass of the screen' the dreams of an abstract art of visual music in the colour organ and abstract painting modern traditions. It was, then, only with the rise of experimental sound and image engineers that the combining of sound and image in time and over time could become a reality for 'visual music'. This was not possible hitherto, however dreamt about. With this breakthrough, however, the visual music of film made a major break-with syncretic visual music art form. The filming of visual music had indeed now become 'a fact', as Diebold (1921, 51) had intimated, in the early decades of the twentieth century. Yet the re-birth of *the film* of visual music in the mid twentieth century was not so much from the spirit of music itself as it was for Diebold and those in the early decades of the twentieth century as it was from the spirit of experimentation with the limits of sound and image technologies and recorders. Visual music, nonetheless, still needed expression, and expression in artistic format at that. A characteristic of the latter half of the twentieth century is the drive to be creative in the unity of visual music expression with *new* visual music instrumental technologies that were not only possible, but also actual.

Chapter 5   THE ELECTRIC AUDIOVISUAL *ARTS-RELAIS*

5.1   INTRODUCTION

'Technology is therefore no mere means. Technology is a way of revealing.'

(Heidegger, 1955, 12, quoted in Kane 2007, 8)

The twentieth century saw the development and emergence of many electronic technologies that facilitated the recording, production and playback of photographic, cinematographic and video graphic images in synchronisation with sounds in radio, television, video and computers. The intervention of technology on compositions in both fine art and music was also facilitated by the new mediums since it provided new methods, processes, images, sounds, as well as new ways of working with integrated images and sounds. The synchronisation of sound to picture in the film medium and, subsequently, in the video medium enabled a linkage between two media, and two arts, and two senses. Several years before his systematic research into sounds with radio and technology and his development of *musique concrète* techniques for music composition, Pierre Schaefer, in his first major essay *Esthétique et technique des arts relais* in 1941 (Schaeffer, [1941-42] 2010), used the term '*ars-relais*' — a term which is difficult to translate into English but which means 'linking arts' or 'indirect arts' (Bizarro, 2011, 2) or 'relay-arts' (Palombini, 1993) — to target what he observed as the common intermediary point and connection between the recording of images in cinema and the recording of sound in radio for the arts, art practices and aesthetics. In this regard, what Schaeffer sought in his conception of the *arts-relais* was the linking of the indirect arts of sound and image.

The subsequent and rapid development of video art in its many manifestations in the mid to late twentieth century, however, is a very large field of study and beyond the scope of this thesis. The focus in this chapter, rather, is on presenting some pertinent examples of some technological advancements that assisted new forms of expression and production of art works that emerged from music composer-led collaborations with film, kinetic and video art. This drive to link sound and image in the field of art culminates towards the end of the twentieth century in the possibility of achieving more universal access to image and sound information by means of the computer and its data and information processing capabilities. Such developments paved the way for not only new forms of access but also new forms of integrating sounds and images to create visual art and music and visual music works.

There are many important developments that will not be examined in detail in this chapter, such as, for instance, the rise of audiovisual installation in the art gallery, the extensive video

synthesis experiments of the 1960s (and onwards) and the evolution of the liquid light show projections for music concerts. It is, nonetheless, of importance to mention these and many other developments that have contributed to the emergence of new forms and means of expression between visual art imagery and music integration, such as: electronic music-led collaborations with filmmakers and video artists that resulted in the use of a projected cinematic component in an electronic music concert setting; new forms of cinematographic and videographic images with sound and music presented either in a fixed medium, such as in a video displayed as a performance in a music concert settings, or as an accompaniment to live music performance with musicians and video projection; inventions of new or adaptations of old techniques and instruments utilising the new electric audiovisual mediums for creating devices to perform electronic imagery along with the continued development and design of instruments to make and perform electronic music; the use of the art gallery for video and sound installations as well as moving image and music installations; the advent of the new audiovisual medium such as analogue video and digital video. In this chapter, we will provide analysis of a sample of some main activities in the twentieth century that sought to integrate the arts through the new mediums and technologies for mass media such as television, radio and video that are of most relevance to understanding the development of visual music during this century.

This chapter begins with an examination of radiophonic art (4.2), where artists and engineers recognised that recording sounds in the manner of recording images can create its own forms of art. This is an important development because before the advent of video art in the latter half of the twentieth century, the two technologies of radio and television were considered to have the same potential for artistic exploration that film had for experimental film works. In the non-objective and new *concrète* films of the early cinema experiments, the images (of objects) recorded are re-contextualized and rearranged to create new juxtapositions and new meanings for those objects. Radio was seen to have the equivalent potential, recording sounds, rearranging them and re-contextualising them, in an analogous manner to the recording and arrangement of images for cinema. Several individuals recognised the power of radio to create new types of sound art work. This leads to the next two sections of the chapter which examines the work of Pierre Schaeffer (1910–1995) who worked with radio technology to do just that; that is to say, to work with sound as art.

It is a well-known fact that the experimental music studios in Europe facilitated the emergence of electronic music and electroacoustic music composition using the technology of radio and audio engineering. What is perhaps less well known is that some of these studios also engaged in collaborations between the new electronic music and new electronic abstract images that were created in both film and video mediums. Music composers who devised new techniques and new types of sounds as a result of the intervention of electric technologies led the way to a

music composer-led approach to marrying abstract moving image with new electronic music sound. For example, Schaeffer's involvement in facilitating the experimental collaboration between *musique concrète* composers and filmmakers of the INA-FR that resulted in the output of several experimental films, from 1960 onwards, that use *musique concrète* compositions as their soundtracks are not well known in contemporary visual music discourse. These films are without dialogue, or a mainstream narrative, yet explore the relation of images and sounds as the fundamental subject matter of the films themselves (4.4). They are, therefore, important precursors to the contemporary practice in the combination of electroacoustic music with cinematographic images and abstract cinematic images projected in the music concert.   This still takes place today. Some musicians and music composers also engaged with creating their own imagery and music to explore the interaction of sound and images through the new electric technologies of radio, television and video. Thus musical ideas arising from the material of the new technologies became the basis for creating a close interrelationship between video and audio signal material. Other composers of new electronic music provided a soundtrack for film artists who then set their abstract imagery to the new and abstract sound worlds of the electronic music composition creating a truly non-objective image and sound result. Not one but two abstract worlds, then, came together and were unified in the audiovisual medium, be it film or video. Today, many electroacoustic music composers create their own accompanying visuals for projection, continuing in the tradition of the electric audiovisual collaborative experiments in the twentieth century. The remaining sections of the chapter, therefore, deal with the way these two world came together beginning with an analysis of the development of kinetic art systems for installations and performance from the 1960s onwards by artists, such as, Frank Malina (1912–1981) and Frank Popper (1918–). Their ideas sprang from an awareness of the interaction between science, art and technology and they sought to relate these fields for the mutual benefit of new forms of art. Many of these kinetic art works explored the interaction of sound technologies with light and electronic and mechanical mediums. Malina led several innovations in this regard, and both Malina and Schaeffer (Malina & Schaeffer, 1972) recognised the mutual relatedness of their work in their respective fields of kinetic art and *musique concrète*.

The final section looks at some examples of late twentieth century practices on the cusp of the emergence of digital technologies for the production of images and sounds. In 1997 and 1998, the author created her first three visual music works just at the end of the twentieth century using both analogue and digital video and audio technology (McDonnell, 'Dazzling and Blinding' (1997); 'Edges' (1998a); 'Towards One' (1998b). Then, video was recorded with a digital camera but it had to be outputted as an analogue video signal from the camera into the computer's special analogue-to-digital video converter capture card. At this time, the video camera and the capture card of the computer did not facilitate a simple file transfer of the digital video information stored

on the electromagnetic videotape from the video camera into the computer environment. Once the analogue video had been converted into a digital video signal and was in the computer, computational processes were used to manipulate the images and the sounds and the video was then rendered into a compressed video file. It was, subsequently, outputted through the capture card and converted back into an analogue video signal in order for it to be able to be stored on a VHS tape cassette and played back on a television monitor. These visual music works represent a technological bridge from the analogue video to the digital video technologies pertaining to their use in visual music compositions. The digital technologies developed swiftly at the beginning of the twenty first century, so that such conversion processes of various signals did not have to take place and there was more communication between devices from camera to computer and to projector. As mentioned earlier, an art research project that investigated the integrative capacitates of digital and computational technologies for the purposes of merging and connecting the audio and the video worlds through digital process took place at the end of the twentieth century that represented what was to come in the twenty first century. The 'Global Visual Music Project' (see 5.6.7.2) that took place just near the end of the twentieth century facilitated such a synergy of visual and music material through digital computational methods. This was an as the name of the project suggests, this was a truly global development. The representation of electronic audio and video signals as digital data enabled both a new form of interface and a new form of access to digital information through the coding and design of algorithms. The customisation of these algorithms could also bring about new forms of live audiovisual performance in which the data and the machine created the forms and the sounds, thus making data the truly global medium at the end of the twentieth century. Remarks on this project in light of developments in the electric audio-visual *ars-relais* of twentieth century concludes this chapter.

5.2 RADIOPHONIC ART

During the twentieth century, some artists used the medium of film medium to explore a shared expression of moving fine-art image and music. Absolute film, with its focus on the artistic possibilities of the film medium image, focused on abstraction and a non-objective subject matter comprising artistic explorations and presentations of pure colour, form and motion 'which doesn't use words' as McLaren (1974) puts it. The subject matter did not consist of literary story. In a parallel manner, the new medium of radio that also emerged in the twentieth century facilitated the development of a radiophonic art that could explore similar non-literary forms comparable to the development of the absolute film and the abstract film. Radio inspired new aesthetic ideas for the artistic exploration of sounds in themselves. Quoting Rudolf Arnheim's (1936) remark that '[I]n radio, the sounds and voices of reality revealed their sensual affinity with the word of the poet and the tones of music' (Arnheim, 1936 in Föllmer; van Dyck, trans., 2004), Golo

Föllmer draws attention, in his article on 'Audio art' (2004), to the aesthetic influence of radio on music, in particular on its 'consciousness expanding effect' (ibid.). Dieter Daniels likewise draws our attention to the earlier 'absolute radio art' theory of the composer and critic Kurt Weill (1900-1950) who, in an article on 'Possibilities for Absolute Radio' (1925), formulated a 'theory of a non-narrative, acoustically abstract "absolute radio art", ... with direct reference to absolute film' (Daniels, 2011, 21). In this article, Weill discusses the possibility of 'an army of new, unheard sounds that the microphone could produce artificially' (Weill, 1925, in Daniels, 2017) and that could result in 'an absolute soulful work of art, floating above the earth' (ibid.). Weill's wrote hundreds of reviews for the radio programme guide *Der deutsche Rundfunk* ('The German Radio'). Weill's was also a member of the *Novembergruppe*, the group that organised the *Der Absolute Film* matinée screening on 3 May 1925 (see chapter 3 section 3.4.2).

5.2.1   WALTER RUTTMANN – 'WEEKEND'

An example of radiophonic art was created by the pioneer absolute filmmaker Walter Ruttmann. In 1928 Ruttmann was commissioned by Berlin Radio Hour to create the film 'Weekend*'* (11'10", 1930). This film would have no visual images, comprising montages and collages of sounds that were nonetheless recorded using the new 'Tri-Ergon process' technology of the film camera that was being promoted by the radio 'which inscribes sound as a light track on the edge of film stock' (Daniels, 2011, 21).

Ruttmann collected and recorded sounds of the city of Berlin over a weekend, therein providing an acoustic picture of the city via the camera but without the image part. This audio film, then, tells a story with sound only. Or more significance, however, Ruttmann saw abstract artistic-musical capabilities of this instrument because he structures and organises the film according to rhythm and musical formulations, creating a form of sound montage. Thus, for Ruttmann, this audio film explores recorded sound for itself:

> Tones and sounds should exist in their own right. For 'Weekend' they were recorded as arbitrary and intentional elements on the soundtrack of an optical sound film using the so-called Tri-Ergon process. For the first time an artistic radio production was created whose material could be assembled and designed according to rhythmic, musical principles. (Weekend, n.d.)

5.2.2   JOHN CAGE – 'IMAGINARY LANDSCAPE NO.4'

In 1951, John Cage in the US used the radio as a music instrument in his piece 'Imaginary Landscape No.4' (Cage, 1951). The four minutes long piece deploys twelve radios where the team of performers tune into radio broadcasts and select different volumes and tones. Daniels explains the novelty of the piece in that it allows the 'mass media omnipresence of the broadcasting stations to be experienced as aesthetic raw material at the time of performance' (Daniels, 2004). Cage, in

other words, created a musical piece through the performance of the sounds of the radio using, what has come to be a prominent method amongst much for the electronic arts of the twentieth and early twenty first century, 'the side effects of technical media, which are typically absolutely undesirable in music, as musical material' (Föllmer, 2004).

5.2.3   NAM JUNE PAIK – LIGHT AND RADIO

Nam June Paik's interactive video art installation titled 'Kuba TV' (1963) uses a monitor displaying a single white light linked with a radio. The size of the white light is determined by the volume of the radio.

5.2.4   CECIL STOKES – USING RADIO BROADCAST TO GENERATE PATTERNS

Cecil Stokes (1910–1956) constructed a device that could project abstract imagery and playback music from a phonograph at the same time.   He patented this device in 1942, under the title of 'Process and Apparatus for producing musical rhythm in Color'. The title reflects very well the multiple functions and processes available within this device. Overall, the device could both produce and generate abstract material and patterns from music and from various light projection processes within the device. It could also perform and play back rhythmical coloured light that synchronises with the musical rhythm, and play back simultaneously with the music. The projected imagery with music was presented as one unit, with a screen for the output of the imagery and a speaker for the audio.   It consisted of various mechanical mechanisms for generating coloured light and rhythmic coloured light.   Many types of interactions could take place with the projected light source, from light interactions with rotating tinted glass plates and polarized light elements, to interaction with lenses. These processes together impacted on the final imagery result at the screen. What is most interesting in one part of Stoke's mechanism for the generation of the pattern is the process by which he uses radio frequency waves that have been generated from the audio signal of an audio broadcast — be it a live performance or phonograph record — in which the audio signal is passed to a radio transmitter and the radio waves are then directed to pass through crystallizing material in order to generate a direct pattern of the audio that is being broadcast through the formation of the crystals.   The crystallizing material sets slowly, embodying the pattern of the particular music broadcasted. The slide is used in the mechanism of the instrument as a basis for colour and light effects. This provides an early version of what you see is what you hear visual, and more importantly a visual that has a close relationship with the music. In the playback of the imagery and music,   Stokes notices this close relationship between visual pattern and music, remarking that,

> The slides that respectively represent portions of the records are shown on the screen simultaneously with the playing of the respective portion of the record. Thus the

audience is seeing the pattern produced by the portion of the phonograph record that
is being heard. (Stokes, 1942)

In the patent, Stokes explains in particular a detailed description of the mechanism for the
generation of the audio-to-image connection in the interaction of the radio waves and the
crystalline material (see Figure 46). He calls this description the short wave broadcasting set.

> In the carrying out of the present process and in the operation of the present apparatus,
> material that is adapted to crystallize upon hardening is disposed between the plates
> 48. Rhythmic or other sounds, either produced by a record or by the original
> instrument or artist, is received by the broadcasting set 86 through the wires 87.
> Mechanisms for transmitting to the set 86 is well known to those skilled in the
> art…During the crystallization of the material between the plates 48, the sound is
> projected from the antenna 89 to the plate 90, the radio frequency waves passing
> through the plates 48 and producing a definite pattern in the plastic material 49 that is
> crystallizing. As soon as the crystallization is complete, the pattern is set. (Stokes,
> 1942)
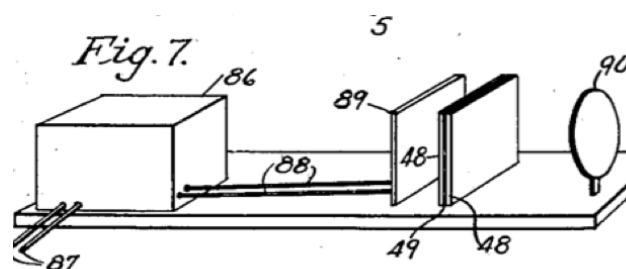
Figure 46 Cecil Stokes: Diagram of the shortwave broadcasting section of the device (Stokes, 1942)

Forsbery quotes the lighting artist John Sonderegger (Forsberg, 2013), who provides an even
clearer explanation of the audio-to-imagery process and how it might work with the duration of a
piece of music. This description shows how the music is spliced into tape loops and the visual
material is built up in a series of slides that represent the crystallization process that took place
with that particular loop of music:

> [Stokes'] procedure was to cut a tape-recorded melody into short segments and splice
> the resulting pieces into tape loops. The audio signal from the first loop was sent to a
> radio transmitter. The radio waves from the radio transmitter were confined to a tube
> and focused up through a glass slide on which he had placed a chemical mixture. The
> radio waves would interact with the solution and trigger the formation of the crystals.
> In this way each slide would develop a shape interpretive of the loop of music it had
> been exposed to. Each loop, in sequence, would be converted to a slide. Eventually a
> set of slides would be completed that was the natural interpretation of the complete
> musical melody. (Sonderegger quoted in Forsberg, 2013)

'Auroratone' was a term used to describe this technology and the mechanical process of rendering
music into projected rhythmically coloured images through the generation of crystal patterns and
light projection effects.

The Auroratone Foundation of America (AFA) was formed in 1944 for the purposes of
using Auroatone techniques and films in the therapeutic treatment of patients, suffering from

psychotic depressions in particular. Bing Crosby supported AFA and Stokes worked with Crosby who provided recordings of his singing to be used as soundtracks for the process in these auroratone techniques. Film print versions of Stokes' projected patterns were made for these therapeutic settings. To date, however, only one of these Auroratone film prints has survived (see Figure 47). Robert W. Martens recently found the 16mm film 'When the Organ Played "Oh Promise Me"' (ca. early 1940s), with music soundtrack by Bing Crosby. This 16 mm print was transferred to high-resolution Digibeta for its screening as part of the Sixties Synaesthetics Program and part of the 'Visual Music - Sensory Cinema 1920s–1970s' screening program by Northwest Film Forum, April 2010. Martens has also put a version on YouTube (Stokes, ca. 1940s).
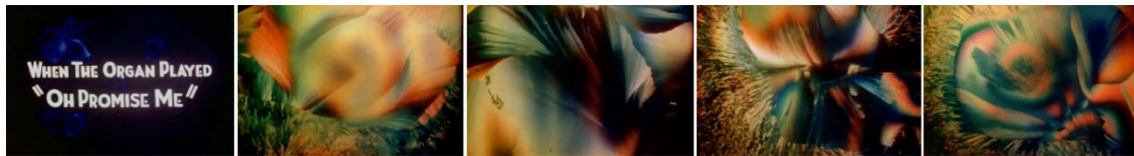
Figure 47 Cecil Stokes: Auratone film, c. 1940s. Frames from the film.

5.3   PIERRE SCHAEFFER AND HIS CONTRIBUTION TO THE *ARTS-RELAIS*

5.3.1   THE SOUND OBJECT AND *MUSIQUE CONCRÈTE* COMPOSITION

Pierre Schaeffer (1910–1995) was a French music composer, theoretician, music producer, arts administrator and an engineer active in research, training and experimentation with creative radiophonic techniques and in using recorded sound as the basis of music composition. While working at the *Radiodiffusion-Télévision Française* (RTF) in 1942, he went on to found the *Studio d'Essai* (1942–1946) in Paris, with the theatre director Jacques Cocteau, to conduct experiments with radiophonic sound (Gayou, 2007, 203). In 1951, he founded the *Groupe de Recherches de Musique Concrète* (GRMC, 1951–1958) with the engineer Jacques Poullin and the composer Pierre Henry (1927–2017). This research group was succeeded by the *Groupe de Researches Musicales* (Musical Research Group, GRM) in 1958 (Gayou, ibid.). In his music research experimentation, Schaeffer was at first interested in using the technology and resources of the radio studio, such as, recorders and record players, to realise a form of radio sound music drama constructed with the juxtaposition of the sounds themselves. He was also interested in composing a study of noises. To do this, he experimented with assembling and gathering sounds and listening to these sounds for their musical potential. In a journal entry about working on his *musique concrète* piece *Étude aux chemins de fer* (1948), Schaeffer writes:

> As soon as a record is put on the turntable a magic power enchains me, forces me to submit to it, however monotonous it is. Do we give ourselves over because we are in on the act? Why shouldn't they broadcast three minutes of 'pure coach' telling people that they only need to know how to listen, and that the whole art is in hearing? Because they are extraordinary to listen to, provided you have reached that special state of mind that I'm now in. (12)

Schaeffer referred to the sounds he had identified as having musical potential as 'sound objects'. By 1949, Schaefer's experiments with radiophonic sounds had developed into a new method and system of music composition with sound objects, for which Schaeffer coined the term '*musique concrète*' (music *concrète*):

> I have coined the term 'Musique Concrète' for this commitment to compose with materials taken from 'given' experimental sound in order to emphasize our dependence, no longer on preconceived sound abstractions, but on sound fragments that exist in reality, and that are considered as discrete and complete sound objects, even if and above all when they do not fit in with the elementary definitions of music theory. (Schaeffer, 1948, 14)

Michel Chion explains further what Schaeffer means by *musique concrète*:

> When in 1948 Pierre Schaeffer gave the name Concrète to the music he invented, he wanted to emphasise that this new music came from concrete sound material, sound heard for the purpose of trying to abstract musical values from it. And this is the opposite of classical music, which starts from an abstract concept and notation and leads to a concrete performance. P.S. wanted to react against the 'excess of abstraction' of the period, but he did not shy away from 'reclaiming' the musical abstract. A reclaiming which, for him, had necessarily to pass through a return to the concrete. (Chion, 1995, 37)

Part of the meaning and method of Shaeffer's *musique concrète*, then, refers to taking sounds as real audible sounds in themselves, that is, as real discrete existences but then, also, working accordingly with them together (musical *concretum*) in their musicality. The ordering and arranging of such 'sound objects', therefore, is not to be imposed externally on the sound objects by appeal to norms and principles of harmony as in classical music, as it were, but discernible within their juxtaposition to each other in their sonority. This involves listening to such founded, sound objects, but not as notes in a classical scale, but in terms of their musicality.

Brian Kane (2014) identifies and summarises the trajectory of meanings ascribable to the term 'sound object' in Schaeffer's writings. Initially, the sound object refers to the sounds that arise from source from the sounding of physical material objects, such as, for instance, using a stick to bang on a tin can. Schaeffer conducted many experiments with recording such sounds of physical objects. Schaeffer then changed his approach and instead of concentrating on the sounding of physical objects he focused instead on the sounds as recorded through the microphone. Through the intermediary of the microphone, he was able to concentrate on listening to sound sources recorded rather than the sounding material bodies. Thus, sound objects now

came to be associated with the identification of the musical qualities through this type of listening to sound through the microphone.

Commenting on this method of listening to sound for the purposes of experiencing the pure sound of sound itself, Kane notes that here Schaeffer follows the phenomenological line of eidetic enquiry developed by Edmund Husserl (1859–1938), the founder of the twentieth century phenomenological movement in philosophy. According to Husserl, our experiences are not limited to the experience of particular objects, such as seeing colours and sounds because we can concentrate our attention towards and identify essential properties (what Husserl calls 'essences') of those particular experiences themselves. Colour, for instance, as a general object can be an object of enquiry and directly intuited as much as colours; sound, too, as a general object, has its own essential properties. By varying our experiences of particular objects given to our actual perceptual sense experiences in search for the essence of colour, we reach an invariant limit, such as in the case of colours or coloured things, that colour cannot but be extended. Insight into the essence of colour as extended is part of our experiences of colours in their structural unity. This forms an essential component part of our knowledge of colour. Yet this general object or essence of colour is given to immediate universal intuition. Because we can search for and seek out such invariant essential features of our experiences, Husserl writes in his famous 1910–11 *Logos* essay 'Philosophy as Rigorous Science' that,

> Intuiting essences conceals no more difficulties or 'mystical' secrets than does perception. When we bring 'colour' to full intuitive clarity, to givenness for ourselves, then the datum is an 'essence' […]. As far as intuition— i.e., having an intuitive consciousness—extends, so far extends the possibility of a corresponding 'ideation' (as I called it in *Logische Untersuchungen*), or 'seeing essence' (*Wesensschau*). (Husserl, 1964, trans. by Lauer, 110–11).

According to Kane (2007), following such an eidetic phenomenological line of enquiry into 'the sound object' has two consequences for Schaeffer. Firstly, there is an emphasis on reduced listening over other forms of listening that focuses attention on sound itself. Secondly, the 'sound object' promotes 'an ahistorical ontology of musical material and technology' (Kane, 2007, 1). In other words, this kind of listening seeks essential features of our experiences of sound that are true of such soundings at any time in any period of time. 'For years,' Schaeffer remarks, 'we often did phenomenology without knowing it, which is much better than talking about phenomenology without practicing it' (Schaeffer, 1966, 262 quoted in Kane, 2007, 1).

Schaeffer's own theoretical work, then, follows in the train of Husserl's thinking, by identifying an analogous problem in the musical domain. Schaeffer writes,

> Let us note, at the very least, that a void exists between musical acoustics and music properly speaking, that it is necessary to fill this void with a science describing sounds, joined to an art of hearing them, and that this hybrid discipline clearly grounds our musical efforts [*que cette discipline hybride fonde évidemment la musique des oeuvres*]. (Schaeffer, 1966, 30–1 quoted in Kane, 2007, 2)

The specific art of hearing required, then, needs to be correlated to and grounded in the pure sound objects of that experience and vice versa. This much, in the musical world, means that knowing how sound manifests itself in all its sonority in sounds is part of this new hybrid discipline. Yet this possibility, nevertheless, was not taken up or addressed in contemporary efforts in music, nor could it, given their musical theory presuppositions.

Schaeffer recorded sounds from the real world and from real world objects onto phonograph records and experimented with the sounds by cutting grooves into the phonograph records and creating loops of sounds. He used mixers to create envelopes to shape the sounds. He discovered when listening to sounds through its repetition in a loop he could hear the relationships between the sounds. Burt writes that as a result of Schaeffer listening to sounds in this way, Schaeffer 'was much more aware now of the 'inner life of sound, of how timbre, envelope, texture, etc. affect the way we hear sound' (Burt, 2014). Here, the understanding of sound object was associated with the recorded sound fragment, which is a piece of recorded sound. The sound fragment, Kane explains, has significance for music composition: 'The recorded fragment, not the physical source, acquired the plasticity of compositional material' (Kane, 2014, 16). Through this experimentation, Schaeffer discovered that the ear took primacy over a music theory approach to organising sounds and that listening to sounds and categorising sounds from listening was a new form of music analysis based on the sounds themselves. Kane explains the objectivity that results from the repetition, listening and variation of sound:

> Many of the techniques developed for producing *concrète* works depend upon variation. The composer subjects pre-recorded sounds to filtration, editing, looping, reverberation, or changes in speed or direction. The results of such processes must be tested again within the sphere of listening, to determine whether these variations present us with 'the same' sound object, or new sound objects entirely. Each variation is an investigation into the objectivity of the sound object. (Kane, 2014, 33)

Chion also defines the sound object as a whole and coherent unity graspable through listening:

> The name sound object refers to every sound phenomenon and event perceived as a whole, a coherent entity, and heard by means of reduced listening, which targets it for itself, independently of its origin or its meaning. The sound object is defined as the correlate of reduced listening: it does not exist 'in itself' but by means of a specific foundational intention. It is a sound unit perceived in its material, its particular texture, its own qualities and perceptual dimensions. On the other hand, it is a perception of a totality which remains identical through different hearings; an organized unit which can be compared to a 'gestalt' in the psychology of form. (Chion, 1995, 32)

Chion, then, tells us in particular what a sound object is not. It is not the sound body, nor a physical signal, nor a recorded fragment, nor a notated symbol in a score, nor a state of mind. The sound object remains the same across different listening modes and the sound object has objective status. The varying of the particular sound to its limits is part of the real experiencing and perception of the whole sound itself. This 'sound object', then, guarantees the objectivity of

the experienced object which is recovered and recoverable in and through this form of concentrated 'reduced listening' as Chion puts it.

Warren Burt (2014) notes that Schaeffer's listening approach to analysing and categorising sounds for composition leads him to realise 'that all his [Schaeffer's] analytical tools are simply useful vehicles for an empirical "assemble-it-according-to-your-own-listening-and-instincts" kind of composing' (Burt, 2014). Schaeffer moved onto recording sounds with a custom-made tape-recorder(s) that he called 'a *phonogène(s)*' (Palombini, 1993, 542, n. 4). It had a keyboard attachment for adjusting and controlling the speed of the tape and thus adding another level of manipulation to the sound. Here, the sound object develops to be more than just a recorded fragment as it becomes part of the *designation* of something new to the fragment through listening and engagement with the sound. Through listening the objective status of the sound *as sound* emerges. In this process of listening, then, as Kane observes,

> More than simply a sample or bit of recorded sound, the sound object now suggestively appears to designate something 'discrete and complete,' the fruits of a mode of 'considering' or listening to the fragment torn from the whole. It seems to be the disclosure of a minimal unit of sound upon which to ground the project of *musique concrète*'. Essentially the objective status of the sound arises because the sound has been removed from its physical-causal source. (Kane, 2014, 16)

Schaeffer explains that this sound object is something real and concrete, and thus objective, because it endures through changes and various levels of listening:

> Schaeffer writes, 'We must therefore stress emphatically that [a sound] object is something real [i.e. objective], in other words that something in it endures through these changes and enables different listeners (or the same listener several times) to bring out as many aspects of it as there have been ways of focusing the ear, at the various levels of "attention" or "intention" of listening (*d'entendre*)' (Schaeffer 1966: 59 quoted in Kane, 2007, 5).

Commenting on this, Chion explains that music operates between two 'isotopes of reality' between the abstract and the concrete. They are part of every perception. The important aspect of composition, according to Chion, is to balance these two sides of reality, the abstract and the concrete.

> In its use of the pair Abstract/Concrete, the T.O.M. refers to the definition in the Vocabulary of Philosophy by Lalande: 'Abstract: every notion of quality or relationship considered in a more or less general manner without reference to any of its representations. In contrast, the complete representation as it is or could be is called concrete.' Abstract and Concrete are 'two isotopes of reality' (24), two faces of every perception, interdependent and complementary, which must be reconciled and balanced in music, against the excess of concrete (in '*savage*' *musique concrète*) or the excess of abstract (in serial and other types of 'a priori' musics). (Chion, 1995, 37)

In many respects, Schaeffer's attempt both to seek and to bring out the experiencing of sound itself as a general object, from concentrated listening efforts in varying recorded sounds themselves, for the purposes of developing a new form of musical composition of 'sound objects

themselves' — which he calls *musique concrète* — is an applied eidetic phenomenological analysis of sound and sounds *in concrete action* of the composer uncovering a realm of a musicality of sound objects that lies outside the bounds of both normal representational thought or perceptual experience and normal music. In this regard, *musique concrète* is an artistic *effort* in the realm of a musical technology of 'sound objects' that is comparable to the efforts of the abstract painting and absolute film making in the realm of 'abstract and absolute images' of the earlier twentieth century.

5.3.2   THE ACOUSMATIC LISTENING

In Kane's estimation, '[O]ne of Schaeffer's most original insights was to identify the connections between recording technology, the acousmatic experience of sound, and a theory of listening' (Kane, 2007, 4). In Schaeffer's theoretical writings on his research and experimentation with music technology in compositions, he developed the concept of acousmatic. The acousmatic is what remains after bracketing 'out the spatio-temporal causes, and distinguish[ing] them from what we are immanently hearing' (Kane, 2007, 3). What is sought is not any causal explanatory analysis of what it is that we are hearing in the sound, but the experiencing's of sounds themselves as the starting-point for his musical compositions. Kane writes that Schaeffer intends for our attention to be drawn to 'the sound's immanent properties and objectivity (Kane, 2014, 24)' and this is helped by 'barring visual access to the source of the sound (ibid.)'. Schaeffer refers to this to be an acousmatic reduction. Kane explains Schaeffer's definition of acousmatic:

> The acousmatic is defined as: '*Acousmatic, adjective: referring to a sound that one hears without seeing the causes behind it*' (Schaeffer 1966: 91). The term derives from the ancient Greek word *akousmatikoi*; it refers to the name given to the disciples of Pythagoras who listened to the master's lectures through a curtain. For the *akousmatikoi*, the physical body of Pythagoras was hidden, leaving them with only the sound of their master's voice. (Kane, 2014, 24)

Schaeffer considered the new telecommunications technologies of recording and radio as being a form of acousmatic, for, as Kane explains,

> For Schaeffer, working in the years after World War II, the new technologies of recording, telecommunications and radio were simply continuous with the ancient acousmatic traditions of the Pythagoreans. Schaffer writes, 'In ancient times, the apparatus was a curtain; today, it is the radio and the methods of reproduction, with the whole set of electro-acoustic transformations, that place us, modern listeners to an invisible voice, under similar circumstances' (Kane, 2007, 3).

We do not see the people, objects or events causing the recorded sounds whilst listening to the radio. In this regard, we, as 'modern listeners', are being presented with an invisible voice in recording telecommunications and radio. When this acousmatic is at work in the new technologies of recording and radio, however, it focuses one's auditory perception towards the new sounds themselves, so that one becomes aware of 'precisely what it is in my perception that

is given with certainty, or "adequately"' (Kane, 2014, 24). The adequacy, nonetheless, is not between the recorded sound to what has caused this phenomenal experiencing for the listener, as this is not present to be seen, but between the hearing and the heard sound itself. What the acousmatic does is to reduce sounds to be part of the experience of listening, and so, 'reduces sounds to the field of pure listening' (ibid.). Like Husserl, Schaeffer refers to this process as being 'a reduction', and so, 'after the reduction [is completed], only the acousmatic field remains'(Kane, 2014, 24). Kane surmises that, for Schaeffer, the '[A]cousmatic reduction promoted an *art* of listening (Kane, 2014, 26). '"Reduced listening" is Schaeffer's name for the audible act of attending to the sound apart from its source' (Kane, 2014, 28) and so what we hear is further explained by the context of the correlated hearing of the sound itself. This, in turn, becomes both the starting point and an integral part of his musical compositions. This is a new way of listening to music too. And it requires a new way of listening both to sounds and to music.

5.3.3   PIERRE SCHAEFFER'S TAXONOMY OF SOUNDS

Since Schaeffer's method of composing with sounds requires him to listen attentively to many recorded sounds, he believed that it would be useful to build a taxonomy of sounds '[T]hrough the selection and appreciation of sonic attributes (Kane, 2014, 29). Since there is no tone without timbre, or tone without intensity, or sound without duration or frequency, and so forth, then Schaeffer set about classifying and organising such 'concrete' attributes of sounds in a similar vein to how one would classify the sounds of a music instrument. Schaeffer devised a *Tableau récapitulatif de la typologie* (TARTYP) as a way to organise a taxonomy of sounds (Schaeffer 1966: 459). (Kane 2007: 5) (Kane, 2014, 29). In his later works, then, Schaeffer was able to work with this sourced material that he obtained and categorized from within his research into such a reduced field of listening to sounds. Thus,

> Rather than identify the source, these later works derive their material from a variety
> of sources, and then organize it in order to bring out some shared aspect, such as its
> grain, its duration, its register, or its timbre. (Kane, 2014, 29)

Once attention is directed towards these founded 'sound objects' and their sonic properties and qualities, and not to the external source that caused such 'sound objects', the focus of the enquiry must gear itself towards working with the essential attributes of sound because the next stage in composing is with such sound objects and sound itself, however generated. Thus,

> These features of the sound object are afforded by entendre. Sounds are not employed
> as indicative or communicative signs; rather, the object is used to focus the listener
> on some intrinsic feature of the sound, regardless of its worldly reference. (ibid.)

In this eidetic reduction to pure sound itself and its sonic qualities, it is of importance to set aside all natural perceptually founded acts of perception that source these sounds in the external world as it is the experiencing of sound itself that is the starting-point. Thus, as Cion comments,

> Indeed, it is important to distinguish SOUND as a physical signal and thus measurable by machines, and SOUND as a sound object, which arises from a perceptual, qualitative experience, which can no more be identified by a physical phenomenon than the perception of a colour is by a wavelength. (Chion, 1995, 15)

Once the 'sound object' is taken for itself as the directly intended correlate of the hearing, any form of causal analysis of those intended sounds (e.g., as sine-waves) cannot identified with what is directly experienced regarding sound itself. From this phenomenological perspective, then, as Kane correctly remarks,

> Although the acousmatic reduction does not bar the possibility of hearing sounds in relation to their source, when combined with the eidetic reduction, it changes the way sounds are conceptualized. They become audible phenomena, understood as ontologically distinct from their causal sources. Either we hear through the sound object to its source or attend to it for its own intrinsic features—but in either case, the sound object, taken as a phenomenon, has priority. This phenomenalization of sound, which is part and parcel of Schaeffer's acousmatic *epoché*, encourages the listener to understand sounds as objects, not as events. (Kane, 2015, 38)

Yet, listening to such 'sound objects' is not music; nor has listening to the essential features that go to make up sounds in relation to tone, timbre, duration, frequency, and so forth contain anything of musicality in itself as it were. There is still the music of these 'sound objects' to be composed and accomplished, that is, the task of rendering such 'sound objects' as an intrinsic component not only *in* but also *of* a musical experience. As Dack, quoting Schaeffer, correctly notes,

> And, in Schaeffer's own words from the 'Solfège de l'Objet Sonore': 'it's not acoustics, but it's not quite music' (7th theme, 8th point) – a good example of the 'in between' nature of disciplines to which he was referring with the word 'interdisciplines' (Dack, 2006, 3)

The art of working with these 'sound objects' and the solfege of their organization is why the musicality of *musique concrète* exists in the between of the *modern* disciplines of art and music.

5.3.4 The *arts-relais* and simulcra

Schaeffer's contribution to the research, development and production of the creative use of audiovisual recording and reproduction is less well known than his work in music technology and music composition innovations. He was directly involved in the production and overseeing the production of experimental film and *musique concrète* collaborations resulting in the output of several experimental films. According to Bizzaro, Schaeffer's interest in the audiovisual field predates his work in *musique concrète* (2011, 2).

Schaeffer was interested in how technology and its representations of sound and image both in radio and in cinema was influencing the development of new conceptions of art (ibid.) Indeed the audiovisual arts, for Schaeffer, announced a new and unique form of art which he endeavoured to explain by the concept of *arts-relais*, which is usually translated as the 'linking-arts' or 'indirect arts' (ibid.) or 'relay arts' (Palombini, 1993, 2) but conveys the notion of a point that goes between music and art that is facilitated by the common ground of technological advances in recording sound and images. Schaeffer wrote about this in his first major essay, *Radio et le cinema: esthétique et technique des arts relais* ('Radio and cinema: aesthetic and technique of the *arts-relais*', Schaeffer, 1941–42, 2010). Bizarro elaborates on Schaeffer's relationship between the *arts-relais* and technology explaining that Schaeffer saw that there was a lot in common between the recording of visual images and the recording of audio in terms of technology and aesthetics. The representation and imitation of a reality through recording technology for cinema and radio creates its own reality in the storage of the medium, what Schaefer calls a '*simulacrum*'. Bizarro explains, by noting that here '[T]he visual and audio images transduced into signals by the recording equipment and stored in a physical medium are none other than *simulacra* of the reality which artists manipulate in composing their works' (Bizarro, 2011, 3). When the *simulacra* are used directly, the 'reproduction *is* the work' and when the *simulacra are* used indirectly, the reproduction is the 'material which comprises the work, as colour for the painter, marble for the sculptor or notes for the composer' (ibid.). Schaeffer observes that cinema 'presents itself as the production of works starting from these *simulacra*' (Bizarro, 2011, 3–4, quoting Schaeffer, 1970, 22–23). Technology, then, can record and represent realities revealing its own nature as represented realties and new realities with which the artist can work. Thus, as Bizarro (2011) points out,

> In Schaeffer's perspective, the imitative process of the work of art reveals its own purely illusory nature by virtue of the representational processes activated by radio and cinema. It follows that, from this point of view too, there is no difference in principle between a painting featuring a face and a photograph of the same subject. Both are inevitably distanced from the original and, in depicting it, throw light on some characteristics while obscuring others. All that can perhaps be said is that direct and indirect representation are distinguished by the use the artist makes of such *simulacra*: if in the first case the reproduction *is* the work, in the second it corresponds to the material which comprises the work, as colour for the painter, marble for the sculptor or notes for the composer. (3)

So, the represented realities, the *simulacra*, of the radio and film can be used in its representative or non-representative dimensions by the artist in the way the artist works with that material. This is why Schaeffer insists, as Bizarro concludes, that a new art, borne out of new technological processes, can only develop its own language and unique nature 'once any temptation to burden the new technological discoveries with responsibility for extending the syntax of already consolidated languages has been abandoned' as only then 'the new arts can affirm their true

nature' (2011, 3). From 1960 to 1974, the research service of The French Radio (ORTF), in collaboration with GRM, produced '*concrète*' cinema works.

5.3.5   A FORM OF CINEMA ONE COULD CALL *CONCRÈTE*

In an interview with the actor Jean Desailly for a television programme '*Discorama*' (1959), Schaeffer explains his idea of the acousmatic as applied to cinema and in relation to films that could be produced at the GRM and ORTF. Schaeffer suggests there could be a new cinematic form that is both technologically and theoretically similar to *musique concrète* (Ina.fr, n.d.a). He is referring to the possibility for a new art to emerge from the new and developing audiovisual production tools for television and radio. Schaeffer is clearly taken with the idea of the relationship between concrete images and concrete music, and thus in exploring the sound object and the visual object, where both are following similar processes of production and investigation and which results in new content. Christian Gosvig provides a short paraphrase of Schaeffer's conversation with Desailly, drawing attention to Schaeffer's intention to 'develop a form of cinema that could be called *concrète*' as a visual counterpoint to *musique concrète* and explains how he tries to apply his idea of the acousmatic to cinema' (Gosvig, 2011). Schaeffer was also interested in the media structures at work in cinema and was inspired by the film works of Jacques Cocteau (1889–1963) (Tournet-Lammer, 2011, 240) and the film work and film theory writings of Jean Epstein (1897–1953). Marc Battier (2007) explains how Epstein's use of extra-musical sounds in his films inspired Schaeffer's interest in a 'new and specifically cinematographic music' and quotes Schaeffer:

> Schaeffer explicitly cited Jean Epstein at the time of the foundation of the Groupe de Recherches Musicales, with reference to his use of extra-musical sounds. The filmmaker, one can say, had already imagined that 'through the transposition of natural sounds, it becomes possible to create chords and dissonances, melodies and symphonies of noise, which are a new and specifically cinematographic music'. (Battier, 2007, 192)

It had been suggested to Schaeffer in the early radio broadcasts of experimental music that the new studio music might be used in the cinema (Anderson, 2015, 204) and as *musique concrète* developed Schaeffer commented about its television 'broadcasting potential' (ibid.). It was from this interest in sound for film that led Schaeffer and Pierre Henry to open up the studios to film directors and to build a library of sounds for film (ibid). Gosvig elaborates on what Schaeffer means by suggesting that these works of cinema *concrète* 'could be called *concrète*', noting that his use of the term is 'an attempt to elaborate on the concept of the acousmatic, that is so central to *musique concrète*' (ibid.). Once one records a heard object (sound) or seen object, one is removing causal considerations of the source of that particular 'sound object' or 'seen object'. Consequently, we can pay full attention to its aural or visible qualities. Since we pay attention to and see, as it were, the sound for the sound itself, many, at the time of the emergence of *musique*

concrète, referred to it as a cinema for the ear. Gosvig comments on the *Discorama* interview between Schaeffer and Desaily and notes that Schaeffer not only 'drew attention to the abstract forms' (Gosvig, 2011) in the selected film clips shown in the documentary but also noted 'the fact that we cannot determine what exactly creates these abstract forms, but only vaguely identify structures and figures' (ibid.). He contests the separation of the senses and believed that the audiovisual media facilitated an 'almost synaesthetic non-sense' (ibid.). By this he means that the normal sense that applies to visible images and audible sounds does not simply apply in these films. All the composers, rather, develop their own personal style and compositional ideas (ibid.). Thus, in sum, a 'concrete cinema seeks the attention and curiosity of the ear just as much as of the eye — the eye listens' (ibid.).

From 1960 to 1974, ORTF and the GRM produced in its early years, under Schaeffer's direction as head of the research department of the ORTF, several research-led experimental sound-image film experiment. A team of artists, composers, filmmakers, television producers worked on these audiovisual experiments (Sonore-visuel.fr, 2016). One of the aims of the research aspect of this collaboration was to forge 'links, correlations between art and technique (Tournet-Lammer, 24) and in the role of television and radio as a source of education and knowledge (ibid. 29). The films were mainly produced for broadcast and television and were conceived of initially as experimental television (ibid. 24).

5.3.6   FILMS FROM THE RESEARCH DEPARTMENT OF THE ORTF – 1950 TO 1975

The collaboration between the GRM and the Service of the Research of the ORTF from 1960 to 1975 in its early years yielded several experimental films and animations of moving images and *musique concrète* music compositions. Schaeffer directed the GRM and the Service of the Research of the ORTF until 1975. Most of these works were set to pre-existing music. They explored unique sound image relationships that were geared towards the new communication and broadcast technologies of radio and television. The films were created for the broadcast technologies of radio and television, but by extending these technologies so that a new form of content could be broadcast on television. The focus and purpose of the research into images and sounds was to create a form of experimental television consisting of experimental images and experimental music. The content, nonetheless, was not always abstract in the sense of abstract film of the 1920s and later, and sometimes the images were more similar to the music of images approach by the authors of *Entr'acte* and *Ballet mécanique* (see chapter 4 section 4.3.5). Each film has the pre-title credit of the following: RTF, Service de la Recherche, direction Pierre Schaeffer, Groupe de Recherche Image (see Figure 48).
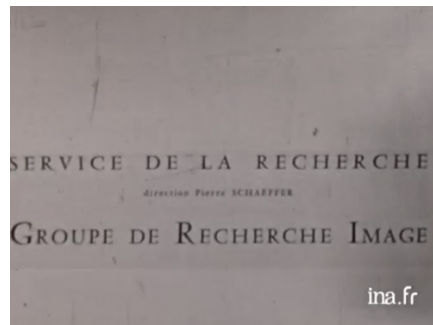
Figure 48 An information frame provided on the films created at the Service de la recherche Groupe de Recherche Images under direction of Pierre Schaeffer. Online archive at ina.fr (Arts sonores, n.d.)

5.3.7 'CONTINU-DISCONTINU' BY PIOTR KAMLER (1959)

The Research Department of French Television Broadcast (RTF) brought together a collaboration between the animation filmmaker Piotr Kamler with the experimental music by Luc Ferrari and Iannis Xenakis. The film is divided into two parts. Part one is set to music by Ferrari. Part two is set to music by Xenakis. The film is built on oppositions, such as, far and close, soft and hard, dark and light, large and small, big and small movements. (see Figure 49)

Other films by Kamler are: *Reflets* (Reflections) with music by Ivo Malec, broadcast 1961; *Danse*, broadcast 1961; *Galaxie*, broadcast 1964; *Tournoi*, broadcast 1965; *Etude 65*, broadcast 1965; *Lignes et Points* (Lines and Points) with music by François Bayle, broadcast 1966; *La planète verte*, broadcast 1966; *Délicieuse Catastrophe* (Delicious Catastrophe) with music by Robert Cohen Solal, 1966; *Meutre* (Murder), broadcast 1968; *Araignéléphant*, broadcast 1968, *Le Pas* (The Pas) with music of Bernard Parmegiani, 1975.

Figure 49 Piotr Kamler: Images from film Continu-discontinu, 1959/60. The images from the second part of the film were used again in the film, Etude 65 (Study 65), with a specially and newly composed *musique concrète* soundtrack.

5.3.8 *OBJETS ANIMES* (ANIMATED OBJECTS) BY JACQUES BRISSOT (1960)

Jacques Brissot was involved with the Image Research Group and created the images to a pre-existing *musique concrète* piece by Schaeffer. The film is titled *Objets animés* (Animated Objects) (see Figure 50). The film was funded by the *Service de la recherche de l'ORTF* (ORTF Research Service) and produced by the RTF. It was broadcast on television in 1960. It was a film that was part of a series of films created by filmmakers in the Image Research Group and the

composers in the GRM in which the films were made from pre-existing music. The pre-existing music in this film, however, is Schaeffer's *musique concrète* sound study made from the sounds of a ball bouncing on a cymbal. Brissot filmed the painter Arman working with rolling balls, necklaces and dripping ink on paper and interspersed the objects that Arman uses with the final results in the painting. The film images do not follow the '*la logique interne des phénomènes sonores*' (internal logic of the sound phenomenon) (Arts sonores, n.d.a) from Schaeffer's music; the images, rather, are inspired more by the narrative of the bouncing of the ball on the cymbal that is the source of the music. In an analogy with this narrative, therefore, Brissot films the painter dropping objects onto his painting and edits the film to consist of objects and the effects created in the content of the painting from the interaction with the object and the painting. Schaeffer notes, nevertheless, that '*tout collait*' (everything sticks) (ibid.) and makes the observation that, '*les choses, qu'elles soient Image ou Son, parlent le même langage'* ('things, whether image or sound, speak the same language') (ibid.) (see Figure 50). It would seem, then, that in Schaeffer's estimation, Brissot, the film-maker, in his artistic synchronisation of visual images and sound objects managed to achieve the kind of complete *arts-relais* unified artistic experience, and language that was not derivative of any consolidated language of the arts in painting and music or in an extended syntax of either *musique concrète* or abstract painting and absolute film to each other, but 'its own language and unique nature'(Schaeffer, in Bizarro 2011, 3).   Other films Brissot was involved with are: *Dans ce jardin atroce* broadcast 1964, *Caustiques,* broadcast 1960 *Fer chaud*, broadcast 1960, *Tic Tac*. Broadcast 1960.

Figure 50 Jacques Brissot *Objets animes* (Animated objects) - frames from the film (Arts sonores, n.d.a)

5.3.9   *ÉTUDE AUX ALLURES* (ALLURES STUDY) BY RAYMOND HAINS

The *Étude aux allures* film was made by painter Raymond Hains to pre-existing music. It makes an attempt to structure the images in a similar manner to the structuring of the sounds in the *musique concrète* composition.

The music is by Schaeffer and is of the same title *Étude aux allures* (1958). The composition is part of a series of compositions where Schaeffer's titles do not refer to the source sound but explore some aspect of the sonic and expressive quality of the sound such as its duration, its timbre, its pace, or its grain (Kane, 2014, 29). For example, other compositions that

do the same are: *Étude aux objets* and *Étude aux sons animés*. Earlier compositions by Schaeffer explore the source sound and reflects the source sound in the title, such as, in *Etude aux Chemins de fer* (1948) which refers to the study of recordings of trains at a train station that were used as the basis of the composition. Kane explains that in his later, more abstract compositions '[S]ounds are not employed as indicative or communicative signs; rather, the object is used to focus the listener on some intrinsic feature of the sound, regardless of its worldly reference' (2014, 29). '*Allures*' is a difficult word to find what Schaeffer means by it. Allures can be translated into English as gait or pace, and so, the piece title can be translated as 'Study on gaits or pace'. Gait meaning a way of walking and holding oneself while walking, the way one comports oneself. Dack, however, teases out what could be particularly Schaefferian meaning of the term in that it could refer to a vibrato or a movement, or a 'wobble' (Dack, 2006, 9). Indeed Schaeffer does delimit 'criteria of allure' for 'types of discontinuous sounds (crenelated)' in terms of 'stable', 'cyclical', 'continuous discontinuous descending/ continuous ascending', 'sparkling' (Schaeffer, 2012, 216).

If, however, one looks at the images by Hains, they are exploring motion and forms of vibrato or oscillation applied to the breaking apart of an image, resulting in a type of shimmering action across the screen. According to the archive of the film on the 'ina.fr website archive', Hains attempts a visual transposition of the acoustic law of oscillation and vibrato. He filmed a scene through a fluted lens that was attached to the camera lens, thus intervening in the image result in the camera and creating an optical vibration effect. The result is thus rhythmic colour and shapes. The archive notes that the coloured rhythm is made 'from the permanence of visual objects' (Arts sonores, n.d.b) however, now the object is de-objectified into a textural material with colour and pattern characteristics (see Figure 51).

Figure 51 Raymond Hains - *Étude aux allures* - frames from the film (Arts sonores, n.d.b)

Commenting on this film Schaeffer remarks on the kinship (*en parenté*) that exists between the sounds and images:

> Le plus remarquable, c'est l'aisance, précisément, d'un contrepoint qui pouvait se dérouler fort librement, dès que la structure des images et des sons était en parenté. Aucun besoin d'ajuster numériquement battements ou mouvements. C'est l'esprit qui comptait, et non la letter. (Schaeffer in *Le contrepoint du son et de l'image* in Arts sonores, n.d.b)

Translated as:

> What is most remarkable is the ease, precisely, of a counterpoint that could unfold itself with great freedom, as soon as the structure of images and of sounds was shared in a kinship [literally, parented]. No need to numerically adjust beats or movements. It was the spirit [of the kinship] that counted [in his piece], not the letter [of mathematically contrived adjusted audio-visual correlations]. (Schaeffer in *Le contrepoint du son et de l'image* in Arts sonores, n.d.b)

Étude aux allures was broadcast on the 1st channel, on January 01, 1960.

5.3.10 *ETUDE 65* (STUDY 65) BY PIOTR KAMLER (1965)

Etude 65 (Study 65) by Piotr Kamler was a study film made in 1965. It consists of the same film 'Continu discontinu' (1960), but without the music made by Kamler in 1961. This film, instead, was reset to new music and became the basis for the composition of a *concrète* music composition by Beatriz Ferreyra. Original music was composed specially for the film, and the result is described as '*une expérience audiovisuelle singulière* (a singular audiovisual experience)' (Arts sonores, n.d.c) (see Figure 4).

5.3.11 *LIGNES ET POINTS* (LINES AND POINTS) BY PIOTR KAMLER (1961)

The film *Lignes et Points* (Lines and points) was a work that was created as a result of a collaboration between Kamler and the *musique concrète* composer, François Bayle. It was conceived as a work exploring acoustic *concrète* sounds and *concrète* images. The intention was to create an abstract film (ref) and it was broadcast in 1966. It was also, however, conceived as part of *The Acoustic Experiment* and was to be staged with four tracks of music and a big screen projection of the film.

Both artists choose the preliminary material they would work with in both images and sound. They wished that the sound and image would work in parallel, creating an imaginary universe (Arts sonores, n.d.d) ,resulting from working in parallel between the images and sound. The images suggest sound impacts, approaching, retreating, explosive surges (ibid.). Similarly, the sounds are based on a similar theme of the lines and points – pulses as points and resonances as lines (ibid.), resulting not so much in a tight synchronisation of images and sound, but in a 'poetic meeting of the image and the sound (ibid.) (see Figure 52).

Figure 52 Piotr Kamler: Images from film *Lignes et Points*, 1961 (Arts sonores, n.d.d)

5.4 THE KINETIC AND THE ACOUSMATIC

5.4.1 ELECTRIC LIGHT AS AN ART OBJECT

Kinetic art enables artists to include the dimensions of movement and light into their artwork. Kinetic painting is one particular form of kinetic art that makes use of actual paint in the picture composition whilst also including a mechanism for allowing the temporal evolution of changing picture elements. All of this takes place and unfolds within the defined construction and confines of the painting in its final presentation. The final presentation typically comprises a translucent screen onto which the changing light and colour-effects are reflected or projected. The changing picture elements, such as, the motion of light forms or the changing of colours, are produced by the addition of a constructed system that becomes part of the final presentation of the painting but is involved in the design and production of the changing elements at the construction stage. Frank J. Malina (1912–1981) calls this constructed element of the painting that enables movement and change, 'the kinetic painting system'. This system, then, is an integral part of both the composition of the painting and its final rendition as a painting. The system can consist of mechanical, electromechanical or chemical processes and it provides a mechanism by which the final picture composition comprises a picture composition of moving light forms and colours that change over time.

5.4.2 ELECTRONIC REPRESENTATIONS - A COMMON ART MATERIAL

A characteristic feature of electronic technologies, whether the representation is of sound or image, is the material of the representations has a common basis in the medium of electricity. This electronic information cab then become the material basis for either representing the sounds and images or for transforming and creating *new* electronic sounds and images. Schaeffer's concept of *simulacra* and *arts-relais* theorise on the new realities of such representations of arts through technology and the impact these new representations have on the creation of new techniques and methods and for new art forms. Schaeffer's observations about the inevitable new arts that come from new material representations of images and sounds serve as the foundation for a very strong contemporary practice in visual music, which is the combination of electroacoustic music and visuals for video projection in the music concert setting.

In the 1960s, Schaeffer and Malina compared acousmatic music and kinetic painting, noting both similarities and differences that have arisen in the acousmatic and the kinetic as enabled through the techniques, methods and means of the electronic mediums and technologies. The infinite possibilities of the kinetic and the acousmatic are still being explored with the

facilitation of new techniques for combining visual and music information to create new manifestations of visual music worlds. As the twentieth century draws to a close, the new technologies and techniques arising from the digital representation of the electronic signal representation of sounds and images has provided another layer of possibility to the exploration of visual music worlds for art presentations and music concert performances. The 'Global Visual Music' research project, led by Vibeke Sorensen, resulted in pointing the way to the new possibilities for relating images and music through their digital representation, computation and manipulation and synthesis into new forms of visual music relations as well as new types of image and sound interaction in an integrated presentation of images and sound. The *simulacra* from the digital representations continues to be explored in the twenty first century visual music approaches to combining images and sounds in combined art and music presentations.

5.4.3   FILMS MADE WITH KINETIC SCULPTURES AND *MUSIQUE CONCRÈTE*

How to generate abstract imagery for film has always found experimental filmmakers seek out their own methods and techniques for doing so. Eggeling used cut outs to create a graduated series of forms and shapes that were then photographed. Fischinger devised a wax slicing machine to generate evolving forms in time that were photographed. Hains used a fluted lens to create a type of oscilloscopic pattern matching the oscillations in the abstract *musique concrète* sounds of the music. Nicolas Schoffer's created kinetic sculptures projecting colour and light in motion through the mechanics of his sculptures. He worked closely with the composer Pierre Henry in realising dance performance works, in which his kinetic light and colour sculptures were used in the scenography. Jacque Brissot created a film content that was based on recording the results of the projections and reflections of Nicolas Schoffer's kinetic sculptures and set the images to an extract of music from the music composition '*Diamorphose' by* Iannis Xenakis. The film is called '*Fer chaud'* ('Hot Iron') and it was broadcast in 1960. The sculpture provided a new type of content of light effects in motion. However, cinematographic techniques of rapid editing of images was also used and the editing and motion effects of the images were set to the music. The images thus were dematerialized through the projection of the kinetic sculpture in the translucent screen. There are salient audiovisual meeting points nd the visual editing seeks to amplify the movement of shapes and lights of moving sculptures that dance on the screen. Rather than focus on a synchronisation of images and music by the rhythm of the images, there is an emphasis on the audiovisual contrasts of the slow inflections of Xenakis' music and its morphology and amplitude and the matching of these musical elements with the internal movements of the light and colour dematerialised images (Ina.fr, I, n.d.b) (see Figure 53).
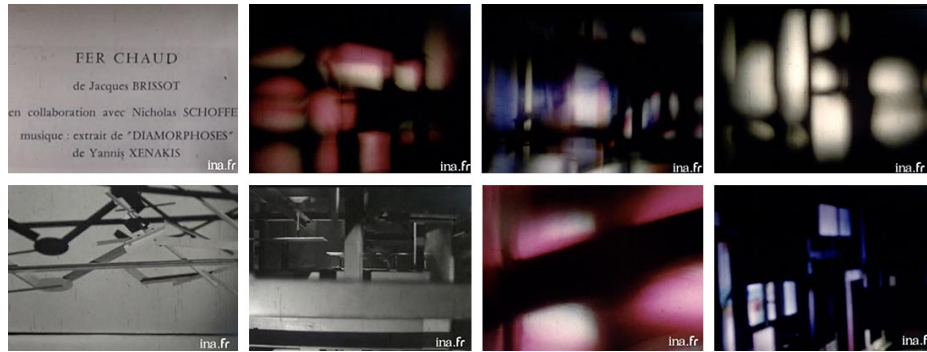
Figure 53 Fer Chaud by Jacques Brissot, 1960 set an extract of music by Iannis Xenakis. (Ina.fr, I, n.d.b)

All of this produces a visual experience of a moving art-work that contributes to the musical experience and be at the same time in concert with the music experience.

5.4.4   FRANK J, MALINA AND KINETIC PAINTING SYSTEMS

Malina was one of the leading artists and technicians in the field of kinetic painting. He edited the collection *Kinetic Art: Theory and Practice* (1974) which contains a selection of articles from the Leonardo journal that document and discuss kinetic art works by other artists, technicians and theorists also active in the field of Kinetic Art from the 1950s to the 1970s. Malina started out as an aeronautic scientist and was the first director of the Jet Propulsion Laboratory at the California Institute of Technology, US. He joined UNESCO. In 1953 he embarked on a full-time career in painting. He founded the Leonardo Journal in 1967, as he wanted to provide a professional research platform where artists could document and disseminate their work, just as the science community do. After having worked as a scientist, he noted,

> how the working conditions and environment of the artist differed from those he had experienced as a scientist and engineer. Working scientists always wrote about their own work in professional journals; they were always the first interpreters of their ideas. In art, there seemed to be no professional journals where artists were allowed to write about their work. (Malina, 2011)

Malina devised several kinetic painting systems: Electro-painting; Audio-kinetic work; Kinetic painting - Interupter system; Kinetic painting - Lumidyne system; Kinetic painting - Polaridyne system; and Kinetic painting - Reflectodyne system. These painting systems evolved over his art career and arose from his interest in exploring the aesthetics of 'producing a pictorial composition on a translucent flat surface that changes with time it without resorting to the projection of light through film in a darkened room' (Malina, 1974b, 37). Two articles he authored, document his methods and approaches to kinetic painting. These are, 'Kinetic Painting: The Lumidyne System' (1968) and 'Electric Light as a Medium in the Visual Fine Arts: A Memoir' (1975).

His first paintings explored the moiré effect, colour and transparency by using layers of wires, strings and fabrics. He was interested in the possibilities of exploring how superimposing layers of material can achieve transparency. Frank Popper explains how 'a certain transparency had been obtained by the adoption of materials fitted into a multi-planed arrangement and that this drive to find different ways to produce transparency led him [Malina] to discover the third dimension in the painting' (Popper, 2000). Malina's wire mesh work 'Transparent Sinusoidal', made in 1954, is a 'structure of several layers of wire mesh, painted mainly on the top layer. The colour is laid on in geometrical patterns not necessarily following the texture of the wire meshes' (ibid.) (see Figure 9).

Malina was interested in how the spectator's change of position, when viewing the painting, would create a movement effect, thereby the painting would produce a sensation of movement in the spectator. A virtual movement is created as a result of a fringe effect, for, as Popper explains:

> As the observer moves, multi-concentric circles radiate in an unexpected manner in different directions. This 'virtual' movement is in subtle contrast with the geometric pattern of the wire meshes and gives an added interest to the sensation of transparency. The fringe effect is obtained from superposed layers of wire mesh. (ibid.)

Malina's interest in exploring the moiré effect and in a desire to improve the 'contrast between a moiré pattern and its background and support' (Malina, 1975, 109; 1987, 407) and thus to improve on the transparency and third dimension effects led him to discover that 'one could use electric light as an art medium' (ibid.; 1987, 408). He experimented with using a 50-watt electric light bulb that he placed at the back of the layers of mesh in his painting to assist both in creating a depth effect and in separating out the mesh and wire layers to assist with the movement effects he was after. His first attempt, however, with electric light caused the painting to go on fire. Experimenting with the appropriate technicalities for using electric light and painting, he finally made his first successful electric light painting in 1955, titled 'Illuminated Wire Mesh Moiré (see Figure 9). He called this new type of painting an 'electropainting'. Malina's period of electropainting taught him 'a considerable amount about the transparency of colour and the use of translucid surfaces' (Popper, 2000) as well as using electric light for artistic purposes. Malina explains how an electropainting is made:

> A stained glass window is an example of an object using the direct transmission of light through a surface made up of transparent, translucent and opaque materials. My electropaintings are of this type of visual art. They are made in the following way: Incandescent clear or opal (frosted) lamps of up to 15W or fluorescent tubes are mounted on the rear surface of a case or frame and light is transmitted or projected through a pictorial surface directly to a viewer's eyes. The pictorial surface, placed near to the light sources, consists of a translucent sheet or plate on which a composition is either painted or made up of a collage of various materials of different colours and transparency. (Malina, 1975, 112; 1987, 410)

By substituting flashing lights for a static light source, Malina was able to add kinetic elements to the painting; he called these paintings, 'kinetic electropainting'. In his work, 'Jazz' (1955) (see Figure 54), the flashing lights were controlled 'by thermal interrupters in the electrical input circuit of each lamp' (ibid.). This results in a type of picture where 'one or more light bulbs go on and off at intervals of one or more seconds illuminating different portions of the picture' (Popper, 2000). Eleven shapes in the picture are 'illuminated by eight on- off flashes of about one sec. duration and by three of about five sec. duration' (ibid.). This created an element of randomness and rhythm in the appearance and duration of the flashes. Popper remarks that, in relation to movement, 'it is only light itself that moves, so that the sense of movement which the observer feels, results from the animation process of seeing portions of the painting in a time sequence' (Popper, 2000).

Figure 54 Frank Malina: L-R: 'Transparent Sinusoidal,' Wire mesh picture, 1954. Photograph Fabrice Lapelletrie. (Malina, 1954) *Illuminated Wire Mesh Moiré*, Electropainting, 1955. Source: Havránek, Vit (2008), 'Who was F.J. Malina?', International Festival for art, science and new technologies (Prague, Czech Republic), 8-15.; 'Jazz' (1955), kinetic electropainting painted wire mesh, tracing paper, coloured cellophane, wood and incandescent lamps with thermal interrupters in circuits (Malina, 1955).

Malina also discovered that the flashes of light worked really to the accompaniment of music, where the 'flashes at times appear to have a definite rhythm that becomes especially noticeable when the picture is viewed while listening to music with a rapid tempo' (Malina, 1975, 112; 1987, 410).

5.4.4.2   MALINA – ELECTRIC LIGHT AS AN ART OBJECT

Malina identified three different types of ways to use electric light as an art object. Applying light for artistic purposes was considered to be a new medium for art. These early experiments with electric light and with kinetic effects, led him to develop more sophisticated kinetic painting systems in which he could improve both the kinetic motion effects and the changing colours in his painting compositions. Electropainting and his subsequent Lumidyne system of kinetic painting are examples of the 'Transmission of light from within an object directly to the eye or onto a translucent screen or external projection of it onto an object' (ibid.). In his Lumidyne Kinetic system, which he invented in 1956 with the assistance of the electronics student Jean Villmer, he sought to device a system where he could 'produce a kinetic picture with continuous

motion and continuous changes of coloured light' (ibid.). He added electromechanical means for providing more continuous motion, incorporating small silent motors in the painting system to power changing light effects. This in addition to the systems he used to incorporate electric light sources and materials to intercept the light sources resulted in him achieving the effects of continuous motion and continuous colour changes that he was after. The Lumidyne system (see Figure 10) incorporates painting elements along with the electric and electromechanical elements and is described by Malina:

> In the second system, which I developed in 1956, the main composition is painted on a fixed, transparent plate (the Stator), and a design is painted on a rotating transparent disc (the Rotor). Light from incandescent bulbs or fluorescent tubes is transmitted directly through the Rotor and then the Stator on to a translucent plate (the Diffusor) to produce a picture combining light, colour and movement. I have called this the Lumidyne system. (1974b, 37)

The motion of points and areas of light on the Diffusor is determined:

> (a) by the motion of the Rotor, (b) by the arrangement of opaque and transparent areas on the Rotor and Stator and (c) by the distance between the Stator and the Diffusor. For example, consider the case in which the whole of the Stator is painted with opaque paint except for a fine vertical line intersecting the center of the Rotor, and the whole of the Rotor is painted opaque except for a fine curved line bent in a direction opposite to that of rotation from the centre to the edge of the Rotor. Then, when the Rotor makes one turn, on the Diffusor a point of light will be visible which moves vertically upward from the center of the Diffusor until it disappears at the top edge to reappear again at the center and move downward until it disappears at the bottom edge. In this way rotational motion can be converted into translational motion. (ibid., 38-40)
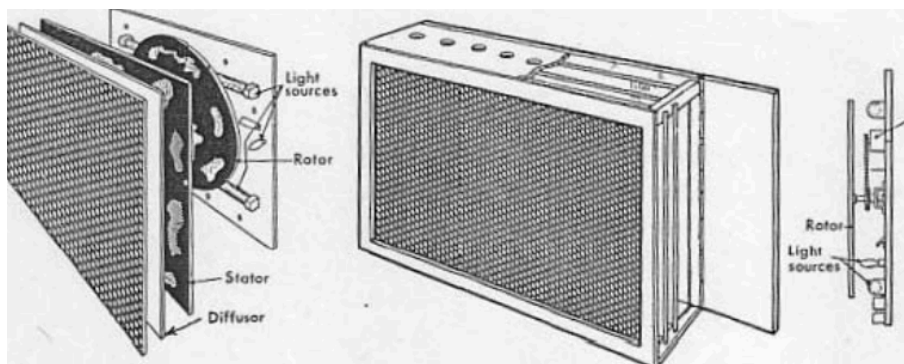
Figure 55 Frank Malina, Diagram of the Lumidyne System. Source: Malina, Frank J. (1974b), 'Kinetic Painting: The Lumidyne System'

5.4.4.3 MALINA – FIXED COMPOSITIONS

Malina's kinetic paintings consist of both fixed compositions and moving and changing colour elements. The fixed composition element is determined by the design that he paints on the fixed transparent plate (the stator) and the composition he also paints on the rotor. 'The rotor design

controls the motion and colour changes within the composition' (Malina, 1987a, 411) as does the arrangement of motors and light sources on the backboard. His method of painting consists of testing the arrangement of parts with the initial composition painted onto the Rotor. He experimented with the results he achieves in this phase of the painting, using gouache painting and cellophane to test the colour and light pattern effects. When he is satisfied with the result, he goes onto to make the design and placement of colour and transparency more permanent which 'consists of painting the opaque portion of the designs with black-board paint and the coloured areas in transparent oil paint' (Malina, 1974b, 41)

Figure 56 Frank Malina: Frank Malina working on one of his kinetic paintings. Still from the film '*Frank-Joseph Malina, Peinture cinétiqu*e' (Malina, 1966); 'The Cosmos' (Malina, 1965).; Sink and Source, Three-component Lumidyne system (one Rotor) (Lapelletrie, 2008).

The painting 'Cosmos' (see Figure 56) is an example of a painting devised with the Lumidyne system, it consists of '65 incandescent lamps and 55 fluorescent tubes, 29 rotors, 13 synchronous motors' (Malina, 1987, 411). A variation of the Lumidyne system is the three-component Lumidyne system, in this system he did not use the diffusor and it consisted instead of just three components, lights, rotor and stator. The painting composition was painted on the stator only and not on the rotor.

> Three-component Lumidyne paintings may also be made without the use of a Diffusor by painting a traditional opaque picture on the Stator with transparent lines and areas. In this case the variety of motions that can be introduced is more limited, and the visual quality of the picture is sharper and 'colder (Fig. 6). (Malina, 1974b, 41; Malina, 1966b)

5.4.4.4   FRANK MALINA – AUDIO-KINETIC REFLECTODYNE SYSTEM

A second way of working with electric light as an art object identified by Malina was the 'Production of shadows of shaped materials and of light images produced by refraction and reflection from mirrors and polished surfaces onto a translucent screen or onto an opaque surface' (Malina, 1987, 408). Malina puts Thomas Wilfred's lumia art in this category and also his Reflectodyne system of kinetic painting, which arose out of the experiments by the Electra

Lumidyne International (ELI) in developing audio-kinetic electric-light art devices. ELI developed two prototypes, titled Chromie No.1 and Chromie No.2. Chromie No.1 added to the usual image-making aspects of the device a light beam that projected onto a rotating colour wheel in which the beam shone onto a rotating polished disk, which was reflected onto a rotor and then reflected onto the diffusor. Chromie No.2 devised a system in which the intensity of sound could affect the motion of light images reflected onto a diffusor. The parameters of sound that control the motion are the sound intensity and three frequency bandwidths of high, low and middle ranges. This system can separate the sound input into three frequency bands, and each frequency band is directed to its own collection of rotation devices and an individual rotor. The frequency information of the sound input, therefore, can thus also control motion.

> The second prototype (called 'Chromie No. 2') is an audio-kinetic object in which the motion of light images reflected onto a diffusor is controlled by the intensity of sound. This is accomplished by projecting light from a special clear 150W incandescent lamp (Type GE DFA) with a built-in reflector onto a small aluminum foil mirror mounted on the needle of a potentiometer whose deflection is dependent on the intensity of sound within a selected frequency range of the sound input. The light from the mirror is then directed onto a single rotating shaped polished aluminum rotor from which it is reflected onto the diffusor. There are three such units directed at the rotor- one for the low, one for the medium and one for the high frequency range into which the sound input is separated. In front of each lamp a filter of different colour can be placed. (ibid. 412-413)

Malina made improvements to these prototypes so that they would create a more interesting and varied visual result and experience. He named the improved system the Reflectodyne system (see Figure 12). This system could produce 'either a kinetic or an audio-kinetic picture' (ibid., 412). The Reflectrodyne system, similar to the Chromie prototypes, operated with a beam of light projected into the image-making compartment. Motor-rotated colour filters intercepted the beam of light, thus allowing a change of colour to take place. The light beam also strikes reflective surfaces, such as, mirrors and shapes of polished metal, which, in some cases, are rotating. The final colour images are produced on the diffusor. The rotation of the surfaces take place at different speeds by means of a synchronous motor. An example work using the Reflectodyne system is Flowers (1965) (see Figure 57).

The audio-kinetic version of the Reflectodyne system adapts the motor elements to drive the rotation of some of the image-making parts so that their rotation is controlled by the sound intensity and sound frequency information of a sound input. This results in the audio information controlling the motion of the image. The sound control part of the audio-kinetic version of the Reflectodyne system contains 'an electronic circuit consisting of a microphone, amplified and two-way relay' (Malina, 1987, 413), which controls the current input of a reversible electric motor, which controls the rotation of some of the mechanical parts in the device. Malina describes its mechanism:

Below a given threshold of sound intensity, the relay in its first position sends a current to the motor, causing it to turn, say clockwise, and when the sound intensity exceeds the threshold, the relay flips to its second position and causes the motor to turn in the opposite direction. When rhythmic music or any sound of strong variation in intensity is picked up by the microphone, the light images of the kinetic composition on the diffusor will move back and forth in phase with the sound input… A circuit with a thyratron in place of the relay can be inserted to cause the intensity of an incandescent lamp to vary in phase with the variation of the volume of sound input. (ibid.)
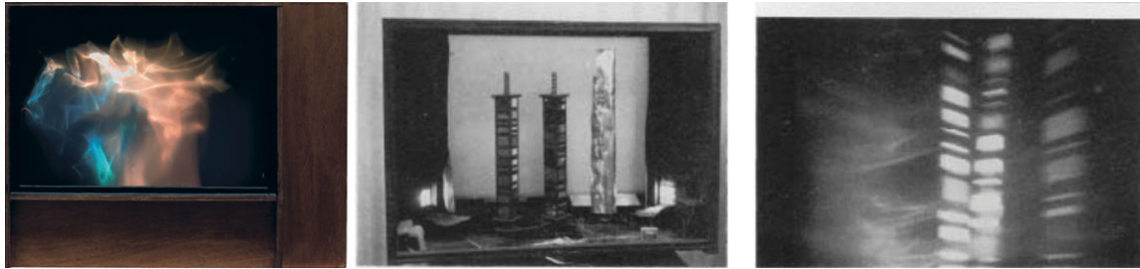
Figure 57 Frank Malina: L-R: *Flower*, Reflectodyne system, 1964 (Lapelletrie, 2008) (Malina, 1964); Audio-kinetic painting, *Entrechats* II, No. 985/1966, using the Reflectodyne system, 1968. View 1: interior view. View 2: an image on the diffusor (Malina, 1968c).

Malina's work *Entrechats, II* (1966) is an audio-kinetic painting using the Reflectodyne system. Two other audio-kinetic works also use the audio-kinetic version of the Reflectodyne system: 'Three Figures I' (1966) and '*La Marseillaise*' (1967).

5.4.4.5   MALINA - LIGHT AND POLARIZING AND BIREFRINGENT MATERIALS

The third way of working with electric light as an art object is the 'transmission of light through light polarizing and birefringent material' (Malina, 1987, 408). The Polaridyne system of kinetic painting was devised by Malina in order to take advantage of the colour changing possibilities afforded by the fact that light can be polarized, 'when light is transmitted through a polarizing plastic sheet or polarizer, only that fraction of incident light passes through that has its transverse vibrations in a particular plane parallel to the optical axis of the polarizer' (Malina, 1987, 414). In this system, he extends the Lumidyne system of kinetic painting by incorporating polarized light and he also makes use of birefringent material to assist in changing the colour in the painting. Malina explains how the birefringent material work in terms of changing colour:

> If a birefringent material with the property of splitting a beam of light into two beams that travel through the material with different velocities (owing to the material's nonisotropic crystalline properties) is placed in polarized light, effects are caused in the light that, when this light is passed through a second polarizer, give rise to changes in the colours perceived. (ibid.)

The Polaridyne technique consists of:

> (1) a polarizer is attached to a transparent or translucent rotor made of polymethylmethacrylate plate (a plastic manufactured under trade names such as Plexiglas, Perspex, etc.) (2) the stator is a sandwich made of a plate of transparent

Plexiglas (nearest the rotor) with pieces of birefringent material fixed to it, then a second polarizer sheet and, finally, another plate of transparent Plexiglas (ibid.).

5.4.5 MALINA INTERVIEWS SCHAEFFER – ACOUSMATIC SOUND AND KINETIC PAINTING

In an interview Frank Malina conducted with Pierre Schaeffer on the marriage of sound and image in 1972 (Malina & Schaeffer, 1972), Schaeffer draws our attention to the importance of exploring sound for itself and its intrinsic qualities without reference to the sound's origin or its image. In his development of *musique concrète* where he explores recorded sound for its own intrinsic sound qualities, he attributes this development to 'the fact that sound has been separated from visual images and that one can master sound in itself' (Malina & Schaeffer, 255). Acousmatics, he explains, was a way to experience sound that already been noted in ancient Greek times, where the meaning of sound is studied when its origin is ignored or unknown. Hence, for Schaeffer, it is of importance that there is an absence of an image connected with sound in order to pay attention to the sounds themselves. When the image of the sound is not associated with the sound, one has to listen more attentively because 'I [Schaeffer] am [is] forced to modify my [his] listening, to penetrate into the sounds alone' (ibid., 256). By comparison, the kinetic painting on a translucent screen that Malina created with his lumidyne system deploys a mechanism where 'the images initiate sounds by means of photocells directed upon the screen' (ibid., 256-57). The technology for this sound and image connection is hidden to the spectator. Malina compares this not knowing how something is made as comparable to acousmatic listening because the audience has to engage with images and sound connections that are not known. By inference, Malina's comparison seems to suggest that the audience is forced to penetrate into the sounds and images alone. Schaeffer notes too that familiarity plays a part in whether one pays attention to production or ignores it, making the point that there is a familiarity with music instruments and the sounds they make, so a listener is not as concerned with working out how the sound is produced. For both images and sounds, however, the impact of new technologies in the twentieth century have played a role in allowing one to access the intrinsic qualities of sound and image. In sound, Schaeffer goes onto explain, 'a technology from broadcasting taught us how to capture sounds and to condition them for another purpose' (ibid., 259). Comparing the impact of this technology on sound, Schaeffer compares it to the impact of technology on images. 'Sounds were torn out of their ephemereal existence and transferred on to tapes – just like images are transferred by camera onto a support' (ibid.). These technological advances also came about at the same time as changes were happening in the broader movements in music and art. In music, there was a change from traditional western music to a more abstract music, so too in art, there was a change from representation in art to the introduction of abstraction. Such technological and artistic changes have allowed for a more abstract exploration of sound and images.

When it comes to discussing the correlation of sounds and images, both agree that seeking out external causal relationships based on some physical or psychological correlation is not productive. Schaeffer, in fact, argues further noting that even where the blending of sounds and images seem to be based on the same physical phenomenon, such as the 'images of sounds [that] can be produced easily on a television screen by using an oscilloscope' (ibid., 251), this does not mean that there is actually a physical connection between the sound and the images, or that what one actually sees and hears is an explanation of causes. In this scenario of seeing the vibration pattern in the images produced from sound patterns, the connection between the two has more to do with a correlation where 'the image of vibration is correlated to sound vibrations' (ibid.). Schaeffer further elaborates that there is no causal intrinsic unity between the images and music patterns but that the phenomenon of a relationship existing between the two is simply a temporal correlation between simultaneous events, with no real intrinsic unity as the causal source of these correlation occurrences; it is, rather, a relationship of co-incidence. What works best aesthetically, for Schaeffer, is not a connection between images and sounds that are based on naturalistic or physical causes, but when sounds are blended artificially with images where we might arrive at 'satisfying combinations' (ibid., 256). The blend is not a seeking out the causal relationship between sounds and images. Malina, too, likes the openness of such an approach to focusing on similar processes for combining images and sound and the possibilities of this approach rather than focusing on physical or psychological correlations. This means that there 'is no unique combination of an image with a sound' (ibid., 257). As a result, one 'has enormous freedom of choice' (ibid., 257) in how one chooses to combine images and sounds. Schaeffer explains how sound reinforces images and that images and sounds quite easily combine for audience without an artist having to even make connections between them. There is a freedom, within limits, for the audience too as part of the aesthetic experience is the reception of the work of art, and so, it is up to the audience (whether that be the composer or the listener-viewer-reader) to complete the meaning of the experience itself and their connections. This explains why, as Schaeffer notes, if one takes a film and dubs in haphazardly with any music from records or tapes, experience shows that the spectator will still find a significant correlation between them. When taking together, sounds always reinforce images in one way or another (ibid., 257).

Schaeffer and Malina give their views on some of the characteristics to consider when blending images and sounds. Schaeffer advocates that the 'blending of sounds with images to obtain aesthetically satisfying results requires an understanding of each of their basic characteristics' (ibid., 256). One needs to know the characteristics of sound and the characteristics of images in order to know best how to blend them. Schaeffer discusses the characteristics of sound in relation to the sounds and their production. He claims that there are two characteristics of sound to explain how we differentiate between sounds and their production, and that is sign

and index. 'A sign is supported by meaning' (ibid.), such as, for instance, with words, as words refer to something and you listen to the sounds in order to listen to the meaning of the words. Here the listening to the sounds of the words is tied to or orientated towards finding their sense and reference. Or, we can listen to sounds as indexes of things, that is, where 'one searches for the cause of the particular sound of the words' (ibid.). In Schaeffer's view, the connection between images and sounds needs to be sought at the level of sign, 'but not in the objects that produced them' (ibid.). We seek the meaning in the sounds themselves and ignore what might have produced them as being significant. Malina explains the characteristics of images and sounds in terms of listening and seeing and draws our attention to the differences between how we process sounds and images. This, too, he argues, needs to be also understood when blending images and sounds. 'Listening to music is a differentiating process, whereas viewing a picture is an integrating one' (ibid.). His example is the case of perceiving speed in the succession of sounds and images. He notes that applying the same high speed to the succession of sounds will be a comfortable experience for the ear, but a high speed does not make for a comparable comfortable viewing if the same high speed is applied to a succession of images. The similarities and differences of both visual images and 'sound objects', therefore, need to be taken into consideration in the production and composition of audio-visual works of art.

5.5 THE ELECTRIC AUDIO-VISUAL TECHNOLOGIES – THEIR IMPACT

Alongside the advent of film medium technologies for the production and playback of moving images with sound, there emerged in the twentieth century a plethora of electronic engineering technologies that could represent image and sound information as an electric video signal and an electric audio signal. The new technologies of radio, television, and video also facilitated new forms of art and new means of expression for artists who worked with the new mass mediums. This paved the way for the development of technologies to facilitate the synchronisation of the video and audio information for recording and playback and for transmission to monitors and speakers. Having such a similar material basis in the electronically produced and stored images and sound, meant that they could be recorded together and also played back together as if they were one medium, an audiovisual medium. Throughout the twentieth century, the electronic technologies of radio and television facilitated the production, storage and distribution of sound and images to a mass audience for the purposes of communication and entertainment. This also brought with it new opportunities to create new forms of artistic content for and with these technologies. The new technologies facilitated the expansion of established arts such as drama and music into forms that could be distributed with the new communication technologies of film, radio and television.

5.5.1   SIMULTANEITY

Light, colour, sound were able to be captured and stored as time-varying electromagnetic signals. The signals could then be manipulated at source, or at output, or in its storage format on the electromagnetic tape. Whether one manipulated the direct video or audio signal, or intervened in the manipulation of the tape containing the stored signal, the apparatus for the producing and playback of the images and sound along with the technology of electronic audio and video signals created new material means and new creative possibilities for artists, composers and musicians. Holly Rogers, who has examined the field of the emergence of artistic activity in the field of video and sound, focuses on how the video technology enabled the boundaries between visual art and music to be further dissolved. Rogers writes,

> The electromagnetic basis of early video technology … gave rise to sound and image that shared a linked material channel. This channel enabled audio and visual elements to be recorded and transmitted simultaneously, allowing a level of synergy rarely before possible. (Rogers, 2013, 1)

Many artists worked with the new mediums for artistic goals. Many others went further, adapting and experimenting with the electronic signals themselves for the purposes of inventing new techniques, devices and instruments and exploring new types of images and sounds in an analogous manner to the inventiveness of the nineteenth and early twentieth century colour organ inventors. Some artists explored the shared space of electronic sound and electronic images, and they engaged in new forms of integration between images and music facilitated by their similar electronic medium basis.

5.5.2   RADIO AND TELEVISION AS A MEANS FOR THE TRANSLATION OF SOUND INTO IMAGE

Fritz Wilhelm Winckel (1907–2000), a pioneer in electronic music and with expertise in telecommunications and acoustics, was interested in how television could be used for art. Brigit Schneider remarks that while Winckel was employed in the private televisions laboratory of Dénes von Mihály in Berlin, Germany, working on the Mihály's television system, he also conducted experiments with linking radio technology and television technology to see whether he could transform music directly into images that were displayed on the television screen. Birgit Schneider describes Winckel's experiment:

> For his technical coupling of sound and image, Winckel used Mihály's television system, which was still partially mechanical and which broke down images by means of a perforated Nipkow disk into a series of light impulses with the low resolution of just 1,200 dots. A radio served as a loudspeaker. The point of departure for his effort to make something visible on the disk was the 'radio's musical and spoken performances,' especially classical music. (Schneider, 2015, 613)

Winckel wrote about his experiments in 'Sound/Image translation by means of Television' (1930), and described his results and research into 'sound images' (Schneider, 2015, 613). Schneider describes the processes which he used to translate sounds from the radio into images on the television:

> Given that these two media process electrical oscillations within a similar spectrum. Winckel believed that it must be possible to represent acoustic impulses in optical form. He then observed the optical effects created by different sound materials on the television screen. (ibid., 196)

The results of his experiments of creating images on the television with the sounds from the radio was 'a moiré like image in contrasts of black and red that altered its appearance to the rhythm of the music' (Winckel in ibid., 613). Winckel discovered that 'the synchronous visualisations of music in time as an analogous relationship of dependencies' (Schneider, 2011, 197) and that the resulting optical imagery was artistically pleasing.

In his observations of the optical effects, Winckel discovered that different types of sounds creating different types of image formations. Classical music created 'semi-oval cast shadows in syncopated rhythm' (Winckel, 1930 in ibid., 197). Percussive beats created 'jagged contours' (ibid.) and quiet soft music generated 'indistinct, cloudy figures' (ibid.). He also discovered that the harmonic figures were generated when harmonic music was used and complex patterns were generated when a full timbred music instrument was used as the source sound (see Figure 58). Winckel writes:

> The figures resulting from the music are uniformly and harmoniously constructed because they are simple mathematical curves represented in two dimensions. The fuller the timbre of an instrument, the more overtones are contained in the sound and the more complex, therefore, is the corresponding pattern. (Winckel, 1930, quoted in Schneider, 2011, 197)
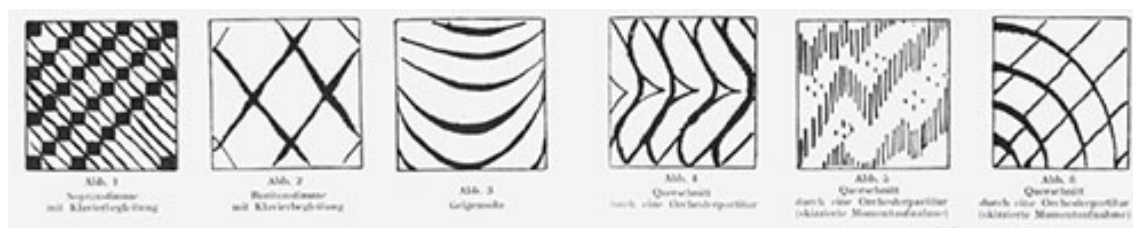
Figure 58 Fritz Wilhelm Winckel: L-R: Creating patterns on the screen of a Nipkow television (1930) from the sounds of classical music. (Schneider, 2011, 196)

Schneider notes that the aesthetic pleasure of the images is coming from the patterns generated by the sound and that the patterns changed in synchronisation to the music (Schneider, 2015, 614), but what was of most interest was that the images took form on the screen on their own. In

this manner, '[T]he moving patterns enabled thus a new way to experience sounds that took form on the screen *on their* own' (ibid.) thus they were a pure formation driven by the radio interacting with the television technology. Thus these images are purely synthetically constituted images (ibid.).

5.5.3 TELEVISION AS A MEDIUM

There are several important developments that took place in the twentieth century pertaining to the appropriation of the new audio and video technologies of radio, sound recording, television and video, such as for instance, the emergence of video art, the experiments in video synthesis and the building of analogue video synthesisers, and the use of all three in the exploration of an audiovisual art for screening, music concert performance, and art installation. Artists, for example, explored video and the television mediums as new visual objects for art settings. The artist Nam June Paik (1932–2006), who worked with a variety of media in his art and studied music in Germany, created several installation art works that were constructed out of some form of modification of television sets as well as audio objects arising from the creation and setting of music and sound in the space of the art installation. In his first solo exhibition in Germany in 1963 titled 'Exposition of Music – Electronic Television', Paik used several television screens distributed in the space of the gallery space that were tuned-in to receive the live broadcast of television. Paik conceived of his art as being a time art. Paik modified the signal of the transmission by placing magnets in, or on the television monitors (Rogers, 2013, 128). This resulted in the television producing new images and sounds that consisted of 'kaleidoscope shapes, luminous colours, and electronic noises' (ibid.) Rogers comments that the exhibition nature of the use of television and music technologies in the gallery was conceived as a 'total Event' (ibid., 127), rather than as an exhibition of isolated works (ibid.). The exhibition consisted of 'four "prepared" pianos, mechanical sound objects, several record and tape installations, twelve modified TV sets' (ibid.). Paik went on to work further with the merging of sound, music, video and television image for art installation and for performance. In another video art work titled 'Participation TV', Paik sets up the television monitor screen to be responsive to the input of a microphone, which 'when spoken into, produced flashes of coloured light on the screen in a direct translation of sound into image' (Rogers, 2013, 129). For research into the advent of video art amongst other practitioners, consult the chapter on 'The Rise of Video Art-Music' by Rogers in *Sounding the Gallery. Video and the Rise of Video Art-Music* (2013) and also 'Audio Art' by Golo Föllmer (2004) and 'Television—Art or Anti-art? Conflict and cooperation between the avant-garde and the mass media in the 1960s and 1970s' by Dieter Daniels (2004) and 'The Videosphere' by Gene Youngblood (1970b).

Other artists invented new instruments, devices, systems and methods that could work directly with the mechanism of the video and audio signal for the purposes of creating electronic video images and electronic sound to create art works, this video synthesis (as it came to be called) experimentation started in the 1960s and a wide variety of electronic instruments and devices were invented, that are commonly known as video synthesizers. Jeffrey Siedler in his introduction to video synthesis on the Audio Visualizers website devoted to the field (a website that was active from 2001-2019) explains:

> Before the widespread use of digital computers in the manipulation of video imagery, many artists and video experimenters used various analogue electronic methods to generate real-time images on a television screen. Many of these methods were borne from the appropriation of technology from analogue audio music synthesizers and analogue computer techniques and reworking this technology for the creation of video images and video signals. Analogue video synthesis therefore is the creation of video imagery using analogue electronic technology (Siedler, n.d.)

Video synthesis, then, is a form of image-making emerged where artists and inventors worked directly with electronic circuitry and the audio and video signal to create electronic images arising from the electronic equipment. Many of the early experiments with the video image consisted of creating video images from the audio signal, or creating sound from the video signal. The inventions that utilised the electronic signals were constructed out of new configurations of existing devices and technologies, pushing the boundaries of their making to make something new, or devices were built from scratch. There are several prominent inventors, authors and artists in this period of video synthesis, such as Lee Harrison, Dan Slater, Bill Hearn, Glen Southworht, Lear Siegler, Eric Siegel, Steven Beck, Dan Sandin, David Jones, Denise Gallant.   Two laboratories in the US facilitated pioneering video art experiments. The Experimental Television Centre, New York and the CalArts Videographics Lab in the California Institute of the Arts (CalArts). Paik also engaged with the video synthesis approach to video images and along with the assistance of the television technician Shuya Abe developed the Abe-Paik video synthesizer. Two parallel fields of electronic art activity began to emerge, namely, the field of 'analogue video synthesis' in which inventors with technical skill built instruments to enact and create new images from the actual technology, such as, in video synthesis image. A parallel development took place in audio, in what is called 'analogue audio synthesis'. Many electronic video and audio artists collaborated to create combined electronic music and video for concerts and installations. Others created devices that could create images from audio information or vice versa.

Woody Vasulka noted that many of the people 'that developed video synthesisers had formal interest in music' (Woody in Hill, 1992). The video synthesis inventors Stephen Beck and Eric Siegel, for instance, built instruments that 'contained some circuits that were modulated by

sound. Woody also explains that another instrument built by Dan Sandin was modelled on the Moog audio synthesizer instrument' (ibid.). What is characteristic of these new instruments and the field of video synthesis is that inventors, artists and musicians all worked on re-structuring the image for television by manipulating the video signal directly. The video technology was built for television, but as Vasulka remarks, video was designed for narrativity and so the framing system of film was preserved and thus translated from film to video (Hill, 1992). Many of the video artists that worked with the signal, nonetheless, explored this framing aspect of the signal and distorted it to create interferences and new images (see Figure 59). Tom DeWitt in 1989 provides us with a definition of video synthesis and the unique position it has in relation to photography and film.

> Video synthesis, the creation of images without cameras, has virtually no precedent in photograph and filmmaking. An electronic signal is generated to fit the technical specifications of a camera signal, but the point of origin is within the electronic circuits themselves. (DeWitt, 1989, 59)

In the REWIND publication edited by Chris Hill in 1995, a succinct definition of video synthesisers is provided:

> 'Video synthesizer' refers to machines designed to produce a video image without using a camera as well as instruments that alter or 'process' the camera image. In the production of a video image, the video signal can be generated by the electron scan of a video camera, but it also can be produced by a waveform generator, or an audio signal. Video signal mixing, colourizing, and luminance and chroma keying are a few of the fundamental video effects that can be produced using basic image processing tools. The self-generating, pulsing vortex of video feedback, achieved by pointing a video camera at the monitor to which it is cabled, was the simplest of effects yet it fascinated many early producers. (Hill, 55)
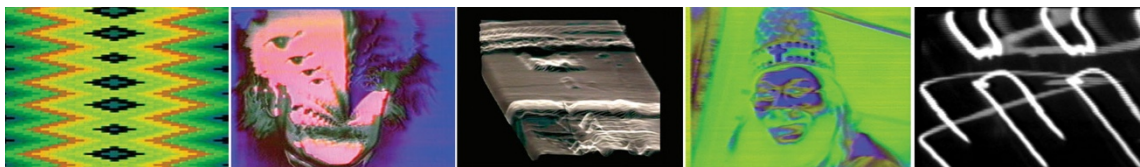
Figure 59 Video Synthesis Images: L-R: Stephen Beck, 'Video Weavings, 1978; Eric Siegel, 'Einstine', 1968; Woody Vasulka, 'C-Trend', 1974; Dan Sandin, 'Five-minute Romp through the IP, 1973; Steina and Woody Vasulka, 'Callligrams', 1970. (Hill, 1995)

5.5.4.1 STEPHEN BECK – DIRECT VIDEO

Stephen Beck invented several instruments that were based on the technology of the television. Becks also named the artform using the television as the means for creating video images as 'Direct Video'. In his essay 'Direct Video: Electronic Artform for Colour Television' (1970). Becks announces this new art by explaining what he means by 'direct video' and the video synthesizer instrument he built to create images

> Television has been employed for most of its history as a vehicle for images which originate outside of itself. Direct video synthesis is an electronic means of evoking

images from within the television system. The Beck Direct Video Synthesizer was designed and built by Stephen Beck last year with a grant from the National Endowment for the Arts. It provides video artists with a wholly new tool for expressive composition, with images never before produced on a television monitor. (Beck, 1970, 1)

Beck explains how the camera is now replaced with electronic circuits that can be manipulated to 'effect the formation of an image on a video monitor' (ibid.). This forming of the image on the video monitor is direct video synthesis. Beck wanted to find a way to expressively control light and to use the colour television set to do that; thus, his idea for 'a visual synthesizer as intermediary between control and display of an image' (ibid.) was born. Beck was also interested in the aesthetics of this new type of art and in building the aesthetics into his invention and interface for creating images.

Back invented several synthesizers to explore the aesthetic possibilities of such control of the video image, by means of accessing directly the video circuitry of the television set. He referred to these instruments as direct video synthesiser instruments, such as, for instance: 'Video synthesizer DV1 00' (1969); 'Main Beck Direct Video Synthesizer (1970); 'Beck Digital Video Weaver' (1974), an 'all digital video synthesizing circuit', which Beck also described as 'A "Visual Processor" for Colour Television Display' (Beck); the Electromechanical Optical Bench in 1972; and Laser scanning projectors and light beams in 1981 (Beck, n.d.).

In 1976, Beck produced the video 'Video Weavings' with his Beck Digital Video Weaver invention. The Beck Digital Video Weaver, consisted of various circuits, consisting of an image processor and programmable parts that feed a video encoder circuit to produce a colour video signal. The circuit can also supply audio frequency signals to provide a sound dimension to the display. Beck's describes the woven aesthetic of this synthesiser as providing 'distinct pictures can be woven in colour, and additionally be animated according to several basic image algorithms, move up, down, diagonally, zoom, scale, by stretch or squeeze, etc. (Beck, n.d.b). Hill describes, that it was based on an analogy between the vertical and horizontal threads used in weaving cloth to 'the construction of the television image (vertical and horizontal scans of an electron gun)' (Hill, ed., 1995, 56) (see Figure 59).

5.5.4.2 STEVE RUTT AND BILL ETRA

The Rutt/Etra Scan Processor was an analogue video synthesis device built by Steve Rutt (1945-2011) and Bill Etra (1947-2016) in 1972. It was able to manipulate video in realtime – that is the video signal of the raster image of a CRT monitor. It consisted of a box, with knobs and dials that the artist could use to control the raster image. The electron beam of the CRT monitor is modified through the magnetic deflection of the beam into the Scan Processor. The resulting images are then re-recorded onto a video camera, which is called re-scanning, providing the artist with the animated images for their productions. What made the Rutt/Etra so important in the

development of a visual music art is that it was built so an individual could uses it. In the 1994 *Ars Electronica* catalogue, Woody Vasulka acknowledges that it was the Rutt/Etra scan processor instrument that facilitated the putting of such an instrument into the hands of individual artists such as himself and Steina Vasulka.

> The instrument called the Rutt/Etra, named after its inventors, was a very influential one. Etra, with his art affiliations, had placed the instrument much closer to the hands of the individual artsts for the right price. Almost everybody, I respect in video has used it at least once. Its power was in the transformation of the traditional film frame into an object with lost boundaries, to float in an undefined space of lost identity; no longer the window to 'the' reality, no longer the truth' (Vasulka, 1994 in Meigh-Andrews, 2014, 145).

The Rutt/Etra device was used by many video artists from the 1970s onwards such as Nam June Paik, Woody and Steina Vasulka (see 5.5.4.4) and Tom DeWitt (see 5.5.4.3).

5.5.4.3 TOM DEWITT

Tom DeWitt, is an experimental filmmaker, video artist, inventor and programmer worked in various media and forms of visual art working across a variety of techniques and methods since the 1960s. He made light shows in the 1960s for live rock music bands such as the Grateful Dead. In his early film career, DeWitt was interested in working with a visual harmony in pictures based on logarithmic spirals, which he notes himself is similar to John Whitney's approach to a visual harmony that creates time variant images based on spirals (DeWitt, 1987, 116). Both Whitney and DeWitt noted that such an approach to a visual harmony has similarities with music harmony. For DeWitt, the visual composition 'was to be constructed from a fixed vocabulary of visual notes, much like the diatonic scale' (ibid.) and he worked also with logarithmic spirals. DeWitt explains the similarity with aural harmony that these spirals have, 'logarithmic spirals have stable structures only at fixed intervals of frequency' (ibid.). DeWitt bases his idea of visual harmony as being an application of Helmholtz methodology to sight. DeWitt explains that Helmholtz pointed the way to demonstrating that music harmony is embedded in the human perceptual system. DeWitt paraphrases Helmholtz key finding:

> Helmholtz concluded that we appreciate the geometric progression in sound frequencies because our ears seem to produce these overtones even in the absence of their physical presence. (ibid., 15)

DeWiit suggests that the psychological phenomenon of the eye 'has intrinsic physical properties' in which the 'centric structure of the retina with is logarithmic density of sensor cell radiating from the fovia, the cone and rod retinal cells …and the processing of the visual cortex' (ibid.) point toward a similar visual harmony aesthetic based on our visual physiology and psychology as music harmony is to the perception of frequencies in sound. DeWitt experimented with such logarithmic geometries in his early films. He worked with audio synthesisers and oscilloscopes

to realise these geometric images. For example, DeWitt describes one such film, 'Philharmonia' (1974)

> In 1974 I produced a work called Philharmonia [4], which was based on the logarithmic spiral. It was realized using an audio synthesizer to draw pictures. If a sine and its cosine wave form are displayed on an oscilloscope as the vertical and horizontal inputs, a circle or oval will be produced. If these wave forms are amplitude modulated by wave forms at frequencies higher than the sine wave frequency, the circle is pinched into a shape like a flower or a rose window. The petals move dynamically but are stable when the modulating frequency is at integral multiples of the sine wave frequency. The pattern in the petal leaves is determined by the timbral qualities (wave shape) of the modulating wave form. (ibid.)

DeWitt was very aware that the work he and other filmmakers and video artists were doing were working in the emerging field of visual music. A visual music that takes its aesthetic precedent in the digital harmony theories and techniques of John Whitney.   He sees this new art form of visual music as being based on the key features of human perception:

> A new art form, visual music, is emerging. Its aesthetic can be deduced partially by examining key features of human visual perception: the structure of the eye, the nerve pathways from the eye to the visual cortex, and functional characteristics of the brain. The precursors to visual music are traditional music and visual art, and their aesthetics are quite relevant in instructing the infant art form. The artists working in visual music are guided by an intuitive grasp of how certain images can directly induce emotional responses. The natural genius of such creators must be respected as an indicator for directions to be taken by the art. This is an exciting era, for we are witnessing the birth of a branch in the cultural tree. If the importance of aural music is any indication, visual music may become a major vehicle for artistic self-expression. (ibid., 122)

DeWitt also worked with video synthesis techniques.   DeWitt invented a system called the Pantomation in the 1970s which adjusted the Rutt/Etra video synthesiser system as well as other audio/ video synthesizers to track live image motion as a means for synchronising moving images and audio.   The invention is described as being similar to the production of chordal structures in one of Laurie Spiegel's instrument inventions, where the mouse can act as a performance controller tracking movement and converting it to changes in the images (ibid., 116):

> My Pantomation system reduces complex scenes to a few key points forming an outline in space. One can draw with it as one would with a pencil. The efficiency of outline generation permitted me to store images in a microcomputer without taxing either its memory or processing power [32, 33]. Some of my work today is focused on algorithms for converting raster-scanned images such as television into a simplified vector format for display with a laser projector. (ibid., 120)

DeWitt turned his attention to the visual music potential of video synthesis and how it would continue to open up a new realm of artistic expression – a visual music (1989, 59). And although he notes at the time of writing that 'video synthesizers cannot begin to encompass the entire realm of visual imagination' (ibid.), he draws comparison to 'the production of images from nothing more than electrons is reminiscent of painting's startling economy' (ibid.) and that the advent of the computer is the 'single electronic tool' that 'stands between the preconception and the

conception of a visualisation, whereby 'the correctly programmed computer can synthesize virtually any image'(ibid.).

<h3>5.5.4.4   Woody and Steina Vasulka</h3>

Stein and Woody Vasulka worked with the Rutt/Etra synthesizer in their video work and made extensive use of it. The Vasulkas worked together and individually on producing and experimenting with video and art from the late 1960s and they 'have been instrumental in shaping video art and defining the potential of electronic imaging' (Sturken, n.d.). In their shared video work, the Vasulkas viewed 'the nature of our early work was non-figurative or non-representational, generated internally through electronic systems' (Woody in Ausubel, 1983). Both systematically engaged in their art in 'examining the properties of the video medium' (ibid.). They founded 'The Kitchen' performance space in New York devoted to the performance and installation of electronic media in 1971. In the biography *Machine Media: Vasulka* (1996), Marita Sturken remarks that one of the methods of the Vasulka's early collaborative work is to 'methodically explore[d] the material relationship of electronic audio and video and the myriad ways the electronic signal can be manipulated' (Sturken, n.d.). Their video work could be called abstract video (ibid.), but they make an effort to state that they were not interested in transferring abstract painting to an electronic environment. They wanted, rather, to create a new reality because 'our goal was to create reality, a certain reality that would testify to its own electronic complexities' (ibid.). A term that they used instead of abstract image was synthesised image (Woody in Hill, 1992). They spent years 'experimenting with scan processors, dual colourizers, multikeyers, programmers, and variable clocks' (Durfree, n.d.. 3), all manner of video synthesizer technologies. One of their earliest techniques is to connect a portapak video with an audio synthesiser as described by Jacques Perron (2000):

> [Steina's] collaborative work with Woody in that period was remarkable for its interworking of audio and video signals: by attaching the Portapak to a synthesizer, they created video images from the audio signal and sound with the video signal (*Matrix I & II*). The goal of these phenomenological exercises was to explore the essence of the electronic image and sound.

They created many works together from 1969 onwards, for example: 'Participation (1969), Calligrams (1970), Decay I (1970), Soundsize (1974), Voice Windows (1986). Woody, in 1992, observed that their work (and others doing synthesised images and sound) 'did not have its own genre of presentation' (Woody in Hill, 1992). There was 'no historical audio-visual genre' (ibid.) where there was a unity of materials in the manner of the new material of voltages and frequencies of what he considered to be a 'unified code' under this[a] new synthetic possibility' (ibid.). Woody explains that their form of video art did not use 'the furniture of the television' (ibid.) as was the case in some of Nam June Paik's video art work. They, rather, were interested in working

with the signal and re-organizing the television signal and thus re-structuring the images. They were thus interested in the artefacts and image interferences of the television signal.

Woody started experimenting with electronic sounds, stroboscopic lights and video in 1967 (Ausubel, 1983) and composed music and made videotape art. He became interested in the 'materiality' of the medium of video and was influenced by the Structuralist artists, who were exploring 'the idea about the material itself: surface, motion, elements, information within a single frame' (ibid.,1). Woody started to investigate computer-controlled video from 1974 and built the digital computer-controlled video facility called the 'Vasulka Imaging System' (Durfree, n.d., 2). Woody also produced a video opera 'The Commission' (1983).

Steina's musicianship and her violinist training was at work in how she approached manipulating video images. She saw 'the process of image manipulation as being akin to playing the violin…the video camera sits on my shoulder like a violin, and I approached video like something to be practiced everyday' (Durfree, n.d., 3). Later, when she worked with video in performance settings, Steina noted that 'it is very inherent in video to be a performance medium' (Steina in Durfree, n.d., 6). Steina, like Woody, evolved her techniques to incorporate new technologies and installation opportunities and worked on interactive performances with a MID violin from 1991 (Perron, 2000)

Steina's video work 'Violin Power' (1978) is a single channel video with sound and is an example of a video image being effected by the audio signal (see Figure 60). The video image consists of a video recording of a person demonstrating how to play the violin. 'Violin Power' then 'weaves the audio signal into the video image'. In the description of the video on the Smithsonian American Art Museum website that purchased the art work in 2008, the audio to image part is described: 'As the tape progresses through three performances, audio wave forms produced by the musical instrument begin to affect the video image and eventually become the video generator itself' (Vasulka, 1978). The work in its original form was performed many times as a 'closed-circuit audio/video performance from 1970 to 1976' (Spielmann, 2004). Steina, however, has performed it since the 1990s with a microphone, MIDI violin and then with special performance software developed in Steim in 1997 (ibid.). The violin parts control different aspects of the frame and speed and direction of effects.

Figure 60 Steina Vasulka: 'Violin Power', 1978, frames from the film

The Vasulkas adapt their techniques and use of technology. Gene Youngblood notes how the technology of the image may change, but the 'performance of the image' on the surface at an experiential level is something that continues across all the media in painting, film and video.

> Thus, the basic phenomenology of the moving image, what Vasulka calls 'the performance of the image on the surface of the screen', remains historically continuous across all media. Digital code, for example, has radically altered the epistemology and ontology of the moving image but has not fundamentally changed its phenomenology. There are no digital images that have not been prefigured in painting, film and video. (Youngblood, 1989, 27)

5.6   MUSIC AND DYNAMIC IMAGES – FROM BROADCAST TO MUSIC CONCERT

Many computer and digital video works that were created near the end of the twentieth century did not have a dedicated space where they could be shown or experienced. Artists from other fields put a hand to making their own dynamic image works and experimented with various mediums and methods to create imagery with music, working with film, video, computer video and digital video works. In particular, musicians and music composers worked with an image dimension to their music work. Other composers have collaborated with filmmakers and video artists to create experimental non-narrative film, for example, Philip Glass who worked with the filmmaker Godfrey Reggio. Other composers have worked with video artists, for example, Steve Reich worked with video artist and partner Beryl Korot on several multimedia music performance works consisting of video projection and music performance. Barry Truax worked with Theo Goldberg to create computer graphic works (see section 4.7.2). The technologies used for these productions range from film, to analogue video, to computer graphics, and to digital video. What is difficult to ascertain is where there is a consistent type of presentation setting for this work. As the century drew to a close, the computer and digital became the main methods and means for creating dynamic images with music. The computer technology, nonetheless, was still linked to video technology for its output and presentation, and so, linked to television broadcasting standards. In order to output a video, therefore, one had to output the video to the devices that could play it back which were video projectors, television screens and the storage media for video. When working with computer video outputting to video projection or a video storage medium, much of the concern was to try to produce a high-quality technical image for the video that could be either projected with a video projector or broadcasted on television. Hence, the TV broadcast standards for outputting computer video were used as a benchmark for production quality. Videos were distributed on computer video CDs, and then onto DVDs. Festivals started to screen the experimental video cum music works as part of their programming, and art galleries also started to curate both historical and contemporary sound and image video works. With such developments, it became apparent that there was some cross-over in terms of the best type of distribution for the works. A video created with a music composition focus could be screened as

a 'film' in terms of a work that is screened to a sitting audience in a darkened movie theater, or as a multimedia music concert work in a formal music concert setting alongside other types of music performance. It could also be distributed on DVDs for home viewing, or it could be broadcast on television. The latter, however, was a rare form of dissemination for these types of works. Some examples of these, nonetheless, are noted below.

5.6.1 EXPERIMENTAL TELEVISION BROADCASTS OF EXPERIMENTAL FILM AND VIDEO

The television broadcasts that resulted from the collaboration between the RTF and the Groupe de Recherche Image from 1960 to 1975 under leadership of Pierre Schaeffer, consisted of experimental film works combined with *musique concrète* compositions. At the initial conceptual stages of this work, these films were conceived as experimental television works, relating the artistic activity to its technological purpose and medium of distributions. There were several television broadcasts of experimental film and video works that explored, in experimental form, the new forms of images and sounds and connection between both. As Vasulka had observed, their video synthesis and sound art works was representative of many artists and technicians working with similar mediums and methods did not have a place of operation. The author of this thesis also started out with the question where is the home of visual music – where does it take place? (McDonnell, 2012). Such attempts to broadcast this new content was one possible home or avenue for the dissemination and distribution of these tightly integrated sound and image works, and so, broadcasts were made. Some of the broadcasts were informational, in documentary style, explaining the processes and informing audiences about this art, along with quoting from works by broadcasting short snippets of works and other forms of broadcast were series-led or curated in which the works are broadcast in their entirety as is the case with the Schaeffer-led collaborations. There are many more that are worth examining, such as, the US subscription visual music channel, but this is beyond the scope of this thesis to do so at this time. Two UK broadcasts will be mentioned here: The broadcast of a documentary on Abstract Cinema in 1993 and the broadcast of a short feature on the Dublin Digital Darklight Festival in 2000.

5.6.2 'ABSTRACT CINEMA' BROADCAST– VISUAL MUSIC

Abstract Cinema was a UK documentary produced by Koninck and supported by the Arts Council in 1993 on the work of the pioneers of abstract cinema. It was directed by Keith Griffiths and broadcast on Channel 4 Television (Griffiths, 1993). It consisted of interviews with filmmakers who discussed their own work and the works of others both present and past under the theme of abstract cinema (see Figure 61 and 62).

Figure 61 Abstract Cinema Documentary, 1993. Extracts from works L-R: 'High Voltage', 1957, James Whitney; 'Colour Cry', year, Len Lye; 'Sangus Series', year, Pat O'Neill; 'Come Closer', year, Hy Hirsch; 'Furies', year, Sara Petty; 'Study No.7', year, Michael Scroggins (Griffiths, 1993).

In an archive record of the information in the broadcast, the synopsis of the documentary states:

> [Abstract Cinema consists of] [T]he work of some of the pioneers of abstract cinema, Oscar Fischinger (1900–1967), John (1917–1995) and James (1921–1982) Whitney, Jordan Belson (b.1926), Len Lye (1901–1980), Hy Hirsch (1912–1961), Mary Ellen Bute (1906–1983), etc., together with interviews and extracts by Stan Brakhage (1933–2003), Malcom Le Grice (b.1940) and others. (Artsonfilm.wmin.ac.uk, 1993)

Leading filmmakers and the film historian William Moritz were interviewed, and they talked about their thinking and processes in their work as well as discussing historical works. Extracts from several films and art works that were mentioned by those interviewed were broadcast alongside their interview such as: Oskar Fischinger, Charles Dockum's Mobilcolor projector, John and James Whitney, Jordan Belson, Hy Hirsch, Mary Ellen Bute, Harry Smith, Michael Scroggins, Stan Brakhage, Len Lye, Pat O'Neill, Michael Snow, Malcolm Le Grice, Fernand Léger's *Ballet Mécanique*, Viking Eggeling, Larry Cuba, Vibeke Sorenson, Colin Scott and Marek Pytel.

Many of the extracts shown were explained in terms of their visual and music connections. The experimental filmmaker Stan Brakhage (1933–2003) in his interview for the documentary refers to the term 'visual music' when describing the new form of film that was emerging in the twentieth century which he called a type film that was enabling a form of exterior of visual thinking or a moving visual thinking. Brakhage remarks,

> that here for the first time in human history we have the possibility to exteriorize visual thinking … so there is a form of film that's trying to evolve that area of thinking that's my calling moving visual thinking and it is intrinsically *a visual music* [The new type of film] is not music but the longing or dream to have a visual music which could be comparable to auditory music would be flexible fluid and so forth I think is an ancient one and it's something that people all over the world share. (Artsonfilm.wmin.ac.uk, 1993)

In Brakhage's estimation, it is the filmmaker and artist Oskar Fischinger that was 'the first great genius that we can see and appreciate, and the film allowed Oskar Fischinger to preserve some of his best work and that has influenced a whole generation of other people in preparing really beautiful visual music works' (ibid.). Extracts from Brakhages films, 'Night Music' (1986) and 'Rage Net' (1988) (see Figure 62) were broadcast as well as clips of his working methods and processes of painting directly on the filmstrip to create the images for some of his films.
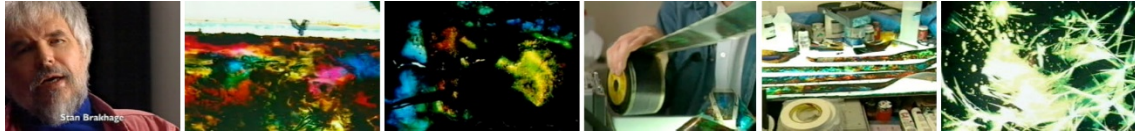
Figure 62 Stan Brakhage and frames from extracts of his works and process shown in the Abstract Cinema documentary, 1993. L-R: Stan Brakhage; Film strip frame from 'Night Music', 1986; Frame from film 'Night Music';
Brakhage describing the process, using paint and chemicals on IMAX stock, of making the film; images from the strip of film.
Frame from 'Rage Net', 1988.

Brakhage's films explore many themes and subject matters., using various techniques, including direct film techniques (painting directly on the filmstrip). He also believes that some of his films are a form of eye music although he prefers these films to be experienced without sound. The musicality is in the visual of the film. It is, in other words, a form of silent visual music. Thus, he remarks,

> I now no longer photograph, but rather paint upon clear strips of film—essentially freeing myself from the dilemmas of re-presentation. I aspire to a visual music, a 'music' for the eyes (as my films are entirely without sound-tracks these days). Just as a composer can be said to work primarily with 'musical ideas,' I can be said to work with the ideas intrinsic to film, which is the only medium capable of making paradigmatic 'closure' apropos Primal Sight. A composer most usually creates parallels to the surroundings of the inner ear—the primary thoughts of sounds. I, similarly, now work with the electric synapses of thought to achieve overall cathexis paradigms separate from but 'at one' with the inner lights, the Light, at source, of being human. (Brakhage in Haller, 1998, 81)

5.6.3 'SHORT ATTENTION SPAN CINEMA' TELEVISION BROADCAST

An event that took place in Dublin near the end of the twentieth century, captured the changes that were taking place in filmmaking, animation and videography. The technology for creating in the three major moving image mediums were beginning to move to the digital. However, in the in-between of these developments in industry, was the growth of independent experimental moving image creators, who started their work and experiments with moving image directly in the computer environment itself. Many amateurs, musicians, and independent artists created digital video works. An interesting development for the author was that this festival provided a showcase for her and others work that did not fit into any traditional genre or boundary. However, this festival was really at the cusp of the digital, because although there was a recognition of the new digital means for creating work, for the actual screening and for the works that were then selected for a television broadcast, the submission video had to be on analogue technology – the Betacam SP tape. In order to present works at this festival to a high production standard, works had to be screened from analogue broadcast quality Betacam SP tape. Although digital means were used to create the works in the festival, at this stage in time, the capability of computers to playback video without stutter was the reason that the superior performance of Betacam SP tape was used.

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The event in question Darklight Digital Festival which was the first festival devoted to digital methods for creating films that took place in Dublin in1998. It consisted of an open call for short films, documentaries and experimental animations that used digital means to create video works. Increasingly as the festival developed, it also included a live visual and music performance element to the festival.

> The Darklight Digital Festival was established in 1998 in Dublin with the primary aim to promote and nurture the cross disciplines that encompass digital work including film, animation, music, projection, interactive work and imaging. Darklight screens a selection of International and home produced work and is accompanied by an exhibition, which provided space for non-projectable digital work, video installations and computer-aided interactive productions. (Sink.ie, 2004)

The author's own works, 'Towards One' was screened in 1999 and her work 'Edges' was screened in 2000. In 2000, Sink Digital Media chose a selection of digital works from the 2000 festival to be broadcast as part of a 12-minute programme dedicated to the Darklight Digital Festival for the UK FilmFour television broadcast channel (Darklight-festival.com, 2000). 'Edges' (McDonnell, 1998a) was chosen as one of the works to be broadcast in the programme. 'Edges' had been screened in the Darklight Digital Festival on 27 May, 2000 as part of the Light 1 screening programme, programmed by Paul Dunne, Mark Cullen, Nicky Gogan and Orla Hyland held and was. The 'Light 1' programme consisted of digital short works from 1 minute to 14 minutes in duration and included a selection of International experimental digital filmmakers such as Jeff Walker, Maura McDonnell, Paul Prendergast, Stephen Ryan, Manuel Saiz, Zbignew Jaroc, Jenni Meredith, Cormac Figgis (Darklight-festival.com, 2000b). The description for the Light 2 screening progamme follows:

> Spinalcolumnbrain, spooky Meryl Streep, melting logo, baby tunnel, blurry camera, mad short computer head, kinda funny weird, kid rant wexford, abstract noise, supermarket arrows, great time lapse, animated baby, people watching, wouldn't say no to the steely eyed boy, at last a little porn, blink and you'll miss it, lovely but feels unfinished, boring child pensioner, get a load of this one lads, repertoire of a few abstract effects, opulent classical interiors, 2001 + the shining, scratch video, cuts up m.streep in nuclear plant disaster movie, disinfectant spray and nudity, quirky take on saying milk, memory disorder * a case study (ibid.).

5.6.4 ELECTRONIC AND COMPUTATIONAL IMAGES TO COMPUTER VIDEO

There were several video artists who started to work with computer graphics and ways of generating computer graphics from the processes of the computer, from programming images and from software to output totally synthesised images. Software programmes could be designed to generate sounds and images together or both were generated separately but put together as a video for final fixed media output. Electronic tools were also developed to interface with the real-time generation of imagery, such as, in using a video switcher in live performance and performing real-time manipulation of the videographic image. What is interesting in this period of the birth of the

computational image is that artists may have created their work in the computer but in order to have their work shown and disseminated, the work was output to film. Some works were output to broadcast quality videotape, but the consumer VHS videotape was not of a high enough quality for video projection. When the computer video could output to a digital video medium, the computer video really did facilitate the development of this means and method of creating works.

Malcolm Le Grice, who published his study *Abstract Film and Beyond* (1977), started out in paint and went onto work with film, and now works with video and digital media, creating moving image art works. In his video 'Arbitrary Logic', the play of colour, forms and sound arise from within a home computer environment, where a software programme generates both sound and image (Channel 4 Documentary Abstract Cinema, 1993). The images in 'Arbitrary Logic', then, are totally synthesized in the computer. Reflecting on his work, he remarks that 'I have come to realize that my main interest is in creating experiences rather than concepts. Ideas emerge from sensation from colour, image, sound, movement and time' (Luxonline.org.uk, 2005).

John Whitney (see chapter 4 section 4.5.3) started out working with film and experimented with optical sound on film by inventing devices and processes and adapting machines to create sound and animated graphics. Whitney also worked with early analogue computers and was awarded a fellowship from Guggenheim to investigate combining graphics with music in 1948. In 1966, he was awarded one of the first IBM artist-in-residence position, and so, had access here to IBM's digital computer technology (Robertson, 2015, 54) and was given assistance by computer programmers working there to create imagery for his films. Whitney was very inventive with the various mediums he worked, and he developed his own processes and devices to produce the images he wanted. While working in the computer environment, Whitney wrote about the potential and power of the computational nature of the computer environment, remarking in 'Computational Periodics' (1975),

> The computer is the coequal of the entire repertoire of musical instrumentation and heir to that domain of musical sound. At the same time, the computer is the ultimate kinetic image generative instrument. The kinetic image is in truth the creation of computer graphics since the cine or television camera is but a recording device and the hand-drawn image of motion is but a cartoon of motion.

Whitney developed and published his theory of digital harmony in *Digital Harmony* (1980) and created, for example, 'Moondrum' (1989), using a computer program and composing his own music for the film (see Figure 63).

Whitney considered these abstract works in moving image mediums, such as in the computer, to be based on a similar foundation to music in that music and the moving graphic forms are about motion. He stresses the point that 'the *content* of music is really motion' and that this, analogously speaking, is really 'a matter of generating and resolving tensions…by a dynamic

process, a continuous matter of motion patterns, [and so,] a kind of architecture in space and time' (Whitney in Robertson, 2015, 56)

Figure 63 John Whitney, Moondrum, 1989

Larry Cuba assisted Whitney in programming Whitney' s film 'Arabesque'. He also made the computer animations shown in a scene in the film 'Star Wars' (1977). 'Cuba used a Vector General 3D connected to a PDP-11/45 computer to make these animations' (Cuba, n.d.b) Cuba also produced his own computer-animated films: 'First Fig' (1974), created at the Jet Propulsion Laboratory; '3/7' (1978), created using GRASS, Tom DeFanti's Graphic Symbiosis System (ibid.); 'Two Space' (1979), using RAP a programming language; and 'Calculated Movements' (1985), which comprises programmed solid shapes, areas, and volumes, rather than vector dots. Cuba was aware that nomenclature was an issue for images that are computer generated and the resulting works, and was interested in the term 'kinetic art' (McDonnell, 2007b). Cuba pursues a form of abstraction where visual perception is paramount (Cuba, n.d.), but recognises that 'because the images are generated via algorithms written in computer language, there is a paradox in trying to use words to describe images for which words do not exist' (ibid.). The term 'abstract cinema' was applied to his work, for want of a better name, as his works were created in the computer environment and the images were programmed, but they were output to film at the time. Raphael Bassan notes the cinematic element to this type of computer work and describes Cuba's work in this context, remarking that,

> The computer animation establishes a parallel between visual perception and a structure of linguistic or mathematical order: it is concerned with establishing a new organizational field for the aesthetic material. …In the sphere of abstract cinema (lacking a better term), Larry Cuba's research is, in fact, at the origin of a new direction which does not yet have a name. (Bassan, 1981 quoted in Cuba, n.d.)

In the film 'Two Space', Cuba created two dimensional patterns that have been generated 'by performing a set of symmetry operations (translations, rotations, and reflections) upon a basic figure or tile' (People.well.com, n.d.) The film has a soundtrack of Gamelan music (see Figure 64). Cuba describes the film:

> Two Space consists of twelve such patterns produced using each of nine different animating figures (12 x 9 = 108 total). Rendered in stark black and white, the patterns produce optical illusions of figure-ground reversal and afterimages of colour. (ibid.)

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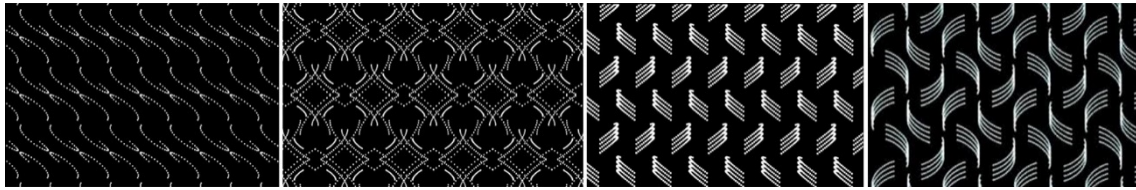
Figure 64 Larry Cuba, 'Two Space', 1979. Patterns and images generated in the film. (Zkm.de, n.d.)

Michael Scroggins is an example of another artist who has traversed several technologies in creating his art work. He studied video under Nam June Paik and Shuya Abe and also assisted them in making the Paik/Abe Video Synthesiser (Scroggins, n.d.). From 1968–1970, he was a member of a multimedia ensemble group for 'Single Wing Turquoise Bird', and he created projected visuals for music which were performed in concerts, galleries and loft spaces. A term that Scroggins uses to describe his work is 'absolute' and refers to his works as being 'absolute animation' and 'absolute video'. The works have a close connection to music, where Scroggins 'aspires to the creation of a visual experience that resembles musical experience' (ibid.). He places his work both as a continuation and an extension of the absolute and abstract cinema traditions from the 1920s onwards and notes that his and the historical works 'achieve affect purely through the architectonic structuring of basic elements such as shape, texture, and rhythm' (ibid.). He is also interested in the meanings generated by colour (Scroggins in Griffiths, 1993). Scroggins refers to some of his works as recorded works, but has also created live interactive video for performance and is active in the field of Virtual Reality (VR), in particular, using 'gesture capture in creating real-time absolute animation in immersive VR' (Scroggins, n.d). At present, he is building a new type of visual instrument, named an 'Anaphorium'. In his analog video work 'Study No.14' (1983), Scroggins created what he calls 'absolute videographic composition' (Scroggins, 1983); these are works consisting of the blend of multiple improvised real-time video performances of computer generated forms, using a video switcher (see Figure 65). The music was commissioned by Scroggins to work with the images in a unified manner.
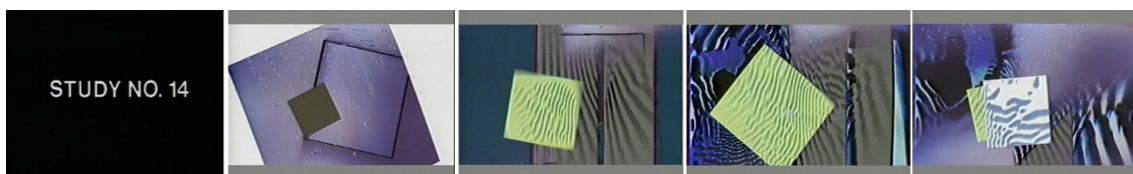
Figure 65 Michael Scroggins, Study No. 14, (Scroggins, 1983).

Similar techniques were used by Scroggins for several of his absolute videographic compositions, such as, 'Saturnus Alchimia' (1983).

5.6.5 COMPUTER GRAPHIC IMAGES AND COMPUTER MUSIC

The composer Barry Truax and the computer video artist Theo Goldberg created collaborative computer video works between 1987 and 1992, utilizing computer graphic image videos by Goldberg and computer music by Truax. The title of these works are: 'Divan' (1985); 'The Wings of Nike' (1987, see Figure 66 & 67); 'Beauty and the Beast' (1989); 'Song of Songs' (1992, see Figure 23); 'Pacific Dragon' (1991); 'Night of the Conjurer (1992) (Truax, n.d.). Goldberg created the images 'with the aid of Vax and Amiga computers' (ibid.). Truax created the music with 'real-time granular synthesis and Frequency Modulation sound synthesis' (ibid.).
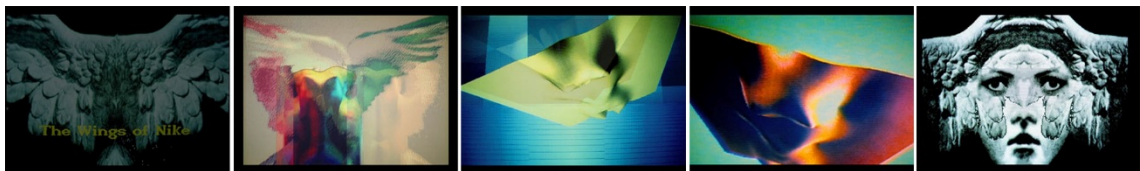
Figure 66 Theo Goldberg Images for Computer Graphic Work, 'The Wings of Nike', 1987 with computer music by Barry Truax (Truax, n.d.b)

A technical note explains the technology used in the creation of the images:

> The computer images realized with a Vax at the University of British Columbia in Vancouver were produced by a Ramtek frame buffer and Metheus monitor display, controlled by customized software by Robert Ross based on the LIG language. (ibid.)
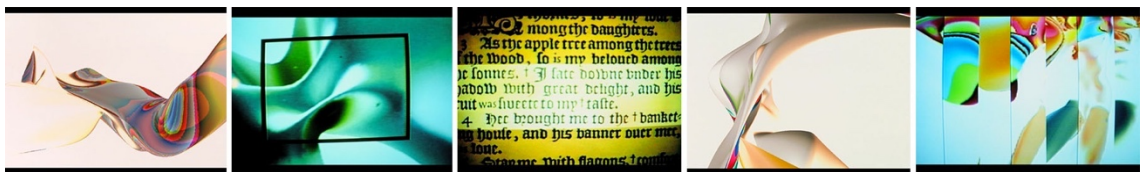
Figure 67 Theo Goldberg images for Computer Graphic Work, 'Song of Songs', 1992 with computer music by Barry Truax (Truax, 2011)

Many filmmakers, video artists and computer video artists as well as computer graphics artists have collaborated with music composers to create multimedia works and these works started to be presented as music concert works. In particular, music concerts that featured what was called 'tape' music consisting of electronic and electroacoustic music, typically played back as channels of audio in a diffused audio speaker array often included a projected moving image

element to these compositions concert. The first multimedia concert performance the author experienced was the music concert work 'Junk Box Fraud', 1997, for cl, trb, 2 pf, 2 speakers, tape, video, composed by Donnacha Dennehy. The Crash Ensemble (of which Dennehy was artistic director) who performed the premiere of the piece in 1997, commissioned the computer graphics scientist and video artist Gerry O'Brien and computer scientist Hugh Reynolds to design the accompanying video to be presented with the music performance and the video part is an integral part of the work when it is performed live. This performance left a lasting impression on the author for how much the colours and forms of the projected video enhanced the music performance experience.

5.6.6 FILM-LED ABSTRACT ANIMATORS

Several abstract animator filmmakers whose work could be categorized as experimental film or experimental animation collaborated with musicians and composers, and or worked closely with a music soundtrack in the realisation of their imagery. For example, Jordan Belson (1926-2011), Harry Smith (1923-1991), Bonnie Mitchell, Jim Davis (Haller, 1998b). Several of animators who used animated film techniques to realise their films went onto include digital methods into their arsenal of techniques.

5.6.6.1 STEPHANIE MAXWELL

Stephanie Maxwell is an animator and filmmaker who has been creating experimental film and animations since 1984. Maxwell has a range of techniques that she uses in her work such as hand-painted direct-on-film techniques, object animation, and live action manipulation. Maxwell collaborates with music composers to add the soundtrack element to her animations, resulting in a visual music expression. Her work consists of a strong relationship to the music creates abstract films in collaboration with music composers. Her animations, 'Please Don't Stop' (1989) with original electronic score and sounds by Dirk Johnston, Robert Westbrook, Robley Gillis and Maxwell (see Figure 68) and 'Nocturne' (1999) with music by Greg Wilder and 'Somewhere' (1999) with music by Allan Schindler, demonstrate the hand painting and hand engraving techniques she uses on the surface of the film. Her films are accompanied by experimental music scores by electroacoustic music composers whom she works in collaboration with, for example, Allan Schindler and Greg Wilder already mentioned. Maxwell also started to employ digital techniques in post-production in her animations at the turn of the twenty-first century such as her use of the 'real time' animation of objects and graphic elements that were transformed and recombined using digital post-production techniques in the animation, 'Fragment', in 2000.
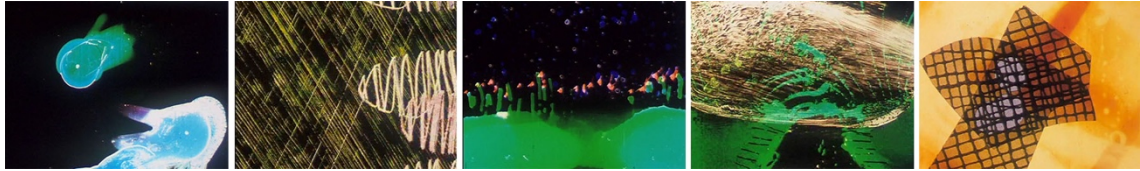
Figure 68 Stephanie Maxwell, 'Please Don't Stop' (1989). Frames from film.

There are many contemporary visual music artists whom have expertise in film and animation and digital animation techniques who develop their animations with a close relation to a specific soundtrack or are able to facilitate the live generation of visuals that react to audio information coming from a live performance of music. One such artist is the award-winning animator Max Hattler (2014) whose works are output to various formats, such as film, video and audiovisual works for audiovisual performance . However, Hattler's oeuvre of work started in the twenty-first century and hence an examination of it is beyond the scope of this thesis.

5.6.6.2   WORKING WITH DIRECT-ON-FILM TECHNIQUES

McLaren and Brakhage used direct-on-film techniques in some of their films. Several contemporary filmmakers and artists who started their practice in the 1980s or 1990s use similar techniques today or have used them at some stage in their practice. It is noteworthy that music is an important part of the expression and aesthetics of their films. For example, Richard Reeves who has been using direct-on-film techniques since 1991, also draws the sound onto the film, for example in his film 'Linear Dreams' (1997) sounds and pictures are drawn directly onto 35mm film. Contemporary filmmakers that use the direct-on-film techniques are Pierre Hébert and Stephen Woloshen.

5.6.6.3   BAERBEL NEUBAUER

Baerbel Neubauer is a contemporary visual music artist and has been making films since 1980. She is also a musician and composes her own music for her films. Neubauer like many of contemporary visual music artists, works in many formats and medias and started working with digital techniques in 2000.   What is of interest is Neubauer's early film works and in particular the direct-on-film abstract animation films that she worked with in the 1990s, where she' painted, stamped and scratched on 35mm film stock directly' (Neubauer, n.d.). The music for these films was composed in parallel with the image compositions of the films. Moritz, compares Neubauer's direct-on-film work, Moonlight (1997) to McLaren and Brakhage's direct films, but notes that her technique is different:

> One of the other miracles of *Moonlight* in particular, and all Neubauer's abstract films: she does not use any editing. All of the effects, the layerings and the precision movements, are rendered directly onto the same filmstrip, frame by frame, with no chance for mistakes. (Moritz, 1998c)

Neubauer explains that such a non-edited approach facilitates the final form of the colour and forms. She explains this when describing the making of the film 'Roots' (1996). Roots used direct-on-film techniques. For this film, she had some images in her mind 'but started painting without a concrete plan' (Neubauer, 1998), so that the direct-on-film techniques themselves facilitates the final result of a 'metamorphoses of colour and form' (ibid.).

5.6.7 MUSIC COMPOSER-LED VISUAL MUSIC ARTISTS

What was most interesting is that several music composers of electronic and electroacoustic music were also starting to make their own visuals for projection in a concert setting as well as making what can be called film works for film screening settings. For example, composers such as: Adriana Abbado (1997), Vibeke Sorensen (2005), Jean Piché, Dennis H. Miller (n.d.), Joran Rudi (2005), Joseph Hyde (2012), Diego Garro (2014), Brian Evans (2005), Maura McDonnell, Wilfried Jentzsch (2014), Jaroslaw Kapuscinski (1998), Bret Battey, Andrew Hill, Hiromi Ishii and many more have created their own visuals for their own music compositions. Here, the moving image part is output as a video channel and is akin to an extra channel of visual art information to be presented alongside the channels of audio in a music concert setting. It was in this practice that took place near the end of the twentieth century that videos for fine-art electronic and/or electroacoustic music were presented in concert settings, and so, are forms of music concert works. An interesting example of an early visual music work led by music composition concerns by intermedia composer Jaroslaw Kapuscinski consists of an animation created by Kapuscinski to accompany his music composition based on the several of Piet Mondrian paintings, titled 'Mondrian Variations' (1992) creating an interesting bridge between painting and visual music.

It is beyond the scope of this thesis to examine all these works in detail here and for the purposes of this research project, however, two authors will be examined in a little more detail by way of representing this category. The author's own work belongs to this category as her work is also representative of composer-led visual music approaches and this also supports the thesis project which has grounded grounding the research in the author's own practice and curiosity (5.6.9). However, it is important to mention the many other contemporary artists are working as music composer led visual music artists.

Such a scenario near the end of the twentieth century, however, was in its infancy and it was something that really emerged as a more common field of practice in the early twenty first century. In the 1990s, the computer video and the digital video technology in relation to cameras and capturing video digitally were emerging as a strong and steady type of medium for working with images. In audio technology, similar digital technologies were being used in audio production.

Vibeke Sorensen[1] is a contemporary visual music artist, video artist, filmmaker, composer, programmer and musician working in experimental new media, interactive architectural installation and visual music performance. Sorensen is one of the most innovative contemporary figures in visual music. Her visual music oeuvre spans several decades; she started creating visual music works in the 1970s and has won many awards. Like many of the authors discussed, such as, Fischinger and Whitney, Sorensen has worked and works across a range of media, technologies, mediums, and processes in the creation of her works. Sorensen studied architecture, violin, photography, film and video (Sorensen, 1998) and was interested in the performance of moving images as well as music in real-time. She was particularly interested in improvisational processes as she 'wanted to perform space and images the way a musician performs a musical instrument' and thus 'create a fluid continuum between interior and exterior, and between sound and image' (ibid.). She also recognised the potential of electronic devices for recording and manipulating sounds and images and the telecommunication possibilities to connect people across cultures 'through these images, spaces and sounds' (ibid.).

Her works have been presented in a variety of art context settings: television broadcast, music concert, interactive live performance, film screening and art installation.   What is noteworthy is her collaborative effort both with composers, programmers and other artists to create works and to produce new events, ideas, technologies and presentations of visual music work. Sorensen has also been commissioned by television studios and technology laboratories to produce works. Sorensen's background in physics and mathematics as well as in art and music has put her in a pivotal position to be able to grasp and work with the potential of the music and image technologies that were emerging in the latter half of the twentieth century. Samuel Putman (1929) remarks that at the beginning of the twentieth century Leopold Survage's paintings for a planned Coloured Rhythm film for the cinema inspired Guillaume Apollinaire to declare that Survage's paintings were 'the glistening bridge' in which the new art had arrived '*C'est de l'avenir* – It had to come!' (Apollinaire quoted in Putman, 1929, 106). Sorensen's approach to visual music in her own practice and in particular in her recognition of the global reach of such art across all nations as well as the global reach afforded by the facilitating tools and techniques for interactive performance could be said to be the glistening bridge of visual music from the twentieth century to the twenty-first century. Sorensen was founder of The Global Visual Music project, an exciting project that foregrounded much of what was happening in the field of

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[1] This section on Vibeke Sorensen as well as section 5.6.7.2 has been supported by generous communications with Sorensen and her sharing of information on her practice with the author.

interactive music and video towards the end of the twentieth century and into the twenty-first century (see 5.6.7.2.)

Over the course of the 1970s and 1980s Sorensen produced several visual music works using several techniques during this early period with video synthesis, audio synthesis, analogue computer animation and electronic music. In her early work with video synthesis approaches, Sorensen was interested in the performance of moving images as well as music in real-time and explains that she and her co-creators used 'oscilloscopes to produce raw dynamic visual images from sounds. We also experimented with using electronic signals from video, frequency shifted, as an audio source' (Sorensen, 1998). The Rutt/Etra Video Synthesizer and Moog Audio Synthesizer at the WNET TV Laboratory were used to create her first visual music works starting in 1974. One of these works, 'Temple' (1975), featured in the Videography magazine on High Tech Video Art in 1979. In 1976, her Master's (MAH) thesis project, 'VideOcean' (1976), comprised a thirty minutes solo visual music work. 'VideeOcean' was shown at various conferences and festivals in both computing and arts fields of the time and it won several awards. The SONY corporation commissioned later visual music works, such as, 'Tempest' (1980), 'Voyage' (1981), and 'Little Wing' (1982). These three works were set to music by Jimi Hendrix and were broadcast on a cable television programme called Night Flight in the 1980s. They were also exhibited widely. Tempest won first Prize in the International Visual Music Festival in 1980. Furthermore, what is of great interest, is that in 1982 Sorensen, along with Tom DeWitt, who is also an author and artist of interest to visual music (DeWitt, 1987), organised a series of live performances of visual music called 'Light Music' in Albany, New York State, which also included some of Sorensen's visual music works. Like many authors, the visual part of a visual music work that has been set to music is sometimes used in another setting. One of Sorensen's video synthesis visual music works, titled 'Rejuvination' (1983), which originally consisted of music composed by Sorensen, was used as a visual projection behind the rock band Oingo Boingo in Good Morning Mr. Orwell[2] in 1984 and it was broadcast across the USA on public television.

Sorensen also explored the early technology of stereoscopic computer animation. Sorensen notes that in her process of working there are several different layers at work and she is aware of the musical aspects to her visual composition in which the shaping of images, forms and geometric shapes is done musically (Sorensen in Griffiths, 1993). Other layers are to do with time. In '*Concurrence*' (1988), Sorensen worked with simple geometric shapes in the computer to create what she calls a simple form of abstraction that is assisted by the mathematic base of computers. Sorensen took images from nature and altered them in the computer, thus re-

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[2] It is important to point out that the credits for the visual is attributed to the engineer, Dean Winkler, but it is in fact Sorensen's work.

contextualising them in geometric formations. Her later work '*MAYA*' (1992) is a stereoscopic computer animation, demonstrating Sorensen's interest in working with computers to expand our experience beyond our physical limitations (ibid.) (see Figure 69). This piece was created at the San Diego Supercomputer Center (ibid.) and involved the collaboration of an inter-disciplinary team, including such individuals as, Lynn Tenyck, Phil Mercurio, Rand Steiger and Tim Labor. Sorenson explains the piece:

> MAYA is a 7 minute stereoscopic computer animation that incorporates paradigms for interacting with space from music, sculpture, painting, and animation. It references the history of abstraction in art and language, and reflects on the nature of illusion. In one scene stereoscopic images are projected onto flat discs making up a small sculpture. Each disc is a circular window to another 3-D space. The result is a perceptual paradox: you see the edges of the disks in a sculpture made up of flat surfaces. But when you look at each separate, 'flat' disc, you see windows to spaces that extend far beyond the space of the sculpture. The two spaces contradict each other, but the mind holds them together. (Sorensen, 1993)
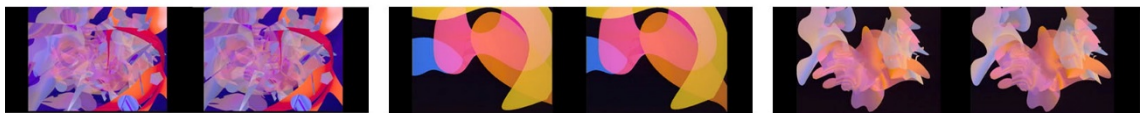
Figure 69 Vibeke Sorensen, 'Maya', 1993. Stereoscopic frames from video (Sorensen, 1993)

5.6.7.2   JOSEPH HYDE

Joseph Hyde is a contemporary music composer and visual music artist, who, like the author, has been involved with visual music since the 1990s. Hyde works extensively with audiovisual and visual music performance for both music concert settings and theatre settings. The author first met Hyde in Queens University in 1999, when both presented visual music works live in a music concert setting. Hyde is also active in the field as an academic and directs the biannual Seeing Sound Symposiums in Bath Spa University, UK. Hyde's early work uses very similar techniques and approaches to creating visual music as the author, exploring some kind of visual equivalence and/ or visual extension of *musique concrète* techniques and musique concrete music. Indeed, he notes that in discussions of definitions of visual music, it is quite rare for a visual music artist to base their technique for exploring visual and music from a *musique concrète* perspective. Hyde writes: 'Somewhat to my surprise, this approach is relatively rare; indeed, some definitions of visual music actually view the field as a subset of abstract animation' (Hyde, 2012, 172). He gives an account of his approach in a theoretical paper on the methods used (ibid.). Like the author, however, he acknowledges that there are a cohort of composers who do come at visual music from the perspective of new music composition, that is, from music composition grounded in electronic, electroacoustic and digital techniques. In this paper, Hyde explains how his

'practice in this field applies ideas derived from electroacoustic music to ocular media (specifically digital video)'. He notes the emergent practice amongst many composers (the author included) 'which can trace its antecedents as much within the musique *concrète* tradition as in relation to the roots of visual music within fine art and cinema'. Hyde develops further the reasoning behind his method rooted in *musique concrète*, explaining that he set out to find visual equivalents for reduced listening, which is a tough thing to do. Hyde observes that is very hard to remove any kind of association from a representation value, be it real or imaginary, explaining 'that, when presented by unfamiliar and abstract sounds, the listener will tend to imagine a source of origin even if such a source is not apparent'.

Hyde focuses on noise and silence as those materials that have less connotation with any source association and provide a rich source of both music and visual composition material. A work can oscillate between noise and silence in both sonic and visual material.

> These sonic states have a number of attributes in common. Both are objectively quantifiable – silence as the complete absence of sound; (white) noise as the total presence of sound – present, that is, across all frequencies (in theory, at least). Neither is found in absolute form in our (human) environment, though we experience many phenomena that are extremely close. Both have a phenomenological typology which is relatively free of associations, both with the environment around us and within the rarefied world of (traditional instrumental) music. (ibid., 173)

The tendency towards noise and silence is explored in many of Hyde's visual music work, from his early work, 'Zeotrope' (1998), to the more recent 'Vanishing Point' (2010) in both music and visual. The camera-sourced material provides a visual noise equivalent to sonic noise, not in the analogy of noise with light, but in an analogy of how the video signal can also be noisy, when each pixel in a video signal has a random amounts of brightness and colour, what he explains is commonly known as 'video snow' (ibid., 175). Hyde continues to push the boundaries of technologies and processes in his works. There are many parallels of origin, thinking and techniques in Hyde's visual music work with the author's own approach to visual music, in particular with regard to the emergence of the processes and techniques from understandings of the common ground of *musique concrète*.

5.6.8   THE GLOBAL VISUAL MUSIC PROJECT

The Global Visual Music Project (GVM) was a project conceived of by Vibeke Sorensen in 1972 but it brewed, for many years, before it was realised in a research project of the same name from 1996-1999, when Intel Corporation funded it as a research project.

In 1972, Sorensen was a musician and visual artist/filmmaker. As a result of experiencing and participating in jam music sessions in the streets of Morocco where the colours, buildings and dancing of the local people to the music created a collective experience, she conceived of her

visual music project. Sorensen describes the inspirational scene before her where 'the atmosphere was thick with rhythm, sound, aroma, and colour'.[3] From this, she visualised a 'visual-music *Gestamtkunstwerk*'. The music performance was to consist of a very large ensemble of music performed in real-time by musicians from all over the world, bringing many and varied cultures together. Moreoever, it was conceived as being able to interact with the buildings and environment and also to extend the music into a visual part to include real-time 3D visuals of a montage of textures, shapes and colours. Sorensen realized this encompassing visual-music project at a time (in 1972) when it was not yet possible technically to realize such a project but she did give considerations then to the technology that would be required: the project would consist of computer connected telecommunications systems and the employment of satellites and electronic audio/video systems, as well as the use of digital 3D architectural models and live video and audio processing. Such was the strength and power of this vision, that Sorensen continued her efforts to realize 'the vision of global visual music, including video and audio synthesis, computer graphics and music, networking, and physical computing into the 1980s and 1990s'.[4]

Sorensen was invited by Intel Corporation to submit a proposal for a research grant and was successful in acquiring the funding. Sorensen was the Principal Investigator for the project and she engaged Miller Puckette, Rand Steiger, and Mark Danks to assist in the project and with input from George Lewis and Stephen Schick (Sorensen, n.d.). Sorensen conceived, proposed and prototyped the Global Visual Music Project and it was then that she engaged the other participants to develop it further, and with Intel's support, ultimately put it into the public domain. Sorensen had already worked with Puckette, the author of MAX/MSP and of Pure Data (PD) in the early 1990s in her effort to add graphics, video, and physical computing into Puckette's then audio-only software, PD. Also in the early 1990s from 1990-1993, she engaged Danks to create software, titled Graphics Extensions for Multimedia (GEM), which comprised a library for a set of extensions for PD described as 'a set of extensions for PD that enable it to draw on Open GL for control of two and three dimensional graphics' (Visualmusic.org, n.d.). This software was created before Jitter for MAX/MSP. Miller and Rand worked on modifying the code of Sorensen's visual music programs to build the code for the GVM and Rand Steiger was engaged to compose the music for the GVM project. During this time Sorensen also continued to compose her own music for her visual music works.

The research goals of the GVM project were both to develop software 'for the creation, mediation, and dissemination of real-time multimedia content, including high resolution two and

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[3] This section on Vibeke Sorensen as well as section 5.6.7.2 has been supported by generous communications with Sorensen and her sharing of information on her practice with the author.

[4] Ibid.

three dimensional graphics, digital audio and video' (Sorensen, 1998) and a networking capability for the software and a communication protocol for the networked distribution of real-time multimedia data. It included two performances with live music, multimedia and the use of the software to stage a public networked, multiple site, public performance. The two performances that took place are entitled: 'Lemma 1' (1997) and 'Lemma 2' (1998) (see Figure 70).

Figure 70 The Global Visual Music Project. 'Lemma 2' photographs from performance that took place simultaneously at the Miller Theatre in New York and at the Intel Conference Center in Oregon as part of the 1999 Columbia University Interactive Arts Festival (Lemma 2 in Sorensen, n.d). Contributors: Miller Puckette, Vibeke Sorensen, Rand Steiger.

These performances consisted of multiple mappings throughout each work that could be changed in real-time. The software had 'the capacity to mix and process multiple sources of audio and video while at the same time generating high-resolution two and three dimensional graphics and high fidelity audio' (Visualmusic.org, n.d.). Sorensen, who continues to create visual music and multi-modal performance, was interested in ideas about what she called 'liquid architecture'. She explains the visual music and artistic-technical vision for the project and, in particular, the collaborative effort that went into the development of the software and the building of the performance:

> A 3 years grant from the Intel Research Council was awarded to the Global Visual Music Jam Session Project to try to realize this vision of liquid architecture and visual music, for real-time performance with networked improvising musicians. This project was a collaboration between myself, composer-programmer Rand Steiger, and Miller Puckette, author of Max, a programming language used widely for multimedia applications and computer music. The three of us have a fluid collaboration, each offering our individual expertise (me-visual direction; Rand-musical direction, and Miller software), while also having a broad and deep mutual respect that allows us to enter into each other's domains freely, by open discussion, suggestion, and even direct action. (Sorensen, 2000)

The result of the project was a system that could produce visual music in a music performance setting and extend music instruments into the visual domain. The system was flexible in order to facilitate the number of ways that a visual music can be created. For example, music could be mapped in real-time to any visual parameter such as colour, scale, rotation, position and shape. For example, this flexibility was at work in each of the projects two performances using the software.

5.6.9   Maura McDonnell – 20ᵀᴴ century visual music video works

The author gives account here of her own entry into and discovery of visual music, just at the cusp of the twentieth century. The purpose of this account is to bring to the reader an insight into the origins of the motivations that the author has in relation to pursuing an understanding of visual music. It was during this period that the author created works that sought to bring together in a close manner of relating abstract visual elements and music by means of computer technologies. This activity triggered her interest in exploring further the field of visual music and to find evidence for it in history and in contemporary work. The author's later works were created in the twenty-first century. The scope of the research document is to limit the analysis of visual music to the twentieth century, and so, there is no account of recent works by the author in this document. However, giving an account of her early works in themselves are enough to support the thesis on two counts: first, they demonstrate that the author engaged at the end of the twentieth century in an arts practice that was already quite mature, but less well known in music, cinema, or fine art discourse, and secondly they indicate that right from the beginning of the author's arts practice in visual music, this effort was interweaved with an interest and research goal of finding visual music both in its contemporary and historical twentieth century manifestations.

5.6.9.1   Visual art and music context

However, to provide some context, it is likely that visual music was something that was incubating in the author from an early age. All her life, she has been engaged in visual art practice, a personal practice, but only one in which she has shared her art works with friends and family. Visual art is something of immense interest to the author from both a knowledge and a practice perspective. Drawing and painting was considered by the author to be about mastering the tools and technical challenges of the tools themselves, or in getting the tools to create a portrait likeness or rendering a landscape in water colour. However, from an early age, drawing patterns, and what she used to call more 'unconscious work', was also of great interest. Here, for example, she explored a motif and let the motif bring her on a journey, not really knowing what the final result would be. Most of her friends enjoyed these drawings the most, and they were often labelled 'surreal'. Nevertheless, upon learning how to use pastels and acrylic paints, her drawings and paintings became more abstract in nature.   An equal love, for the author, was music. She only started to learn a music instrument, the tin whistle, when she started national school in Ireland after moving there when she was ten years old. She started a formal music education when she was twelve, learning piano, cello and guitar as well as being a member of numerous choirs, music groups and school orchestras. Her third-level education was in music, mathematics and history and the major component of her music degree was in piano performance and keyboard harmony. It was in keyboard harmony, where one had to compose and perform a full improvisational soprano, alto and tenor harmony at the keyboard to a given base line or from a melody line to the accompanying

harmony in the other musical parts, that she excelled while studying music. She conceived of these musical parts as lines of interweaving melodies as being akin to the weaving of patterns. Her music professor at the time, the late Professor, Rev. Noel Watson (d. 2014) knew of her interest and practice in visual art and often remarked – 'wouldn't it be wonderful if you could forge a career in both keyboard harmony and art'. Both of us would laugh at the idea.

5.6.9.2 FROM PRACTICE TO RESEARCH AND BACK AGAIN

It was in the mid to late 1990s that the author embarked on her arts practice in visual music. The entry into visual music came from two artistic standpoints, one of them from a music technology education. A surprising outcome of being a student on the Master's in Music and Media Technologies Course at Trinity College, Dublin, Ireland from 1996-1998 was how this course facilitated an education that being deeply immersed in the science, technology and aesthetic concerns of working with music and media technologies. For the author, this knowledge was both a source of creative inspiration for creating music and for creating digital images. The other artistic standpoint came from the author's personal daily practice in visual art – drawing, painting and her interest in mastering the tools of painting and visual art expression. While engaged in painting, her interest was always to capture light and shadow, but most of her work in the 1990s was abstract. It was while working on her paintings and attending the music and media technologies course, that she discovered that the new knowledge she was acquiring in the music and media technologies course, such as, knowledge of psychoacoustics, of how sound travels in multiple directions in space, of how a pitch contained an ordered mathematical ratio of harmonics, was having a major influence on how she thought about the visual element and visual forms in her painting. She started to draw from this new perspective of music grains and harmonics in space, making equivalences of line and colour and spatial relationships in the area of the picture, trying to capture a layering of visual elements, giving a sense of multiple figures and grounds akin to the grains of sound in granular synthesis (see Figure 71).

This was deeply satisfying to do and made the work more meaningful for the author. Thus, 1996-1998 was an intense period of learning. It was during this time and learning how to use digital video editing tools in order to gain skills in editing sound-to-video that she found there was something also, most interesting, about this timeline in the digital video editor. She quickly became more interested in creating abstract *visuals moving in time* in her digital video assignments than attending to the technical aspects of adding a soundtrack to a video file. She found that she could take the ideas from working with the visual elements in her abstract paintings at the time and add a new dimension to them, that is time. The visual element *now* had its own life – it had become an autonomous element in the space of the frame which could be moved, repositioned, scaled, rotated, or made disappear and appear over time. This aspect of a moving abstract visual excited the author to such an extent that she declared to the course director, Dermot

Furlong, that she had found what she had been looking for all her life: a means to bring visual art and music together – a moving abstract art.

Figure 71 Early Pastel Drawing, 'untitled' by Maura McDonnell, 1996 exploring musical ideas in visual form.

McDonnell's Master's thesis project, titled 'An Analysis of the Concept of Harmony in the Audiovisual Composition 'Towards One'' (1998/1999), incorporated both an electroacoustic music composition that used music *concrète* techniques, digital sound synthesis design and sound editing techniques, together with the design and craft of a visual composition to be combined into one singular work in which sound was played on loudspeakers and images were synced to the sound and projected with the help of a video projector. The work that arose from this thesis 'Towards One' (1998b) was premiered at the graduate music concert show in 1998, held in the Beckett Theatre, Trinity College, Dublin. After graduation, the author then embarked on independent research into the field of visual music, as well as being invited back to teach on the Masters programme that she had just completed. There was a ten-year gap in the author's visual music practice, from 2000 to 2010, where countless studies were created, but no new works. Some of this was to do with health issues, the other technology issues, but mainly, most of her activity during this time was devoted to teaching music and image related topics, of which visual music was one of those topics and also engaging in researching the field of visual music extensively. It was during this period the author also engaged and networked with the international contemporary community in the field. In 2010, the author returned to an arts practice in visual music and today continues to create visual music works. Although the author likes to compose her own electroacoustic music tracks, most of her visual music work consists of working with other

composers recorded music, or with working directly in collaboration with a music composer or musician. Research, teaching and practice have grown together over the last twenty-year period and all feed into each other in the coming to understand visual music in the wider art-historical context of its visual music history.

Becoming fluent with the preferred digital tools so that they can be worked with expressively and intuitively has taken many years. The artistic process of crafting visuals and music together in a myriad of ways with the help of digital tools in the computer is what the author does in her arts practice. Music is an important aesthetic ground for the actual crafting of a visual music work. Each piece of music, however, brings the author on a different journey of discovery in terms of handling time, motion, colour, form and the visual result for each point in time in the artwork. The structuring of the visual part is itself an act in music composition as it is the music piece that acts as the ground and is the starting point for the visual composition. Nonetheless, the development of the content of the visual part is done by visual means – and the process of working entails reworking extensively the images until the final image is found and formed. It is very like writing, words are reworked until the articulation happens. Similarly, visuals are re-worked until the articulation happens. Once the starting point is right, the work of creating the visual music visual can begin.

5.6.9.3   DISCOVERING SIMILAR 'VISUAL MUSIC' CONCERNS AND SOLUTIONS FROM HISTORY

The questions that were asked of the research and aspects of the history that were focused on in this thesis have revealed that her own work has some points of comparison with issues that were of concern by historical authors in the twentieth century. Quite surprisingly, the author found that the approaches, questions and solutions that these authors sought in their work were similar to the concerns and approaches and questions that the author sought in creating integrated visual music works. For example, the question of form and how to describe it has always been quite difficult to articulate for the author in relation to her own approach to form. As she does not take a direct mapping approach to elements of image to music nor a direct mapping of colour to musical tone, then how could she account for form in her works. Several of the historical figures examined in this thesis provided some insights that have helped the author have more clarity in what form means to her in her works.

Kandinsky approached colour and its relationship to form as an independent and important autonomous element in its own right in the space of the picture. For the author, colour is one of the most important parts of the work and colour is considered an independent aesthetic element in both its autonomy as a visual element but also an expressive power in its relation and proportion to other visual elements in space and in time and within the area of the frame in the work.

It was Len Lye, with the help of Laura Riding, in his articulation of form as being movement that also really resonated with the author. Composing motion is an important part of her work, but it is something similar to Lye's idea that it is in the motion that the form is got. For the author it is a quite complex process of layering multiple motion timelines from which a form eventually merges. The contemporary visual music artist Jean Detheux also has a similar approach to form, where the visual elements are in a constant process of change. This is a result, Detheux states in the programme note for his 2005 film Liaisons, of an "intense meditation on a world in constant renewal, where every form that emerges is immediately engulfed by the next one" (Detheux 2007b).

Norman McLaren's approach to the creation of a work from the perspective of solving a problem of technique or seeing where a technique can bring one in terms of deciding what happens in final artwork is something that resonated strongly with the authors own approach taken in some of her works and studies. For example, mastering a complex effect in Adobe After Effects will lead the author to see the potential of the visual result for being the beginnings of the visual part of the work. For some works, the music is considered first, a visual impression might form and then, there is a period of intensive studies and activities to find a technique that could move towards the impression. Or sometimes the desire to investigate a technique will lead to the selection of a piece of music that could be used to help really come to know the technique. This was the case with building the visuals for the work 'Duel Tones' (2016). A granular synthesis timbre was used to generate particles over a range of values. The visual results were used then as the raw material to build the imagery for a new work.

5.6.9.4 AUDIOVISUAL COMPOSITION

The author's first three visual music works were produced between 1997 and 1998 and are titled 'Dazzling and Blinding' (1997), 'Edges' (1998a), and 'Towards One' (1998b). One of the works, will be examined in more detail, and the analysis of the other two works are available to read in the appendix (see Appendix II for analysis of 'Dazzling and Blinding', Appendix III for analysis of 'Edges' and Appendix IV for analysis of 'Towards One'). The reason only one work is selected is that the unique methods that the author developed in creating this first work, became the basis of a typical approach and methodological process that has been taken in subsequent works.

At the time of making these early works, nomenclature was difficult, and the author did not use the term visual music to refer to the work as such but did describe that what was taking place was a visual music. With no knowledge or awareness of previous work in the field, except for the attendance at one multimedia music concert, the author focused first on the music. Music was the entry point to the visual and it led the way into the visual and so these works were considered initially to be music works. The visuals were seen as an extension of the music. One definition

initially used by the author was that these works were a visual form of *musique concrète*, as it was apparent to the author that the techniques that she developed with the visual was directly related to techniques that had been earned in creating *musique concrète* in the computer using digital sound editing software. The term video did not seem to fit nor film nor cinema, but that was mainly because at this stage the author had no skill in these fields. Indeed, at first it felt like one ought not to be working in a field that one did not have training or knowledge of. However, the computer environment that the author encountered of digital image and digital video allowed for an experimental access to images, in which one could freely explore digital processes without worrying that one was going to ruin some expensive equipment. By the third piece, 'Towards One', the importance of the cinematographic techniques was recognized as being an important consideration for working with the images, however, the investigation of cinematographic techniques was done from a music technology perspective. However, a period of study started into the field of the history of experimental cinema and video.

However, the author was not sure what kind of audience would such new combined music and visual works appeal to. It had visual art components, cinematographic components and music concert components. Would an audience sit down in a cinema and spend ten to fifteen minutes watching this as a type of film? The author came to the conclusion during this time that it was the music concert setting that best served the presentation of this kind of artwork. Yet, there were possibilities for presentation in short film festivals or in experimental television broadcasts too. One term that was settled on for the third work, was that of 'audiovisual composition' (see Appendix IV).

5.6.9.5   IMAGES AND MUSIC CONCEIVED AS BEING THE SAME MATERIAL

The author liked the fact that the term 'audiovisual composition' emphasized the compositional part of the piece both the music and visual compositions. What the author came to learn in making these three works, was that in the computer, both images and music had the same material basis, that is their digital form of numbers, and various higher-level forms of representation available through computation and thus, physically and conceptually, both images and music were reduced to the same material. Therefore, having such a conception of both images and music as being the same 'stuff' enabled the author to build complex relationships at the level of the digital material representations. To the author, both images and music were made plastic in the computer, were infinitely malleable and infinitely connectable in all kinds of relationships from tight synchronized relationships to counterpoint relationships to the weaving of an audiovisual tapestry of multiple forms of visual music relationships. However, the term audiovisual did not sit well with the author as it removed from the term the artistic-ness of the musical aspect of the work and just how important that was in the conception and naming of the work and of the spirit of the work. A common term, the author discovered, that is used in Canada to describe the same type

of work with a close visual music expression is 'video music' (Piché, 2003). Piché used the term 'video music' and in wrote of the distinction of music video from video music. Video music he notes is a form that is suitable for all digital means of production for both image and music and that it is a hybrid form that delivers at the same time in image and music a poetic and open vision of the imaginary (ibid.). Original quote in French:

> *Une forme qui s'approprie tous les moyens de production numériques tant pour l'image que pour la musique. Une forme hybride qui livre en même temps en image et en musique une vision poétique et ouverte de l'imaginaire.* (ibid.)

Similarly, this term video music did not sit well either with the author as it puts emphasis in the actual term on the medium of video. The author prefers the term 'visual' rather than 'video' as for her, visual puts emphasis on the visual artistic activity in devising a visual music expression and that the means and medium for that expression is open, it can be video, computational processes, film, installation, interactive media and so on. However, both of these terms are useful constructs and many authors use them. The author then when examining works that are declared a video music or any other term, examines these works for the purpose of identifying the visual music expression taking place in the work. Art works then can incorporate a visual music expression or can include such expression in the work are also to be considered a visual music work, for example video projection aligned with music in dance theatre performances. The author now believes that her early works were visual music works.

5.6.9.6 ANALOGUE TO DIGITAL TECHNOLOGY TRANSITIONS

The three twentieth century works comprised of a music soundtrack and 'visuals' that were combined in computer video software and output as video to various video formats, from VHS, S-VHS, Betacam SP tape formats and computer video formats for playback. They were works that experimented with the methods, processes and software then available in the earliest versions of digital image, video editing and digital video effects for the computer – Adobe Photoshop, Premiere, After Effects 2.0. The three works, like for many of the artists mentioned in this chapter, represent the beginnings of a new phase in the crafting of imagery for, with, and in a close visual music expression with the music, on the cusp of a purely digital process and technological means for both creating and outputting work. The author created these works with a mixture of analogue video, digital video, computer video and digital video effects techniques and they were output to analogue video formats for music concert, film festival and television broadcast playback. They were created just before video could be projected directly from the computer for playback. The big constraint for the author at that time was the power, processing and storage capacity of the computers that were used, as she did not have access to any super-computing systems but had access instead to high-end prosumer computers. The author did her best to procure a custom computer with the highest Random-Access Memory (RAM), processor

capacity and storage capacity, the computer had 2GB Ram, 100 GB storage and a single core Intel Pentium II processor. This, nonetheless, was a sign of things to come as more individuals entered the prosumer computer market in order to customize a computer system as much as they could afford in order to create digital art and music. The author at the time was delighted with the freedom that the computer tool enabled, as it could create, edit and make music *and* it could create, edit and make images and it enabled one to combine both images and music together and to playback images and music together through outputting the images and music in a synchronized time-code relationship. Having a background in music and media technologies as well as a lifelong personal practice in drawing and painting as well as an interest in particular in abstract painting, the author had discovered a tool that suited her way of working with artistic ideas. The computer was the means by which she could access both images and sounds and their relation in one place. She had found the expressive tool that motivated her to create expressive art works. Even with the best possible system that she could access at the time, the video 'Edges', which has a duration of four and a half minutes, took three weeks (day and night) to render at broadcast quality, and that was also with some considerable compression applied. The computer video could not be played back on the computer. Only when it was output to a Betacam SP broadcast quality videotape, could the video be played back at the correct speed. It also played correctly on an S-VHS tape that was output for preview purposes.

5.6.9.7 MUSIC TECHNOLOGY LED TECHNIQUES WITH COMPUTER IMAGES

The process of working with the images for these three early videos consisted of gathering images and video footage. Images sourced were from analogue and digital video camera footage, still digital photographs and scanned drawings. The images were processed and manipulated with digital video effects applied to footage using the software Adobe Photoshop, Adobe Premiere and Adobe After Effects in their 2.0 versions. Once captured in the computer environment, the author worked with these, using the video effects filters available in these software platforms to completely transform the images, making the images totally plastic, a term used often when crafting these images was working with the plasticity of images in the computer environment, this excited the author, who was interested in developing a process of working that involved testing multiple versions of a colour combination with a few clicks of the mouse. The author having knowledge of painting techniques, knew that to totally transform a painting's colour scheme meant to re-paint the whole painting. The idea that the process of editing in the computer enabled one to save versions of experiments with colour and manipulation effects, and to also undo and to not destroy the original image was a very liberating aspect of working with images in the computer. It also enabled one to explore many variations of one idea and keep these variations stored to come back to at another time. One could build up collections of experiments of manipulated imagery. Then use these collections as the starting point for the structuring of the

final composition. A good metaphor is that of orchestration. The composer chooses the instruments and the sorts of timbres to be used by which then the music pitches, rhythms, melodies are played on. The visual part can be constructed in a similar manner, the visual musician creates the various versions of colour and forms that then become instruments, the instruments are combined in the final composition to create the overall work. The animation and events of the music were also used as a structuring timeline, which was then combined with the final render of the images. The music for 'Towards One' consists of an electroacoustic tape piece composed by the author. The visual and music part were composed together. The music for 'Edges' was a mix of excepts from the music compositions by composer Barry Truax's from his 'Digital Soundscapes' CD.

The author had knowledge and experience of digital sound editors and sound design techniques and had created music compositions by design digital sounds with digital audio and sound synthesis methods, such as, granular synthesis, Frequency Modulation (FM) synthesis, Amplitude Modulation (AM) synthesis techniques, as well as using MIDI to compose music and sound editors to manipulate sound. From a music composition perspective, the author had composed music using various digitally-mediated artistic techniques, such as, for example: algorithms using C-Lisp Music, applied *musique concrète* techniques with Sound Edit digital sound editing, composed string quartet in minimalist style music with MIDI equipment, designed sounds with the KYMA Capybara object oriented digital sounds synthesis modules and hardware, and also written machine level code in digital signal processing to execute a phasing type echo to an input sound sample. The author was well versed in the power of digital tools to work with sound in the computer.

The preference for working with sound was to explore the manipulation of short sound extracts and to layer these together, mixing at different percentages and at minute offsets in time. Interesting sound effects were created this way and many of the sounds suggested rhythm, motion and percussive elements yet seemed to belong to each other as one group, a timbre. A technique with which the author liked to work in sound was to layer the same sound into itself several times with a slight offset, which resulted in numerous reverberations, timbral, melodic, percussive and sonic effects. The surprise element of such sound manipulation was very interesting, as was the quest to search for a good sonic and musical result. The author referred to this technique as a multiple layering approach to sound, so that the machine — that is, the computer — calculated the mixture of the sounds in a purely mathematical manner and the sonic result was further manipulated until a desired effect was reached. In a way, this was a particularly digital way to work with sound and, at its foundation, really consisted of simple computer operations, such as, select, copy and paste. When mixing channels of sound in audio, a percentage of each audio track could be so specified that the signal would not distort but effectively be mixed by the computer,

through all the audio parameters, so that the separate sounds would sometimes blend into a new unified sound that was different to its original source.

The micro-motions discovered in endless sound manipulation was carried over into a way of thinking about the visual part. The entry into video-editing came from a music technology-led skillset in digital applications for creating, editing, synthesizing, and composing sounds in the computer. The filters and effects for images and digital video were just as exciting to explore as were the filters and effects available in digital sound editors. One could manipulate groups of images and these images could be grouped into categories of texture, colour scheme, shape, motion. These manipulated images could then be layered and combined by controlling the percentage mixture of the colours and/or the opacity. This is similar to the sound editing and manipulation method of combining extracts of sound through manipulating the mixture of the volume of each extract and how much of the volume of one sound mixes into the other sound. Controlling how much volume a sound layer had in a sound mix was compared to controlling how much opacity or colour mixing could control how much of the information in one layer of imagery could be mixed with another. This was the very technique that the author discovered arising from sound editing and applied to image and video editing and this simple principle is one of the working methods used in all her visual music compositions. It was discovered that following through on this music making method that resulted in musical micro-motions into the visual domain of image and video editing also resulted in the most interesting micro-motions too in the visual part of the final frames of the work.

5.6.9.8   MAURA MCDONNELL – 'DAZZLING AND BLINDING' (1997)

Coming to the images and video in the computer, the author did not have a familiarity with the language of video or photography, and so, filters that were geared towards those skillsets such as, colour balance, brightness and contrast, and keying did not have much significance to the author, except that they were available in the filter menu in the software, however, the author used these filters that were intended for correcting video and creating green screen composite videos, as if they were a type of paint brush, they enabled the images to be explored for their artistic resultst. This was a form of pushing the boundaries of the technology and these in-built techniques to see just what one could do with these effects. The image and video editors were approached as if they were audio and sound software. The author discovered that images could be manipulated in similar fashion to the ways of audio and the very technique in audio that the author had come to use frequently, that is, of complex layering of audio to create new sounds and timbres, could be deployed in the image and video editor. It took time, nevertheless, to build skill in such merging of images and it took time to find the image equivalent of the way that an audio editor could mix the percentage of copied and pasted audio tracks.

For the first piece, the author used found footage as the basis of her visual content. At first, the author gathered footage of objects, such as, random images of ornaments, utensils, and chairs and eventually started to create her own image objects in digital image software, such as, circles and shapes, textures, background colours, abstract style painting type pictures and utilized some of the manipulation techniques, such as, corner pin, scale and rotate in image editors to apply to any type of footage item brought into the software. These techniques enabled one to place and shape a footage item in the space of the frame and gave some control of the arrangement of the visual elements in the frame. She built up a library of images made up of such random image objects. The qualities of light, colour, colour combination, texture and shape were attended to when gathering together objects and when manipulating image objects. Images were then manipulated digitally exploring all the various filters and effects already available in the image editor. The difficult task, at first, was to assemble these objects in the video editor to make a coherent and artistically meaningful result. With not having any video or photographic language, the author conceived of these objects as sound objects and conceived of the frame of the video as the space from which to assemble the sound objects. She wanted these objects to blend and mix together to make up a new type of whole, just as in audio editing the blending and mixing created a new type of whole timbre or sound.

The author's first attempts were clumsy, and she assembled the objects as if creating a collage, keyframing some motion animation, such as, change of position, scaling and rotation. She found that using the keying filters allowed the objects to blend more, which was what was desired, but again first attempts were clumsy and awkward, and the blends were jagged and dissatisfactory. Endless permutations of images, nonetheless, were created using these methods. When the author selected the music, she wanted to work with, she would use its structure and timbral effects over time as the timeline for subtle transformations and changes in the image material. The source images and videos and generated imagery were no longer recognizable after this process of manipulation and transformation was complete. The source images had become for the author pure material of which she did not know what to name, except to say 'material'. In the first video 'Dazzling and Blinding' (1997), the music selected was a short extract from a pre-existing music recording by the composer Kaija Saariaho, named 'Dazzling and Blinding'. There was a shimmering vibrato effect in the background of this extract that was difficult to animate too. The author wanted an analogous shimmering effect to be in operation throughout the background of the piece, and for foreground image elements to appear across the frame as events in time, appearing and disappearing when deemed necessary. The challenge was to produce this shimmer effect. After trying keyframe animation and frame-by-frame techniques, the effect just could not be achieved. It was decided, therefore, to find a found footage item that had a similar pacing or speed of motion. It did not matter what the recording was, but that it was of a particular

speed of activity. A search on the internet (at a time when there were very few videos on the internet, and if there were, they were very small size and compressed) yielded a good quality video of a musician playing a fast piece of music on the piano and where the piano keys and the double octave playing of the hands could be easily seen. It was thought this had the pace and vibratory motion required. Through an involved process of working with a conversion of the video into a series of still images, applying a filter and an automated behaviour action in PhotosShop on the rest of the images of the video as well as applying some colour filters and polar coordinate effects to the image, the resulting effect created the vibrato and shimmering effect desired. It now no longer looked like a stride piano performance (see Figure 72). The visual image looked according to the author like it was a shimmering background in analogy to the shimmering effect perceived aurally in the music — a visual music *concrète*.
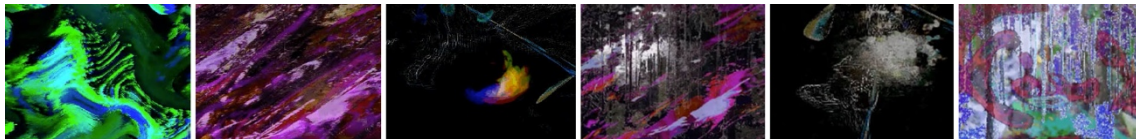
Figure 72 Maura McDonnell. 'Dazzling and Blinding' (1997), frames from the video. The first frame denotes the shimmering effect achieved from manipulating video footage of a musician playing the stride piano.

5.7 CONCLUSIONS

Without the development and advancement during the latter half of the twentieth century of visual and audio technologies that could bring together in real time the creation, editing and blending of images and sounds on the one platform of the computer, visual music, as we now know it from the end of the twentieth century, could not have come into existence. In the hands of the visual music artist, the expressive power and capabilities of working with sound and image non-syncretically to produce unified experiences of visual music pieces both continues and advances, in a way hitherto only dreamed of by the colour organ inventors of the eighteenth century and the abstract painting and absolute film makers of the nineteenth and twentieth century. The twenty first century, however, has witnessed an exponential use and growth in automatically generated audio-visual productions. To what extent such automated synthetic efforts advances the art of visual music would depend upon the extent to which that development advances or forgets the understanding achieved in the earlier efforts and desire to make music visible and make the visible music in visual music.

Chapter 6   CONCLUSION

The various conceptions of visual music in the variety of art practices in the twentieth century have contributed towards the development of a varied and complex visual music practice in the twenty-first century.

6.1   MAIN CONCLUSIONS

This thesis has found and concludes that the term visual music today can be used to denote two things: One, visual music refers to an artwork. Two, visual music is a form of expression that can be used when combining visual art images with music across a range of presentations from concert, to VJ concerts to screening to installation to dance and theatre.

In relation to One, the specification of an artwork, the term visual music is a unique and holistic special category of art work that typically conjoins music and visual art together intentionally by an artist or artist musician and also presents the artwork as combined visual art and music. That does not necessarily mean that a visual art that has not been conjoined with a music part is not a visual music work, as there are instances of silent visual music, in which a visual is constructed as a result of an intricate engagement with musical ideas but is deliberately presented in silence. Silent visual music approaches have their precedent in the silent Lumia works of Thomas Wilfred or in the silent visual music underpinning some of Stan Brakhage's ideas. Nor does this exclude the work where a composer uses images and visual art deliberately engage with in order to compose their music composition. Nor does it exclude those collaborative works between a musician and a visual music artist to create music concerts that consist of a music performance with a visual accompaniment. But the term does point in a rather special way to those works of art that designate the combined music and visual art or image to be a visual music work. The author designates her art work to be a visual music artwork as do many other contemporary authors do too.

In relation to Two, the term visual music can also designate a unique type of artistic expression – a visual music expression that can be sought by any type of artist from any of the art fields such as visual artist, musician, composer, filmmaker, programmer, theatre practitioner, dancer or anyone from any of the art forms who seek to explore the cross-art, cross-media, cross-modality, cross-sensory potential of pushing back the boundaries of an separate art and seeking to create a fusion of visual art and music as part of a wider artwork. The artwork can be a designated work that intends to explore a visual music expression in a visual music work and/or it can be an expression sought between visual and music elements that are used as part of a larger artwork such as in the set for a dance or theatre performance. Here the visual music expression

becomes one part of the overall language of expression of the total art work – visual music contributes to the *Gestamtkunstwerk*. Even if an artwork is not designated as a visual music work of art, or as having a visual music expression as such by the artist, some works do indeed exhibit visual music characteristics whether intended or not. That is the state of play in relation to visual music today, yet the field of visual music is continuously evolving.

6.1.1 TWENTY-FIRST CENTURY VISUAL MUSIC

The twenty-first century has seen an exponential growth in artistic activities in relation to visual music. This, undoubtedly, has been facilitated by a wide variety of factors, such as the evolution of sophisticated digital audiovisual technologies, advanced effects in digital video effects software, together with an increased capability of computers and computational approaches to share parameters between image and sound data and to design multimodal computational images where sonic data can be used to drive the data values for image data and vice versa. This rapid development of digital technologies has also enabled artists and technicians to share their knowledge and to disseminate their projects both in terms of artistic presentation and in terms of academic research in the fields of music, visual culture, film, digital arts, media and musicology. Other fields such as neuroscience and cognition are also contributing to the field of visual music, and in the future will contribute more to the field, as an understanding of how the brain processes music and visual information such as rhythm and harmony will enhance how an artist might understand how to go about a multi-modal and multi-sensory approach to their visual music art practice. For example one such research group operating today in this field is the Crossmodal Perception group headed by Professor Charles Spence at the University of Oxford (n.d., Cross Modal Perception). Jack Ox, an intermedia artist who has been working in the field since the 1970s as an artist and researcher in the field, has recently completed research on connections between elements of the concepts in conceptual metaphor theory and blending theory and intermedia. In the abstract to her PhD thesis, Ox observes that 'Cross-modal projects and intermedia works use similar concepts' and that there is a 'natural engagement of metaphorical principles in mapping between different perceptual domains in science, design, and art (Ox, 2015). There is active research and collaboration also between scientists and synesthetic artists and the author has recently engaged with this field as a collaborator, practitioner and the sharing of research. As artists engage more with these knowledge fields, and come to a fuller understanding of multisensory experience, the future of visual music is bound to move towards such research as enriching both scientists and visual music artists in another level of understanding of how to work with combined media. What is exciting about the twenty-first century to date is the amount of visual music work and research that is being conducted.

An examination of the twenty-first century's developments of visual music has been beyond the scope of this thesis as the primary focus of this research concerned the development of visual music from its origins in the eighteenth and nineteenth centuries up to its emergence and establishment of itself as an autonomous artistic expression by the end of the twentieth century.

6.2 OVERVIEW OF THE CONTRIBUTIONS TO THE FIELD OF VISUAL MUSIC

The examination of the twentieth century historical evolution of a conception of visual music is of importance because identifying and discussing the central features and characteristics of visual music that were learned in the past both inform and have a significant bearing on the practice of visual music today and into the future. Such an examination of the twenty-first developments, then, can take place in future research and is best served by a collaborative research effort by several practitioners and theorists.

The research started out with some assumptions that the main history for a visual music art today is in the abstract films of a number of filmmakers operating in Europe in the 1920s and in the later film work of Oskar Fischinger and Norman McLaren in particular. Indeed, these filmmakers are important contributors to the field, but it was surprising to find that there is a largely overlooked area of experimental twentieth century composers who actually embraced having a visual accompaniment to their music, such as Pierre Schaeffer and Barry Truax. For musician/ music composer led visual music artists, such a legacy is important and worthy of further examination. This finding therefore, has been reflected in the title of the thesis – A form of cinema one could call concrète as reference to this strand of visual music history and to acknowledge, how the author's own visual music work arose in experiments with digital image and video media applying musique concrète techniques and concepts to images and video. One of the findings of this thesis has been to uncover some historical precedents and to designate the category musician / composer-led visual music artist. This precedent is of relevance for contemporary music composer led visual music artists.

This study also contributes to the visual music research field by incorporating the viewpoint as applied to the field, by a practicing visual music artist who is interested in understanding the tenets and characteristics of visual music as an evolving art practice that increasingly developed over the twentieth century. The author is immersed in that problem-solving and experimental approach to crafting visual music works with visual music relationships and is so primed to look for the significance of the visual music in other works and writings in the twentieth century.

The author's own practice straddles the twentieth and twenty-first centuries, and the works examined at the end of the last chapter were those created in the twentieth century. In terms of their production process and medium, the author's early works belong to a form of experimental

television broadcast and an experimental video projection with sound. Two of the early works (in broadcast quality Betacam SP videotape format with stereo sound) were screened at the Darklight Digital film festivals, and one was included in a television documentary in an experimental television genre. The potential for presenting the author's work in a music concert setting happened when her piece 'Towards One' was presented as a fixed media music concert work with video and stereo sound in the Samuel Beckett Theatre, Trinity College Dublin, for the Multi-Media Technology M.Phil. Graduate Show concert in 1998 and, subsequently, at the Queen's University Sonorities Festival, Belfast in 1999. However, as the original focus was on broadcast quality television of the late 1990s, the format of these works is not of high enough technical quality for large-scale video projection in today's music concert presentations of visual music. They are of their time in terms of format and technology. Their value, nonetheless, resides in the fact that they brought the author into a commitment and a belief in the potential for designating an art field as visual music. The methods used in these works have been identified as methods and techniques taken from the field of music technology.

Like many of the artists examined in the last chapter, the author has continued to pursue a visual music arts practice into the twenty-first century. Thus the author has also been able to take advantage of advanced video effects available in digital video effects software as well as other numerous possibilities with using the expression coding language available in Adobe After Effects as well as output video files to a higher resolution and technical quality for large-scale projection. The author also has explored other forms of image generation, for example, utilising the audio-to-image creation capabilities of the interactive software Isadora and fractal-based software to generate more serial and periodic imagery. The author's most essential techniques for creating and crafting imagery with music, however, has not fundamentally changed since creating the first work 'Dazzling and Blinding' (1997, see 5.6.8.8).

At the end of this study, therefore, the author would like to look back at this study of finding visual music in its twentieth century history and draw attention to some of the major features of visual music from this period that are of relevance to its origins, understanding and evaluation. We have followed the trajectory of visual music, from its earliest mentioning and conceptions in the eighteenth and nineteenth centuries, through its major development from painting to film in the early decades of the twentieth century, up to and including its continued advancement in the twentieth century which, as that century drew to a close, witnessed the emergence of a form of artistic expression *sui generis* that began to call itself 'visual music' (Imgardt (3.2.2), Fry (3.2.3), Diebold (4.2.3), Van Doesberg (4.2.4), Dow (3.2.4), Moritz (4.4.2), Fischinger (4.4.1), Brakhage (5.6.2), Whitney (4.5.3), McDonnell (5.6.8.8), Abbado (5.6.7), Miller (5.6.7). For our research, we were guided by three research questions: (1) what does the term 'visual music' mean in the twentieth century and what conceptions of visual music are understood; (2) what are the common

characteristics of art practices that explore a close relationship between a visual and music element across a range of technologies, mediums and technique; (3) what is the dominant expression in visual music and can it be identified and categorised. These research questions will be revisited in section one of this chapter (6.3), taking into consideration the answers to those research questions and some new and unexpected findings that have been discovered through the research, writing and practice of visual music that has taken place for this thesis. These findings about visual music, however, are complex, but they can be summarised, collated and sub-divided into two main categories, namely: those that concern sonic themes for visual art (6.4), and those that relate to the various forms that were explored and developed in the visual expression in visual music (6.5). Taken together, both the sonic themes for visual art and the visual expression in visual music has led to the singular emergence of visual music as an autonomous and recognisable art practice itself, where the 'term [itself]', as one commentator remarks, 'can be considered today to be familiar enough to speak for itself' (Hyde, 2014). This, we address, in the final section of this chapter (6.6).

6.3 RESEARCH QUESTIONS REVISITED

Regarding (1.) the historical account of art practices and commentary in which the term visual music was used, what has been found is that the various conceptions and uses of the term visual music are linked to the evolution and development of the technologies and mediums that enable the realisation of visual music forms. Several authors used the term 'visual music' for different things. Conceptions of visual music were first applied to painting at the turn of the nineteenth century, referring to the new content of cubist, symbolist and abstract painting. This conception of a visual music, however, was part of a wider conception of the possibilities of integrating the arts and expanding the visual arts to include a content chosen by the artist themselves.

The context for considering visual forms in painting to be a visual music are also linked to the scientific effort of comparing colour and sound that emerged in the eighteenth and nineteenth centuries and the experiments in both the design of mechanical instruments and in painting in exploring a colour-tone analogy. The analogy continued and developed into experiments in producing a new mobile colour art and a colour music art in the twentieth century, with further developments of mobile colour instruments for both composition and improvisational performance. Experiments in installation art of which a kinetic form of colour and light were installed in visual art gallery settings, therefore, are an expansion and elaboration of the idea of a mobile colour art and the building and design of colour instruments. Many of the kinetic art installations forged a close relationship to sound in that the sound was able to enact a change in the actions of some aspect of the formation of the image results. Other kinetic art installations were used as a form of creating abstract content in film, or for a dance performance, generating

dynamic and complex imagery of intermingling forms and colours. The term was applied to various forms of non-objective film throughout the twentieth century. At the same time, experiments in creating synthetic sound in film enabled filmmakers to consider creating a direct type of relationship between sound and images where the actual geometric shape that could be viewed in the soundtrack could be presented at the same time in the visible part of the film. Thus an analogy between geometric shape and sound was explored. The direct relationship between the reproduction of one form of information, such as the geometric shape of sound on the soundtrack and the presentation of that geometric shape in the visible portion of the filmstrip, became the basis for exploring how technological interventions and reproduction of sounds and images can forge very direct and close relationships between sounds and images. This was explored in the video synthesis experiments and the early television experiments as the video signal, by providing a time-varying waveform, contained the potential for a much more temporal and immediate link between sounds and images. That both video and sound could be represented as time-varying waveforms enabled the forging of a visual music to take place at the level of a fundamental motion unit. This, in turn, spurned research into the global nature of the digital data representation of sounds and images towards the end of the twentieth century and that continues to this day into an infinite number of possibilities of combining sound and image information to create powerful and meaningful visual music works.

Regarding (2.), the range of art across the different art practices that have used different means, mediums and technologies in visual music, this thesis has examined what kind of relations were sought between visual elements, visual art and music, as well as pointing to the conceptions of music and sound that underpin each artist's correlation of the visual and music. By reading into these artists works a bit deeper, one can find that although the means and objectives for each may be different the actual visual music explored has some common characteristics that are evidence of a general concept of visual music that traverses mediums, techniques and methods. Technology enables new types of images and sounds to be created and enables new forms of relationship between music and images to be sought. It also provides new tools, new means of access to music and image parameters, and so, new possibilities for artists to explore and to devise new techniques. Each of the technological underpinnings of artists' works examined contributed to the evolution of new technologies and contributed to expanding the pool of access to a larger base of artists who could access those technologies. The reason that more artists can create a visual music art or use a visual music expression in their work is because more people have access to the tools by which to explore possibilities. Thus one can categorise the common characteristics by which all the differing technological renditions of visual music take place as belonging to a general category of 'sonic themes for visual art' (see 6.4).

Regarding (3.), the author, as a practicing visual music artist, was already committed to the idea of a visual music as an expressive art form and this was how she explained her own form of artistic expression. In this regard, the thesis did start from the standpoint and experiential assumption that a visual music expression does exist. The question, however, that the author raised in relation to the research conducted and of all the works, practices and commentaries studied was what kind of concept and expression is at work in visual music that can explain the interrelationship between visual art and music concepts that operates in the art practice of artists committed to exploring such relationships. Each artist had their own conception of the expressiveness operating in their art works. The author expected to find that through an examination of the expression at work in the historical practices, one could find a useful generic definition of visual music to fit all types of art (both historical and contemporary) taken from all the various forms of practices. This was not actually the case; a one-fits-all definition was not found. The author also expected to be able to identify a concept of visual music that could be applied as a singular technique and as a descriptor for artists and commentators alike. This, however, also was not found. What was discovered rather through the painstaking reading, collating and writing up the research from the historical field and from the findings obtained about what type of artistic expression there is at work, was that the term 'visual music' is a very useful term that captures and categorises the variety and ranges of the particular practices in the works examined. This is why such a term is useful and appropriate for examining contemporary and future works. No other term enables one to account for the variety of technologies, forms and means used to express a close relationship between visual art and music. It is the visual music expression that turns out to be the common characteristic across all the works examined (6.3).

6.4   THE SONIC THEMES FOR VISUAL ART

In this section on the sonic themes for visual art in visual music, the various types of approaches to content in visual art that have been examined in this thesis will be discussed. What has been found is that in all of these approaches the overarching approach to content was the exploration of sonic themes in a visual form. There are two broad approaches taken to exploring the sonic themes for visual art that has been found in this thesis. One content consists of forms in painting that are a form of visible music. Another content are forms that come about as a result of creating a form of expression that takes some of its inspiration from music and music expression. A visible music approach has within it various approaches. Both music's tonality and music's atonality has been explored in visible forms. The creation of mobile colour in colour organs and instruments is another visible form of music. The means and forms of expression also have had a significant part to play in the type of visual content that is created. There is an interplay between the means with which an artist chooses to work and the techniques that the artist uses and devises as well as

the way in which the artist uses the means to explore conceptions and connections of music and visual art and their interrelationship. The means of expression influences the forms of expression. The various means identified throughout the twentieth century are: cinematographic and videographic expression; the conception of the image and the image as a construction unit which the author names as the visual music image construct; the synchronisation of the arts through synchronised mediums; the transition from creating content for broadcast to creating content for performance; the exploration of kinetic and new realities through the exploration of methods of manipulating light and sound with technology and the influence of music technology on the techniques and processes for creating images. Another development in art that has had a significant influence on the evolution of sonic themes for art, is the development of abstraction in painting.

6.4.1   SONIC THEMES IN McDONNELL'S ART PRACTICE

As the author was already both an abstract visual artist and musician before she entered into her visual music practice, there were three parallel developments that occurred between 1996 and 1998 that facilitated her own discovery of the field (5.6.9). One, learning about the science and technology of music triggered a new understanding of abstraction in her painting and drawing works and made abstraction more meaningful for her. Two, learning how to create music compositions with music technology and a thorough understanding of the science and engineering of sound which she applied in music compositions and three, the timeline in the digital video editor was conceived of as if it was a sound editor and a means for adding time to her abstract painting. It was at his juncture that she felt that abstraction had found its home in the technology and means of music production (5.6.9.7). Upon discovering many of the musical influences in the development of abstraction, it seemed all the more powerful, that the visual artist now had the physical and technical means to easily create an abstract visual expression in and over time. Abstract paintings could have a temporal element. In that temporality, the abstract painting could also be aligned to the temporality of music, at the very point of its sounding and so visuals could sound at the same time as the sounds could sound. The aesthetic concerns were enhanced and expanded upon as a result of these new digital image and video means. For the author then, it was a knowledge of the sonic – how sounds behave in their harmonic structure in time and over time that was translated and explored in a form of making the visual sonic too. Listening to the sounds of the music as they are sounding was also crucial. Being able to access the audio track of a piece of music facilitated endless opportunities to listen and come to know a piece of music. The digital video editor provided a measured timeline upon which the visuals could be composed in tandem with the music as it is sounding in a type of weaving together the two mediums through listening, looking, rearranging, moulding, making and all the artistic processes used to realise the visual

composition to the temporal structure of the music as it sound and is available to synchronise with in the audio track of the video editor. The author considers that visual music is the end of abstraction (6.2.4) and that the condition of music sought in the early abstract paintings of the twentieth century finds its ultimate home in the art that enables music to be present in the visual art work as an equal part, and that is, in visual music.

6.4.2   MUSIC AS CONTENT

6.4.2.1   SONIC THEME – A SUBJECT MATTER

One of the main common findings of this thesis is that both the knowledge from which an artist operates and the means with which that artist has to work have a significant part to play in the development and evolution of that artist's work, the art, its subject matter and content. As McLaren (1914–1987) noted of his own practice (4.4.4), the subject matter of his films often evolved in and from an interplay between his interest in music and his desire to learn a new technique in animation production. In his experimental animation works, he often made the subject matter evolve from an interaction between this process of exploring a technique with the means at his disposal, yet without any particular subject matter in mind *a-priori*. On the other hand, when he worked closely with music, McLaren viewed the music to be the subject matter for his film. In this way, the music acted as a script and score for the subject matter of the visual part of the work. Making music the subject matter of the film is a common method by which this visual music artist worked and by which many before and after him still work up to the present day. This particular way of working with visual music as closely related to the expression of a particular piece of music that uses the soundtrack for the work, in fact, sealed the fate of the *visual music* expression. With this 'visual music' idea, as Diebold (1921) said of Ruttmann's film, 'painting and music are wed', and 'the birth of film from the spirit of music is a done deed' (4.2.3). This done deed of visual music in film of course applies, by extension, to any medium that enables simultaneous and synchronised presentation of two or more mediums involving images and sounds.

6.4.2.2   SONIC THEME – A SONIC KNOWLEDGE IN PAINTING

When Imgardt (3.2.2) talked of a visual music in 1909, he too referred to the sonic themes of painting in which the subject matter comes from knowledge of sound and music. Here, the application and interpretation of this sonic knowledge is the new theme of painting. At the time of Imgardt's writing, the dominant attention fell on exploring the proportionate and vibratory nature of colour in analogy with the harmonic proportionate basis and vibratory nature of musical tones in tonal music. Such an interest in the mathematical basis of the acoustics of music permeated the artistic experiments explored in the pictorial contents of painting. Colour and its hues, tints, shades were subject to studies in their proportion, relationship and application in the

content of painting until such proportionate studies of colour *itself* became the very subject matter of painting itself. This is evident in the visual art work in what Apollinaire coined 'Orphism' (1913), in Synchronism paintings and the works of the Musicalist painters (3.5.5), and in the techniques of pointillism by Seurat (1859–1891) and divisionism by Klee (1879–1940).

The scientific and technical knowledge of many of the artists in the latter half of the twentieth century enabled them to invent their own mechanical and electronic techniques, processes and devices for generating images and sounds. Some appropriated existing machines and technologies, or re-purposed them for the means of achieving a particular artistic output. John Whitney re-purposed machines, using, for example, a pendulum system to generate periodic graphics and synthetic sounds (4.5.4). From the time of Castel's 1725 '*clavecin oculaire*' (2.2.3 and 2.3.6), artists and technicians in the colour organ tradition have come together for the purposes of building instruments to perform colour to work on solutions and experiments to invent totally new devices that were based on solid mathematical and engineering knowledge shared about sound and music, light and colour. Thomas Wilfred went further still, devising a new art of light that arose from colour music inventions. He envisaged that these light instruments (*Clavilux*, c. 1930s) were their own art, what one can call a form of a silent visual music (2.4.2). Such an inventive approach to re-purposing and extending the capabilities of machines and technologies still takes place today. Artists, technician-artists and technicians continue to work on adapting the available technologies in order to explore an interaction for artistic goals with images and sounds. Some artists, for example, seek to adapt current and past technologies such as, for instance, combining computer programming with the re-purposing of vector monitors and games consoles in order to access the beam of light to enact a real-time audiovisual performance. Using such approaches with technology, Derek Holzier explores what he calls 'vector synthesis' (Holzier, n.d.).

6.4.3   VISIBLE MUSIC

6.4.3.1   COMPARING THE STRUCTURE OF MUSICAL TONES WITH VISUAL PATTERNS

Many of the commentators examined in this thesis alikened the harmonious and proportional relationships in the patterns of ornaments and shapes used in painting, drawing and architecture to a form of visible music. This comparison took place across the entire range of artistic mediums and technologies, such as: in the arabesque patterns of Runge (2.2.4); the projective ornaments of Bragdon (2.2.7); the design patterns of Dow (3.2.4); the optical sounds created from the graphical ornament experiments of Pfenninger; the sounding ornaments of Fischinger (4.4.1); and the proportionate systems based on musical harmonics of da Vinci (3.1.2). The music that is referred to in the early explorations of a visible music are pitched tones of tonal music and the music scales

of tonal music harmony and composition. What is comparable here between the visible pattern and music is the balance and proportion of the design or shape in both its whole and its parts, and the harmonic structure of individual musical tones and the relationships between musical tones in a tonal music scale. The octave serves as the whole for the ordering of the tones in a music scale. The external form of a shape as a picture element in a picture and the shape's constituent parts can also be constructed according to harmonic proportions in analogy with the construction of harmony in the pitched tones of the musical scale. The whole of the music composition is comparable to the composition of the whole of the picture.

6.4.3.2 ATONALITY AND INDEPENDENT VISUAL ELEMENTS

Music's tonality influenced painters and colour organ inventors interested in exploring a harmonic and balanced scale of colours and forms to create consistent colour gradations and accurate forms and compositions in their paintings and devices. So too, however, the emergence of atonal music influenced painters and how they handled form and colour in the painting. For Kandinsky, and the Bleu Reiter artists, the very nature of atonality by its release of the tone from the tonal music scale and making the tone an independent entity in itself in the music composition inspired Kandinsky to conceive of the constructed forms and colours in his paintings to act like independent tones in the space of the composition. He named these constructions of form to be 'sounds'. Such 'sounds', for Kandinsky, were independent, chosen, crafted and positioned according to the inner need of the artist who brings them forth into the composition. With each development in music's language of composition and its technology there has been many artists who are inspired to explore parallel developments in the visual domain. The author was inspired to create visuals in the manner of the crafting and composition of a *musique concrète* composition technique. Joseph Hyde an electroacoustic music composer who has developed a practice of audiovisual composition describes his audiovisual practice as having evolved from a *musique concrète* thinking as he was also interested in taking ideas '*unique* to *musique concrète* and apply them to visual music works' and states that he was engaged in evolving a kind of 'video concrete' (Hyde, 2012). This general approach to the field of visual music then is similar to the authors own entry and approach to the field and it is interesting that both of us met in 1999 at Queens University, when we both presented visual music works there. Many contemporary music composers who also work with visuals often have as their starting point some musical element that has come from music composition, be it a technique, a musical form or style, an interaction with a music technology, or a translation of such techniques into the visual domain. Such atonal approaches to colour and form have evolved to exploring the micro-tone or the grain, and finding such equivalences in the visual domain.

Visible music also emerged from the idea that there could be an art of a performance of colour grounded in an experimental understanding and investigation of a direct equivalence between specific music tones (musical notes, pitches) and specific hues of colour. In pursuit of this idea, what was sought was an instrument that could be designed and constructed for the purposes of performing what came to be known as 'mobile colour' (and even a mobile geometry, with cherubs such like as Castel imagined) in a manner of how a musician can perform and play the tones of a music composition. The initial assumptions in these experiments were that such a coloured music playing and performance of colour might actually help us understand music visually as there seemed to be some fundamental laws of correlation between coloured hues and tones. And if one could find these fundamental laws, then a systematic instrument could be designed with its own type of notation, similar to music notation used to score the intentions of the composer, and instructions for a visual music composition. Attempts to find a fundamental systematic basis for a playable and performable colour led inventors to investigate this idea further and experiment with such possibilities. Initially, the systematic basis was sought in the colour-tone analogy of Newton. As other scientists, however, adjusted the colour-tone analogy and devised different scales of colour, so too did the colour-tone analogies vary from inventor to inventor. What thus transpired was that it was too difficult to find a universal systematic law and basis for a colour-tone analogy approach for the design of the instruments.

Nonetheless, it was found that light, colour and their interaction had their own expressive possibilities, and so, for many, a colour-scale analogy and structure was no longer seen as a necessary requirement to explore the possibilities of a connection between a visible artistic element with a music performance. This is not to say that such an approach to instrument design or the design of a comparative system to investigate such scales in not artistically valuable. Today, such activities still take place, albeit with different technologies to those used by the colour organ inventors of the early twentieth century. It was found, rather, that a systematic art of colour music could not be established by relying on a changing and varying colour-tone analogy approach. Today, a colour-tone analogy might become the basis of building a mapping strategy in computational methods, where a parametric value of an image displayed on the screen of a computer monitor is mapped to a parametric value of a sound that is output to a speaker. It has become one part of many possible mapping strategies that can be used between music and images.

A characteristic of the artistic and technical investigations into the expressive aspects of colour and light itself, however, resulted in experimentation with how to enable a dynamic, mobile and changing colour presentation in a design mechanism that could facilitate such dynamic and changing colour. Many artists and inventors still conceive of this mobile colour as a type of musical expression.

6.4.3.4   THE MUSICAL QUALITY EXPLORED IN COLOUR

Colour was explored in a musically expressive manner in all the mediums examined in this thesis, from colour organs, to painting, film, video, video synthesis, and composited computational images. What type of musical expression it was to be differed according to the knowledge framework from which an artist operated. An artist versed in music has a different point of entry into exploring a visual equivalent expression of a musical expression than an artist who is starting from a technical standpoint and versed in the science of light, acoustics and electronic methods. What is common to all approaches, nevertheless, is that, in a general sense, music and musical expression acts as a model for artistic autonomy. Colour is now free from its function to represent known external objects in the natural world. It could now represent other aspects of human experience and knowledge, such as, the emotional power of colour, the way in which colour can create relationships between other colours in a picture, the hidden nature of colour, such as, for instance, its vibratory nature and its subjective and physiological basis. Colour could be used by, what Kandinsky (3.3.2) calls, the artist's 'inner-necessity' to shape the forms and structures of the picture content. In this regard, a colour is an autonomous element in the picture space, just as much as a sound is an autonomous element in a music composition and performance. Thus colours now can be considered to be similar to how a music composer might freely choose notes, timbres, and sounds in a composition in a free and autonomous way. Colour as a material and substance in itself becomes a building block in the construction of a picture. For some artists, such pictures result in new worlds, new forms of communication, new forms of picture experience, and new types of artistic content. For others, colour had other types of similarities with music in that colour could be made to appear, disappear, expand, retract, move thus *constituting* a rhythmic element to the dynamism of colour. For others, groups of simultaneous colours acted like a form of tonality, whereby a select choice of colours was akin to a key signature in music. Colour harmony models and theories that developed from the nineteenth to the twentieth century facilitated a pool of knowledge in relation to colour harmony choices. Furthermore, when colours are made mobile in a painting surface, or have the appearance of movement as in film stills, they too can be arranged and organised in the picture space to merge, mix, separate, act in concert, act in chords just like notes of a music composition in a static or moving picture.

6.4.3.5   MUSIC PERFORMANCE WITH MOBILE COLOUR

In music performance with mobile colour, interest in colour focused on its dynamic, expressive and rhythmic qualities. This led some inventors to focus on the expressive possibilities of colour without it having to be bound to fit the dynamism of a tonal music system model. What became more apparent to these inventors and in their inventions was that there was a musical quality to the play of light and colours in the dynamism and mobility of colours themselves. In this regard,

it did not seem to matter whether the dynamism and mobility of colour was the same as the dynamism and mobility of sound. Artists and inventors clearly acknowledged and recognised the differences between sound and colours. For some artists and inventors, however, what became of more interest was the possibilities afforded by the integration of the two phenomenon of colours and sounds in the two arts of visual art and music. A mobile colour could be presented alongside a music presentation, such as, for instance, in Alexander László's multi-projection *Farblichtmusick* (Colour-Light Music) concerts with his *Sonchromatoscope* colour organ projection instrument (2.4.4.2), and in Fischinger's films in *Raumlichtmusik* (Space Light-Music) multi-projection contexts.

6.4.4 THE END OF ABSTRACTION

The development of abstraction in painting and its subsequent deployment in the moving image media of experimental film, animation, video, television, computer images and digital media had a major impact in the development of visual music. The two main differences between painting and moving image media lay in that, firstly, the moving media facilitated music to be played with the abstract images. It also, however, facilitated a mobile and changing abstract image resulting in a type of complex, layered and multiple event imagery akin to the complex, layered and multiple event sounds in music. It has been the author's opinion, for some time now, that abstraction finally met its home in a visual music art where both visuals and music are present in the artwork at the same time. In many abstract paintings, particularly in the early part of the twentieth century, the music is not actually present in the work, it is hidden; this is the case, even if music is what is explored explicitly through a translation of its form into a visual form, or through a similar physical basis for colour and sound in their vibratory forms. The abstract painting is never going to be a music expression. It is, however, difficult to dismiss a visual music work as being *not* a music expression when the music actually plays at the same time as the visuals and the visuals deliberately seek out the musical events and when it forms and structures its dynamic script. The music expression is part of the visual music work as experienced by both its creator and receiver. The abstract content of much of visual music work is similar to the abstract content in painting, except with the addition of time and a mobile frame. The approach to abstraction in painting is still of relevance to the approach to abstraction in some visual music works. It really is worthwhile to examine the theories, approaches and knowledge that abstract painters accumulated in order to inform their own practice. In the quest, however, to explore music in many forms, abstraction in art was not really going to be complete until it could also include the musical element as sound itself in the making of the art work. Novalis had imagined that an integrated art needed a specially designed architecture to facilitate the simultaneous showing of visual art and music, and, for Novalis, such architecture was to also include the recital

of poetry. Thus, for Novalis, the solution to integrating the arts was to build spaces where such integration can take place (2.2.5) and he sought for the integrated expression of these arts wherein all the combined arts displayed in a room would share a common theme or artistic goal. It was, however, the evolution of production technologies, techniques and mediums that facilitated a physical means and method for combining the two arts of abstract images and sounds and integrating these two arts. The abstract image in the painting became the abstract image in the technological representation and, with the aid of audio technologies, the sound part could be now tied to the abstract image in time, thus resulting in an infinite number of possible combinations and relations between visual images and sounds. Once the image and sound could be connected in this way, a true 'visual music' could unfold and complete, in the author's estimation, the ultimate end of abstraction.

6.4.4.1 CONDITION OF MUSIC

As much as music is about form, analysis, structure, composition, musicianship and skill, the actual quality of music in its sounding is a fleeting and temporal ephemeral thing. Its existence owes much to the human being's aesthetic experience and encounter with the art work in its condition of temporality. Music's beauty is in the aesthetic arrangement of its sounds and the resonances that such arrangements have when sounded to an audience. When painters explored a new type of content and picture, in abstract painting, they sought an analogous fleeting and temporal ephemeral experience as in a music experience. Instead of looking at the perfect external object ordered in the content of the painting, the human being enters into the artwork, in a sort of overwhelming way, where the mystery of the arrangement and choices of forms and colours that the artist has made, is not known *a-priori* but manifests itself over time of its appreciation. The contents of abstract paintings are like the musical content of unique music compositions. They have to become known for themselves. To look at an abstract painting is to search for its meanings, its coherence, its structure and to be drawn into the relationships that the artist has constructed for the picture. In the experimental forms explored in moving image technologies of film, video and computer video, the visual forms have also been chosen and brought into being by the artists interaction with the technical and medium means, the music and techniques. And, in many cases, it is like what McLaren says, the subject matter evolves in an interplay between the artist wanting to explore a technique with the means in order to bring about a content (4.4.4). So, too, with Kandinsky who, along with many of the abstract painters of his time, recognised the importance of moving beyond an empirical approach to picture construction based on laws and theories of picture, light, colour, and towards valuing the intuitive interaction between the artist's need to make whatever forms is needed and to adjust whatever elements of picture there may be in order to resolve all the parts of the picture to the whole of the picture (3.3.2). In many visual music works, one can recognise, almost immediately, the palette of shapes, forms, colours and

rhythms that this work will explore, similar to how one might recognise immediately the timbres, orchestration, pace, harmonic and rhythmic material that a music work will explore. When music and abstract images are presented together in a temporal and spatial interplay of the artistic elements belonging to each of the separate domains, a new type of unity emerges between the visual and music. The visual part becomes tied to the music, and so, becomes the condition of music itself. It is hard to just look at a visual music work in the way one might look at a static abstract painting. One is brought on a temporal journey of changing pictorial elements and images, and it is in this dynamic unfolding that the visual reaches the condition of music. Fischinger recognised this unique quality of visual and music in his early *Studie* films, for, it is on the wings of music that the visual creates the feeling.

> The *flood of feeling* created through music intensified the feeling and effectiveness of this graphic cinematic expression, and helped to make understandable the absolute film. Under the guidance of music, which was already highly developed there came the speedy discovery of new laws — the application of acoustical laws to optical expression was possible. As in the dance, new motions and rhythms sprang out of the music — and the rhythms became more and more important. (Fischinger, 1947)

6.4.5 MEANS AND FORMS OF EXPRESSION

With the advent of each new technology that enabled a closer integration of the two arts of colours and sounds and facilitated modalities of visual art imagery with a music soundtrack or music performance, the means for expressing a visual music multiplied. Some technologies have become more readily available to a greater number of people. Each technology provides its own techniques of working and has an effect on the final content, forms and content of the art. One, however, can overlook, in the use of a technology, what went before in an earlier medium. In this thesis, it has been demonstrated that there is much to learn about visual music from examining the theories and practice of the colour organ inventors, the artists and painters who explored abstraction, and the filmmakers who studied motion, acoustics and choreography to create precise timings of their graphical moving forms and colours. It is to Kandinsky, nonetheless, that visual music owes an incredible debt for he stressed and drew attention to the importance of the role of the artist in the creation of form and content, in the forming of form. His arguments to support this important part of art stopped art from becoming either overly prescriptive or overly judged in terms of a right judgement. He opened up the path to the music composer that is inside every painter and visual artist, in their handling of rhythm, repetition, choice of colours, building of forms through the interplay of forms and colours, creating vibratory effects, creating moods, creating places for the eye to rest or the eye to dance. He justified the subjective nature of creating form as being an irreducible and the most important part of art. The music composer creates the content and the form in their choice of timbres and sounds, so, too, the visual artist creates the content and the form through their choice of shapes and colours. It is not an arbitrary throwing

things together; it is, rather, a very involved creative interaction with the material and means at the artist's disposal. That a visual artist could now use sound and music as part of the forms and colours of the painting, extending the pictorial forms and colours into sonic and aural spaces, so too the composer could now use forms and colours as part of the music presentation, extending the timbres and sounds into the pictorial space. The means of combining moving image and sound technologies from the later twentieth century enables the crossing-over of the two domains and modalities since they become the same material, once in the computer and once expressed together.

It takes a considerable amount of skill to engage with technologies and techniques pertaining to machines and computer programming, and a considerable amount of learning as to how the machine works and what its potential may be. Some general global technologies, protocols and standards, nevertheless, have emerged for the mass communication technologies of film, television, video and computers. This has resulted in common mediums for all. One did not have to re-invent the medium in order to make the art, or build a one-off custom-designed product — a level playing field emerged. The access to these more common technologies has made the creation of moving images, recording sounds and images, editing sounds and images a new language for communication.

6.4.5.1   FROM CINEMATOGRAPHIC TO VIDEOGRAPHIC EXPRESSION

A cinematographic expression gave way to a more videographic expression, when the television broadcast technologies and video technologies emerged in mid-twentieth century. 'Videographic', as a term, refers to a graphical type of content created with video images, much akin to the non-objective content of abstract painting and abstract film. It thus creates similar aesthetic results as abstract painting and cinema, but adds new dimensions and visual forms to the image result. Scroggins takes note of this technical shift from film to video by referring to some of his works as 'absolute videographic compositions' (5.6.5). It also refers to the video technology underpinning the image making. Video, like film, was designed to record images. Thus many aspects and processes for working with filmmaking were incorporated into video-editing technologies, despite the fundamental physical differences in the representation, recording, storage and playback of images. The frame for instance was still a unit with which to work in video editing. However, the unique representation of colour, image and light information in the video technologies meant that artists could exploit the manner in which images were drawn line by line, or manipulate the monitor signal to distort and change the image. This gave artists a new type of image content accessible through the manipulation of the apparatus. Digital video incorporated both analogue video representations of images and the filmic frame in its interface. As digital video editing started to evolve near the end of the twentieth century, the artist had access both to a filmic frame and to a video frame comprising scanned lines of colour and light,

as well as the digital representation of the lines and frames through the technology of the pixel and the vector. The pictorial image had many forms of plasticity in it. The only thing that it did not have much of near the end of the twentieth century was the ability to easily hand-draw the computer image, but that technology did develop later. Artists examined here experimented with both cinematographic and videographic forms of expression and utilised the techniques of these technologies as well as the inventing new techniques with the technologies to achieve the forms of imagery and final art work desired (see Table 2).

Table 2 The interplay between means of expression, technique and conceptions of visual and music
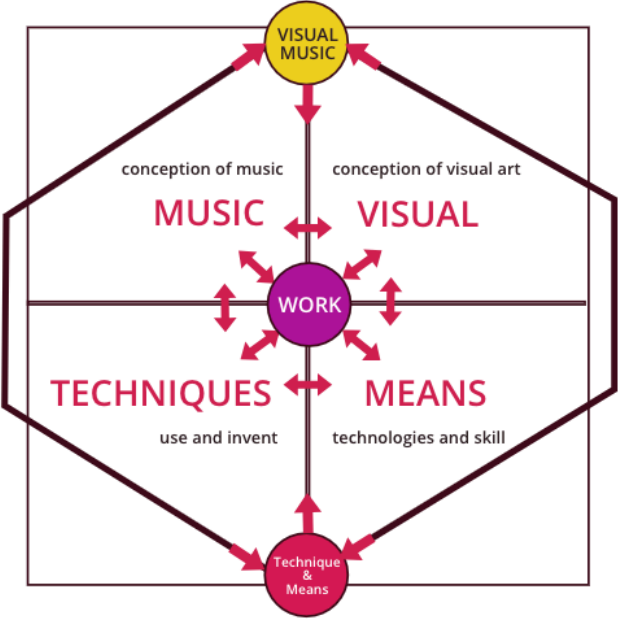
In other words, an integrated system of working with visuals, music, techniques and means was now possible for the production of a visual music work of art.

6.4.5.2   THE VISUAL MUSIC IMAGE CONSTRUCT

The development of technologies pertaining to the recording, reproduction, representation and storage of images (and sounds) has enabled a variety of ways of conceiving the visual image part of the visual music expression, such as, for example, as an art object or as a working space for the artist to work in or as the final perceptual and artistic unit from which one encounters the visual part of the work. Both the visual image and how it is both accessed and operated on in the technological processes that can be used to create the final image makes for a more complex construct of image in the visual music work. For example, many new technologies include in their design and interfaces methods for operating on images from older technologies resulting in a wide range of choices and a wide variety of processes that can be used by the artist to construct the visual image. Thus, although the new technology might provide a new means of accessing an

image and for creating imagery, it can also enable an interplay between older mediums, older technologies and the incorporation of the interfaces of older mediums and technologies into the newer technologies. One could call the incorporation of older constructs into new technology as being backward compatible. Yet, regardless of whether the new technology has such a function, the artist can still work with new technologies using a metaphorical way of working with various forms of possible image representations. It is this aspect of working with the visual in a visual music work that is most liberating.

The different ways of conceiving of the image for the construction and creation of the image part of the visual music work, or in constructing the image part when using a visual music expression to compose images with music can be listed as follows (and are summarised in the diagram in Table 3): Screen; Surface; Frame; Area; Video; Space; Image; World; Data.

SCREEN – this designates where the image is the final output that is projected onto with the music played in a live performance, or with a soundtrack played through speakers.

SURFACE – is an aesthetic construct from which to composed the visual part of the work and the visual music part of the work, exploring relationships between the sonic surface and the visual surface in a constant form of interplay over the duration of the work. The surface is a useful construct for composing visual music works. Rather than conceive that one is composing a film or a cinematographic scene, one is composting a surface, a surface that is alive and, to quote Malevich, 'born' (3.3.3).

FRAME – the construct of 'a frame' as designed for photographs and film is also incorporated into video technology and into digital computer video. It thus is linked to the outputs of algorithmic or programming processes for generating images. An artist may choose to conceive of the frame as an aesthetic space from any of these technologies, or as a mixture of all or some and thus construct the visual part with an awareness of the dynamics of the frame, both in one moment in time and across time. The frame can be conceived of cinematographically, graphically, and in a painterly way. The frame allows one to control the timings and durations of images. The frame can also function as a workspace from which layers of images and sounds are combined as if one was working at a workbench, arranging materials to build an object. The frame can also provide a deeper level of access to new spaces, such as, movement into and out of a frame, creating a sense of depth and perspective. The frame can operate at a level of a fixed perspective frame, or it can comprise multiple simultaneous perspectives of various layers and levels of visual and music information; it thus can provide a mobile perspective and become a container for motion effects and actions.

AREA – the area of the final output of the visual part of the work is another way of looking at the image. In digital computer video, the cartesian workspace has been coded into the software interface enabling a level of access that is more mathematical in nature than cinematographic. Each pixel has X and Y coordinates, and each pixel can be accessed through effects plugins, transformation properties, or programming. Programming images allows one to access each point of the cartesian space and create relationships between these points, for example, Larry Cuba's images have been programmed to work with the grid like features of computer video frames (4.7.4).

Table 3 Various visual image constructs and conceptions

SCREEN Project image Output Unity of visual and music	Aesthetic Art work surface Sonic image surface Visual music Visual composition SURFACE	FRAME Cinematographic Workspace Fixed perspective Mobile perspective Multiple perspectives
Viewing area Aesthetic boundary Surface area Working space AREA	Scan Lines Signal Pixel Vector Code Field VIDEO	Cartesian space 3D space Perceptual space SPACE
Visual image Sonic image Visual music image IMAGE	WORLD Art world Imaginary 'visual music; New concrete reality New sensory reality Aesthetic experience Visual music world	Binary representation Transferrable numbers Multiple modalities Multiple combinations New medium DATA

VIDEO – the technologies pertaining to the display of video (such as the technology of the monitor and the screen displays) provide another form of access and means of constructing the visual image. The video signal itself can be accessed as has been shown in the video synthesis experiments of the mid-twentieth century and that continue today in a revival of video synthesis techniques and forms of image making. The Vasulkas used the time varying nature of the video signal for the purposes of creating a new type of image that has been conceived as a result of the video technology and exploring its technology as both a tool and process for image construction. The scanlines and fields of the image display can be interfered with and exploited to create new types of images. In contemporary work, often analogue video technology is mixed with digital and algorithmic and programming control of parameters, which demonstrates another example of how technologies both old and new can be mixed (e.g., Holzier). The distortion of the video field displays were exploited in video synthesis techniques to create new images. Today, artists distort

the compression algorithms of the digital video technologies to create art works based on compression artefacts, for example the artist Rosa Menkman.

SPACE – when one creates a visual image for a visual music work, one is creating an aesthetic and artistic space that comprises visual and musical material. That space can be a flat type of space, such as, in a graphic design print, or a flat surface from which motion and visual elements act in or on, or the space can have some sense of depth, as in a cinematographic space, or a 3-D space, or a complex mathematical dimensional space. The space can also have multiple levels and layers acting in it at the same time, whereby one layer is prominent and others are suggestive and acting in the background and there is an interplay between these multiple spaces and layers. The space can also be where the music acts, where one experiences the sonic space in the visual space and the visual space in the sonic space. The space is something that the viewer and audience needs to come to know over the course of the work and is thus reliant on the viewers' perception of the space and all that takes place there in terms of visuals and music.

IMAGE – the image in a visual music work is a complex construct and it is what the artist actually constructs. There are three images in operation in a visual music work: the visual image, the sonic image and the visual music image. The artist chooses how these images interplay and operate together in the combined space of the work. The visual music expression is expressed in the images and the relation of the images to the music. The image provides a unifying construct from which the visual music operates in the work.

WORLD – what the artist is doing is effectively creating a new aesthetic world that consists of a combination of aural and visual elements and cues that we as human beings are naturally disposed towards in our natural environment and so are able to come to the visual music expression operating in the work. The development of abstraction in painting and, particularly, ideas pertaining to the absolute and the absolute creation paved the way for subsequent artists to create abstract works that comprise aural as well as visual elements. Malevich used the term 'world' to describe what he was creating in his painting (3.3.3). The author considers that in a visual music work, one is creating a visual music world. Kandinsky (3.3.1) said that there were infinite possibilities for creating forms. So too with visual music worlds, there are infinite possibilities for selecting visual and aural elements in the work, exploring each part separately and exploring the interplay and relationship between all the parts. Filmmakers noted that, once in the film medium, the images and sounds are material. For example, McLaren said he was working with the same material, so too did Len Lye. The author also conceived of images, sounds, music, and visual elements in the computer as being the same material. There was now a level playing field from which images and music were now represented resulting in new processes of construction. Processes for composing with sounds were applied to processes for composing with images.

DATA – this brings us finally to what data means in the working of a visual music piece. The representation of music and images in any of its technological forms, but particularly in its digital representations, has provided immense new processes and techniques for working with constructing images and sounds. An image in digital format consists of digital information, software effects, effects plug-ins and computer coding and programming has allowed an image to be represented in time and space in a multiple of forms. For each form of representation, parameters are provided from which to vary that representation. Each parameter can provide values and each value can be changed over time. The parametric access to image representations in the computer has enabled a multitude of relationships to be set up between parameters within the image. It has also enabled the crossing over of data values from image parameters to music parameters and vice versa, thus enabling a level of communication between images and sounds and immense aesthetic and artistic possibilities for image and sound combinations to be explored. Sorensen recognised this potential of relating digital image and audio information in the Global Visual Music Project (5.6.7.2). When working with images as 'data' in a visual music art, then, one can conceive of the images metaphorically, physically or technologically. For example, an artist can move between considering the image as a working space for the output of code and computational effects, or can conceive of the image as the frame as in a frame of a film, or as a surface, or as a 3-D space, or as a series of scan lines in a video image or as an artistic world.

6.4.6   COMBINED ARTS

6.4.6.1   COMBINED ARTS IN SYNCHRONISED MEDIUMS

The technologies of film, television, video, and computer provide the ultimate means for putting the two arts of visual art and music together. The recording of images and sound with film, video and audio recording technologies as well as the development of the technologies that enabled the post-production of these recordings have resulted in new methods and means for assembling sounds and images and, ultimately, for manipulating the new machine representations of sound and images. The art of visual art, in whatever form it takes, be it in film, video or computational algorithmic processes, is still output to a visual medium to be seen, just as the art of music, in whatever form it takes, be it, in electronic, recording, or algorithmic processes, is still output to a sound medium to be heard. The two arts are still quite separate. The technologies of synchronisation, built into the audiovisual mediums of film, television, video and computer processes, is what facilitates the combination of the two arts.

6.4.6.2   MAKING SOUND VISIBLE

Creating content in one art by generating the content from another art has taken place across a wide variety of mediums and technologies in the twentieth century. Making sound visible and vice versa is a common theme throughout the arts. The approach in painting to make the

phenomenon of some aspect of music visible through the crafting of patterns and shapes was taken up by artists exploring the mediums of film, video and computational methods. the mediums of art. The translation of shapes and ornaments into synthetic sound by means of film, enabled artists to explore a direct relationship of immediate connection between the shape and the sounding of that shape through the medium of film. Similar direct methods were used by artists exploring the interplay of electronic video and audio signals, in custom built devices or through the manipulation of the television screen by radio frequencies, for example Winckel's patterns on the screen of a television set from the sounds of classical music (5.6.1). Sorenson brought such a direct approach to the possibilities of relating images and sound by exploring the manipulation of data, that could be designed to output sound from images and vice versa (5.6.7.1). The twenty-first century has seen much more being done in this regard. To make such connection meaningful, a lot of work needs to be done in making data exchange between sound data and image data work successfully to enable an audience to recognise the direct relationship between the sounds and images. However, a method for generating content is to use the data from sound to create data values that generates processes that act on or generate images. It takes clever design and artistic experimentation to get the best results and is in its infancy according to the author but has great potential to develop over the twenty-first century.

6.4.7 FROM BROADCAST TO PERFORMANCE

An unexpected finding in this thesis research was the significance of the early experiments in creating an experimental television broadcast, or an experimental art for broadcast television in the collaborations between researchers in television and radio in Paris in the late 1950s to 1975. Not only did Pierre Schaeffer invent, with his colleagues in the GRM studios, *musique concrète* and music composition methods, he also was one of the first to see the potential of television broadcasting technology as a new means of both creating and disseminating art (5.3.6). Schaeffer once rhetorically asked of radio, 'why can't we listen to pure coach?', meaning to the sounds of recorded trains themselves. A television equivalent of 'pure coach', for example, could be the recording of pure colour patterns or light patterns reflecting off the surface of a coach, as it speeds into the station thus giving us a visual equivalent of 'pure coach'.

The abstraction of the image and the music and rhythm of the montage and the editing of these early experimental television content works are the pre-cursor to the trend in the twentieth first century visual music approaches where an electroacoustic music composition is paired with an abstract imagery in a music concert or fixed-media-screening concert presentation. The significant development in the twenty first century in this regard — and it had already started near the end of the twentieth century — is that the music composer, in particular the composer of electroacoustic music, either creates themselves or includes another artists visual video work as a

video channel and presents a visual with their music in concert. The French television experiments were quickly appropriated into music concert works with a projection of the film and later video as being a part of the concert. Similar imagery and electroacoustic and electronic style music were used in experimental dance works and this still continues today. It is interesting to note that the music technology with which the filmmakers working with *musique concrète* music, and *vice versa*, was more electronic and electricity based but the images were not created with television technology. That, nonetheless, was to come not long after. The important role of television technology, television standards for the output of video and the devices, such as, projectors linked to television technology, had a significant role to play for artists in creating a new type of imagery with broadcast quality video. On the cusp of digital broadcast video, much of the techniques for making images with video effects started in this in-between time from the development of digital versions of broadcast television and video. Many artists and composers explored projecting a video in a music concert as this thesis has demonstrated, and this continued to evolve as a significant approach to visual music practice at the end of the twentieth century.

6.4.7.1 CONCRÈTE OBJECTS IN MUSIC AND PAINTING

In his art, Schaeffer brought to the fore the role of 'the concrete' in music (5.3.1). Artists and filmmakers also refer to the concrete nature of their art. Kandinsky preferred to use the term concrete or real art to describe his art, rather than the term abstract. The concrete objects can be examined, even if they are not natural objects, but they are real in whatever new circumstances the object finds itself. Hence, it follows that a conglomeration of colours, lines and planes in the corner of a Kandinsky painting are as concrete as a representation of a chair with a realistic rendering of light and shade in the corner of the painting. So, too, in visual music, a conglomeration of visual elements at this point in time and in that space of the screen, along with a screechy type timbre and a sporadic percussive sound, panning from left to right, is as much real as the video playback of the sudden stopping of a car with the sound of the screeching of the brakes.

6.4.7.2 KINETIC FELT QUALITIES

Many of the artists who explore a visual music are interested in exploring the kinetic qualities of light, colour, and form in both time and space and with composing and forming these kinetic qualities in the whole of the work. Kinetic can refer to moving parts, or it can refer to vibratory effects taking place within the whole of a material. In this way, the interest in the shared vibratory nature of colour and sound influenced approaches to colour by painters. A surface in the space of the video image can exist as an object itself that also can have within it a conglomeration of textures in which subtle variations, movements and vibrations of the image material and the textures are taking place, creating a type of vibratory shimmering effect. To the author, such a visual effect is analogous to the shimmering vibratory effect of subtle motions of grains of sound

or the interaction of harmonics and the temporal transformations and interactions of grains and harmonics over time to create a lively quality to a sound. Hain sought to explore a visual equivalent of the oscillation and vibrato of sound in the film '*Etudes aux allures*' (1959). Schaeffer's music was used as the soundtrack and this resulted in a counterpoint that was based on spiritual kinship rather than on numerically adjusted synchronisation of images to beats in the music (5.3.9). The author sought a shimmering effect, when selecting the video footage of a slide piano player in her work 'Dazzling and Blinding' (1997), in order to emulate the timbral effects perceived in the music and to capture the mood and tone of the subtle shimmering and vibration of the harmonics. Kandinsky talks of the '*Stimmung*' of a painting which can affect the experience of the painting enabling a corresponding enhanced experience for the spectator, a kind of tuning into the painting and experiencing emotions that are beyond words but are in response to the painting (3.3.2). Others talk of the vibratory effect of colour. Schaeffer talks of an '*allure*', a kind of motion, colour and vibratory effect in sound (5.3.9). Visual music works exploit the kinetic qualities as artistic and aesthetic qualities, with each artist exploring these qualities in their own way.

6.4.8   EXPLORING VISUAL MUSIC FROM A MUSIC TECHNOLOGY PERSPECTIVE

The sheer volume of creative experimental film works aligned with *musique concrète* music, arising from the experimental research approach to provide content for an experimental television broadcast, marks the starting point for a form of visual music expression that has been music technology led (5.3.5). Each of these films explored relations between the new music and the experimental film in unique and individual ways. It was recognised at the time that the relationships between the music and images were based on various approaches such as: Structuring the images in a similar way to the structuring of sound in a *musique concrète* composition; in the combination of filmic images and *musique concrète* compositions, there arises an extended syntax by which the two separate and independent arts are related and linked; the use of vibratory effects in images and in music; the unfolding of a counterpoint between the images and sounds; the mathematical contriving of audio-visual and visual music relations; imagery universe that consists of a poetic meeting of images and sound and not just synchronised meeting points between the two.

6.5   THE VISUAL MUSIC EXPRESSION

The second section of this chapter draws out the other main finding in this thesis, and that is that there is form of artistic expression that can be called a visual music expression. The form of that visual music expression is influenced and linked to the means that an artist uses and how such means influences the type of artwork that is created. The artist chooses the means by which to

explore a visual music expression. Such means have been demonstrated to be wide-ranging in technology, medium and technique throughout the twentieth century. The artist's role in this expression is important. A visual music expression, then, is similar to an abstract form of expression in visual art. It is a general category for a manner of approaching the combination of visuals and music in an art work. Visual music is both an art and a form of artistic expression that an artist uses in the crafting of a visual in a close artistic relationship with musical sounds resulting in an artwork that comprises the co-presences of the so crafted visuals and the musical sounds.

The four main categories that artists and inventors have concerned themselves with in the evolution of a visual music expression are: form; colour; composition and expression. This section discusses these four categories.

6.5.1 FORM

This thesis set out to understand better the visual language of visual music designated works and found that the visual language has its own autonomy in terms of substance, material and intention, as is to be expected. Musical ideas informed some of the content of visual art and still does today. In the evolution of a visual language, however, one of the fundamentals for a visual music expression is the question of form. One could think that this answer is quite straightforward and that the form in the visual language is the music or sonic theme. The Russian symbolists, for example, noted the sonic themes underpinning painting at the time (3.2.1). The reality, nevertheless, is more complex. Music may have influenced and led the way to evolve a different approach to form in painting and, subsequently, in the absolute, abstract and non-objective films, videos and kinetic art of the twentieth century. Each of the artists encounter with form and the means to express form, however, found a way to develop form in their own particular way.

In a visual music work or approach to art, one could think that the question of form is quite straightforward in that the form in the visual language and content comes from the music or sonic themes. This thesis has shown, nevertheless, that there are various conceptions and approaches to form and form creation in the evolution of a visual music expression which the author systematically organises into three main categories: structural forms, fixed forms and emergent forms (see Table 4).

Table 4 Types of form in visual music

STRUCTURAL FORMS	FIXED FORMS	EMERGING FORMS
COMPOSITION	OBJECTS	FORMS FROM LIGHT
PROCESS	ABSTRACT / CONCRETE	FORMS FROM MOTION
TECHNIQUE	MATERIAL	FORMS FROM EXPRESSION
INTUITION	MACHINE	FORMS FROM EXPERIENCE

6.5.1.1   STRUCTURAL FORMS

The structural forms of music and visual art that explores a musical expression are the invisible structures that hold the work of art in its wholeness and totality. It involves the choices an artist makes about the composition in its wholeness and totality and the relating of all the parts to each other and the relation of the parts to the whole. The process for making the work consists of the technical means that the artist has access to and chooses to use in order to make the work. This consists of the tools, devices and the processes of making that enable the artist to design and compose the structure and content of the work. As has been shown in this thesis, many artists invent their own devices and their own tools, or adapt available tools and technologies to explore and experiment with artistic ideas that come about through the interaction with the technology. Schaeffer invented a whole new set of techniques with radio technology that resulted in a new way to compose music (5.3). Sorensen investigated the possibilities of a global medium and material such as digital computer data in order to create a visual music work based on the same material approaches to form making (5.6.7.2). The creative musician, composer and visual artist take into consideration the compositional structures in the planning and execution of their work. The approach to structure forms the language from which the artist works to create an overall shape and development of all the various artistic elements in the work. The structures in music take into consideration the temporal element as well as the choice of timbre, combination of timbres, harmonic content, and the choice of rhythmic and melodic, tonal and atonal aspects. Music as a language has developed a whole archive of structural approaches to crafting the music piece. In this thesis it has been shown that music in its compositional structure has been emulated in visual art forms, such as in the conception of Scriabin's '*luce*' score based on the notation and structure of his music composition. Several painters translated various classical music forms into

painting form, for example, Ciurlionis did not believe there should be any divisions between the arts and he translated the principles of the musical forms into paintings (3.4.1). The essential nature of music in its sounding oscillating waveforms and the language of music in its organisation of sounds was considered to represent not just a language and essential nature that music had but was a universal language available also to the visual arts where colour and the organisation of pictorial forms belonged to the same universal language (3.4). Klee looked to music to assist in creating a useful language for painters to explore new dimensions in painting. Music offered a means for structuring the life force and 'originary energy' underpinning all art and for providing a solution for structuring form and time in painting (3.4.2). A shared structural approach to the composition of music and visual is exemplified in the emergence of artists who work with both music and visuals in their work. Each artist brings to the creative table their own mix of skills, interests and starting points. The music composer might start with the ideas for the music composition and extend these ideas into the structure for the composition of the visuals for the visual domain, or the composer may start from visual ideas and extend these into the music domain. The music composer who also creates their own visuals in a close artistic expression with the music is engaging in a form of structural exchange between music composition and visual composition. Similarly, the visual arts artist who composes their own music and sounds for the soundtrack for their visuals can approach the composition from either domains. Many artists work between the two domains. The technology of making has a considerable influence on the structures of a visual music composition. In the author's 20th century visual music works, the technology pertaining to music technology had a considerable influence on how the author thought about, and structured her visual and music compositions. In the works that were set to music, the technology and the development of techniques with video effects technology mirrored the author's skills with sound-editing, sound design and computational methods in music composition. Focusing on editing, manipulation, blending and effects, the author found that she was translating the skills of music technology in relation to sound manipulation into the visual domain of video editing and effects. The technology for image and sound manipulation had similar operative processes that were compared and experimented with in a cross-domain manner influencing the structuring of the image material. Similar to Klee, the author used music technology and music composition language to explain the process of image manipulation used, such as cut, paste, mix, filter, layer, merge, and explained her first pieces as being forms of a *musique concrète* approach and equivalence in visual art.

6.5.1.2   FIXED FORMS

The fixed forms in a visual music work are typically related to music in some way. The painters who created patterns, shapes and designs to emulate the harmonic structure of tones, or who created forms with a deliberate use of colour to create a vibratory effect, or the filmmakers who

articulated a rhythmic progression of a form either through frame-by-frame camera recording of hand-made objects, for example, in Eggeling's 'Diagonal Symphony' film, 1925 (4.3.4) or through computer processes, for example, in Whitney's 'Moondrum' film, 1989 (4.7.4) or through using video manipulation effects to craft layers of video into geometric forms, for example, in Sorensen's 'Concurrents', 1988 which references concurrent computation(4.7.4) and McDonnell's 'Towards One' video, 1998 (Appendix IV), all produce fixed forms. Forms, then, can be either the original source object that is recorded or represented and then used and reconfigured into the new aesthetic world of the visual music image. Forms can be abstract, or they can be concrete. Forms can be made through the mechanism of the machine and its material elements, such as, the light sources in a kinetic installation, for example, in Malina's 'Flowers' Reflectodyne system kinetic painting (4.5.4.4), or the pattern result from the imprint of the action of radio waves on a chemical substance, for example, in Stoke's 'Auroratone', c. 1940s (4.2.4) film made with his auroratone process invention, or an algorithm that can convert digital audio data into digital video data in the computer.

6.5.1.3 EMERGENT FORMS

Many of the artists mentioned in this thesis, in particular those who worked with the moving image technologies, commented on the manner in which a form can arise over time and as a result of motion effects. Lye and Riding (1935) note that the marks of a physical shape that come from movement happen in the 'movement-conscious' human being and in the human being's mind. The movement creates the shape. A form can evolve in the motion of all the visual elements. The animated movement in Lye's films comprise fleeting shapes and groupings that suggest shape that one can only get a glimpse of in the overall experience of the overall visual effect of the film in time (4.4.3). Much of the motion in a visual music work defines the form and enables forms to emerge. One of the author's consistently used methods is to construct an image and its forms by building a complex layering of multiple timelines of images that each have a motion action in it, but, at the same time, when the layers are merged, forms emerge through the interaction of both time and motion. Some forms are not planned and happen as a result of the technique and process of working with the materiality of the video. Light processes and interactions with materials and reflections can also generate forms as much as the colour organ inventions and kinetic art works demonstrate. Controlling the type of forms that light can take is part of the solution that a light artist will seek. Light can be made to respond to sound and music, and so, can represent the phenomenon of sound through light as was shown in the various television experiments with sound, for example, in Winckel's patterns on a television screen created through the translation of acoustic oscillations into optical patterns on the monitor (4.6.2), and which are increasingly controlled today by digital code and computational processes. Forms can be temporal in that they transform, mutate, change, disappear, appear, emerge, recede, move in the timeline of the

visual music work. It was this capability that film afforded which assisted Eggeling and Richter in releasing the movement they felt had accumulated in their long rhythmic scroll paintings (4.3.3 & 4.3.4). In this way a form can be a moment in time, or it can have a longer duration. Many of the colour organ colour notations focused on the rhythmic evolution and durations of forms, mapping properties of music to properties of forms. Forms can emerge, then, in the experience of the work and in its reception and perception in the eye of the beholder. Forms, in visual music, can be tied to the musical unfolding of musical events. What can emerge is a visual music form where the shape and the musical element seem to belong to each other and work in tandem. Or, a music event can seem to cause a reaction in a visual event in a form of cross art counterpoint. It has been shown in this thesis that many artists considered the point of contact and connection between the visual element and the music element is a form of counterpoint. Sections of the authors work 'Towards One' (1998) was conceived of as a counterpoint, whereby a musical rhythmic element took place in the music, the music became softer and quieter as the visual element responded in a like type rhythmic pattern. As has been already mentioned in this chapter, one aspect of the evolution and transformation of visual music throughout the twentieth century can be attributable to the artists desire and need to shape and make form with the chosen means of expression. This artistic-led choice in the creation of form is at work in some of the approaches to crafting a visual music in art. Kandinsky, McLaren, Woody Vasulka and Sorenson allowed the more intuitive aspect of form, making it to be a key factor in their artistic expression and in the final result.

6.5.2 COLOUR

The earliest visual experiments discussed in this thesis that sought to bring together the visual and the musical were based on both comparing colour to music and on combining colour and music. There was no singular systematic way to do this as an art. Visual artists, musicians and inventors approached the comparison and combination of colour and music in unique and individual ways. Indeed it was in painting that such individualistic approaches to using colour was something to be acknowledged as being an important part of art making and form making in art. The artist chooses the colours and forms according to 'an inner necessity' as Kandinsky said and from a need to work with forms and colours with the chosen means to do this. How colour was conceived, either as an aesthetic object or as a scientific object, had some bearing on the type of work or invention the artist created. Colour operated as an essential aspect of the art work in all the forms of visual art and music expression that were discussed in this thesis. Knowledge about colour and the technological representation of colour and colour making only served to enhance how colour could be used by the artist in the work. The multiple possibilities for use of colour, for colour combining, for colour in form, for exploring the relationships between colours means

that there are immense choices that can be made in relation to colour. In this study, colour has been found to have various characteristics.

6.5.2.1 COLOUR AS PHYSICAL OBJECT

Colour is physically linked to light and light has physical properties such as wavelength, particle, intensity, reflection and absorption. Technologies have been able to harness the power of light to generate colours through the activation of these physical properties of light. The colour organs invented used light as the source of the mechanisation of a colour presentation. The physical nature of colour as light became the source of an analogy with music that informed many of the early colour organ inventions. Film mediums, video mediums and digital video use light to generate the images on the screen or in the projected image. The software and hardware of various technologies are able to interact with the mechanism of light and colour generation in the computer or the custom designed device to enable an artist to manipulate that light and colour information by providing the artist with tools and interfaces that make meaningful interactions with constructs of colour accessible in higher level forms to the artist. Some artists explored how the light mechanism that playback the soundtrack on the film, could be experimented with to generate sound by means of drawing shapes directly onto the soundtrack, thereby resulting in forms of synthetic sound. Fischinger and Bute did this, and McLaren excelled in this regard and he exploited this as a way to create a 'seeing sound' film in which the size, width, height and duration of shapes visible on the screen were the exact same shapes audible on the soundtrack thus creating the ultimate visual music connection and tightly synchronised visuals and music. Other artists can control those interactions with the display device and the software and hardware to form their own meaningful constructs and to program or construct those meaningful interactions.

6.5.2.2 COLOUR AS PHYSIOLOGICAL SENSATION

Colour also has physiological properties and studies into the physiological basis of colour (Goethe, 1808) assisted colour theorists in devising systems of colour organisation and colour combining that was linked to how we perceive colour. Many of the technologies for producing colour in video and in the computer are based on a similar system to the physiological basis of colour in the eye. Artists exploited these physiological properties to mix colour and to combine colours into natural harmonic forms. The phenomenon of the after image, where the eye sees the opposite colour under certain conditions, called the complementary colour, becomes the basis for colour harmony systems such as in colour wheels, in which chords of colour are based on the physiology of the eye perception of colour and the mechanism of the visual system in the generation of colour. The Synchronists exploited the physiological basis of colour in the devising of colour scales that were used as content in their painting and the artist Seurat devised the pointillist painting technique based on the physiology of colour.. Colour as a sensational effect

in the human perceptual system is exploited in the abstract and non-objective content of early 20th century painting and in the subsequent non-objective content of film, video and computer video.

6.5.2.3 COLOURS AS VIBRATION

One of the most consistent themes across the mediums of painting, film and video has been the conception of colour as vibration. The physical vibratory nature of colour and the perceptual and subjective nature of colour as well as the artistic effects from combining colours as well as the subtle perceptual and emotional responses to colours and colour combining was considered to be the property and quality that was most like music. The human eye and visual perceptual system is responsive to the 'specific electromagnetic wavelengths between roughly four hundred and eight hundred nanometres' (Cubitt, 2014, 111). The subtle vibratory underpinnings of colour is deemed similar to the subtle vibratory underpinnings of sound in music. Thus, colour having this property of vibration that was similar to music, had a hidden energy that could be sensed by the viewer as much as how the hidden energy of music could be sensed by the audience. Cubitt comments that in relation to colour, 'the interplay of physical and optical light produces in the human sensorium a storm of sensation' (Cubitt, 2014, 112-113). He observes succinctly that, stimulating this storm of sensation 'has been a technological as well as a creative challenge for centuries' (ibid.). The use of colour to elicit sensational effects has been one of the chief ways that a visual music expression is explored. Thus the vibratory nature of colour and sound is associated with that mysterious, sensory and emotional appeal of both phenomenon. It is understandable that artists would seek to exploit a sensational work that could present colour and sound in a combined form, doubling up the sensory effect on the human sensorium. The author herself is interested in this hidden vibratory nature of colour and colour combining and in creating works, spends a great deal of time in building visual material in which colours are combining, and interacting at minute durations, and subtly blending and appearing across the frame of the image, building up a form of colour complexity that is considered by the author to be similar to the complexity of sound and timbre in music.

6.5.2.4 COLOUR AS MATERIAL AND SUBSTANCE

Colour, then, is an ephemeral material when it is explored artistically in its technological modes. Colour is also a solid substance in its representation in the technological material and in the devices and tools that enable one to create colour. The substance of colour in paint and light might be physically different, but conceptually and artistically colour can be approached as an object that is not bound to its physical material and substance. It is a type of fundamental category in itself. The visual artist understands colour as the hues, tints and shades of a colour and uses it as an essential ingredient in the art work. Hence, the theories of colour that informed the painters of the early 20th century and assisted in artists in exploring colour as its own artistic material is as relevant to artists working today with colour. What the representation of colour in

the contemporary digital forms today provides is another level of access to the artistic possibilities of colour in a visual music expression. Authors who understand the new computational representations of colour in digital platforms are well placed to exploit the new possibilities of colour in visual music works. There are, however, many computational platforms and digital video effects software that provide exciting levels of access to colour. It is, therefore of importance for artists interested in a visual music expression to learn about how colour works perceptually, physiologically, and artistically to be better informed about colour choices in their work. This type of knowledge for the visual music artist is akin to the musician needing to know the rudiments of music.

6.5.2.5 MEASURING COLOUR

The desire to approach colour in visual art from a scientific and empirical basis encouraged visual artists to engage in finding ways to measure colour. Theories of colour informed the colour studies and choices by painters. In the 20th century, painters explored this measurement aspect of colour to create accurate gradations of one hue of colour between light and dark shades and accurate relationships between colours. Artists devised colour wheels, for example Runge (2.2.4). Colour theory developed and evolved over the 20th century and provided artists and industry with models and systems of colour that are capable of being accurately reproduced, so that when one uses a specific colour in one device it will be reproduced correctly in another. When colour was capable of being reproduced in film, Fischinger was one of the first experimental filmmakers to use new colour processed in his films. The fundamental basis of colour in the technologies of film, video and computer video is based on representing colour mathematically in specific colour spaces, hence, at the level of the material of colour in these machines, colour is linked to a mathematical model of colour. Colour reproduction nonetheless varies across devices, and is still a difficult aspect in relation to the presentation of a visual music work.

6.5.2.6 COLOUR HARMONY

The colour organ inventors and particularly those that devised precise colour to music scale tone mappings hoped that by playing colour in a manner of playing music, an analogous colour harmony could be found. The colour harmony would be the same as music harmony. It would consist of scales, triads, keys and various music rudimentary characteristics, such as, duration, rhythm and tempo. Yet, despite the success of each systematic definition of colour harmony designed in the colour instrument invention in its own right, this did not lead to the discovery of a general set of rules for a colour harmony that could be founded upon any basic laws of colour and sound. Colour, in fact, had such different properties to sound that it was only when the colour organ inventions explored colour and coloured light for its own sake such as, for instance, in the art of light by Wilfred and in the generation of many kinetic devices of the mid to late twentieth century which enabled, through reflections and refraction, a mobile coloured light and coloured

light forms that the more expressive nature of colour and light came to be investigated for itself. Thus the display technologies that present the televisual, videographic, and cinematographic images are now based on a harnessing of colour and light exploited for its expressive colour possibilities. Artist's choose their own colour harmonies, either through an informed knowledge of colour design, or through an intuitive approach to colour choices. The successful visual music works have a command of colour in their expression as much as the successful musician has command of the music of their music instrument.

6.5.2.7 COLOUR RELATIONSHIPS

Exploring the relationship between colours is one of the techniques and methods by which a visual artist works with colour. Colour harmony models have evolved that are useful and helpful for artists in making their selections about colour. Working out how colour works with sound, however, is also another technique and method an artist must develop when using a visual music expression. Systems of colour and sound relationships can be sought and many of the colour organs focused on a systematic mapping of colour to sound. Many artists develop their own unique perceptual and emotional interpretations of colour-to-sound relationships. Some of these artists base their interpretation on the associations that colours have for them or the associations that colour-to-sound might have for them, and some of the artists have a form of synaesthesia which makes these associations predictable and consistent for that individual. The author starts many of her works with a sense of a colour palette with which she would like to work, and it usually two colours that sparks the creativity. Her first work 'Dazzling and Blinding' started with a green, black and white colour palette that was suggested by listening to the chosen sound track. For a recent work 'Silk Chroma' (2010), the palette chosen to work with was red and green, which was suggested from the reading of passages of text from the novella 'Silk' by Alessandro Baricco. Her latest work 'Digital Alchemy' (2018), the colours pink and gold were the colours that she associated with the chosen micro-tonal music composition by Cobi van Tonder. There are always two, or more colours that suggest a new work. Colour choices provide a starting point for the author and helps create the initial impulse to start a new work.

6.5.3 COMPOSITION

The creation of the visual part of a work incorporating a visual music expression is a form of composition. Many artists took music compositional approaches as the basis for composing visuals. The music composer that also creates visuals combines music composition techniques with visual composition techniques. However, the visual artist who works with a given piece of music or a particular music performance is also engaged in composition. The composition is the craft of the work and the whole of the work. Kandinsky called many of his paintings, compositions. For him, he further distinguished the compositions from the improvisation works.

Klee, took the language of music as the basis of a language for composing the visual part of his paintings. A universal language of composition can be seen to be the basis of many of the artists examined in this thesis. Such a universal language focuses on the more invisible things of an artwork such as speed, dynamics, rhythm, velocity, variable speeds, scatterings, motions, phrasing, direction, upwards, downwards, forces. Music works with these variables to too do visual art works and in particular visuals in a close expression with music art works. Creating dynamic changes to things like visual forms and colour preoccupied many of the artists examined. Mary Greenwalt devised the rheostat to create a fading in and out of colour and form to create a variation of light values akin to what could be described as a visual form of musical 'intonation'. Such intonation of light and colour is a particularly expressive aspect of many of the technological approaches to create a moving image visual with music. The colour organs, the light art, the kinetic art, the mediums and technologies of film, video and computational methods all provide means to create intonations of light and colour and thus creating that similar dynamic quality of changing tone that can be created in music to give a tone or timbre its musical quality and expressive quality. Lye sought to compose motion itself, which being an invisible thing could only be seen through the forms that emerge in the motion of the visual elements.

By the late twentieth century, however, the final output for works that explored a visual music expression in either film, video or in early computer and computational approaches to image making, had their own particular visual constructs with which to contend, enabling one to compose the frame, the field, the area, the space in which the visual part occupies. The artist chooses the mix of constructs that they are drawn to work with in their own visual compositions. The author viewed her early work as being about composing motion and time with some consideration to the composition of spaces. For example, the works 'Dazzling and Blinding' and 'Edges' were conceived of as a variety of spaces with motion taking place in them, but 'Towards One' added the idea of a surface into the construction. Here, the author created several motion surfaces that were subsequently combined to create a complex layering of interacting timelines of several layers of motion surfaces. Many people have commented that the authors work has a lot of depth to it, perhaps it is this layering of so many surfaces that contributes to that sense of depth. Recent works are more about creating 'worlds', environments of music, sound, space, surface, colour, form and motion that are interacting together as if they all belonged together.

6.5.4   EXPRESSION

6.5.4.1   INTUITION

A very important finding in this thesis is how important intuition is in the creation of an art work. Kandinsky called it 'an inner necessity' that determines the choice of the means of expression and is one of the most important factors in the emergence of form in a work. McLaren called his

approach the subject matter evolves in the exploration of a technique. Lye worked with motion and it was in the motion that figures and forms formed for fleeting moments in time. Fischinger crafted a choreographed and precise motion that were based on the laws of the acoustics of the soundtrack he was working with. It is the artist's hand in the elucidation of a work that is often that important ingredient in the art work. Intuition in art in the twentieth century, was associated with spirituality and with a universal law of art expressing the human being's need and search for meaning in experiences that are characteristically lived by each and every and any human being. Eggeling and Richter made the transition from painting to film by keeping this essential ingredient of art and the important role of the artist's choices and interests in determining the art work. Film developed into an industrial model of production and hence moved more towards entertainment in its mainstream forms. Despite this, although technologies might take on a dominant entertainment model for the creation of art, there is always room for the intuitive approach to using technology in art. A subjective approach to the exploration of colour in a contemporary visual music work is as much about the artist's intuitive choices and their experimentation with what works. The desire to experiment to find what works can be found in all the examples examined in this thesis. The experimentation in art is often passed down to later generations as the basis for a new technology or a new approach to the use of a technology. The use of sensors and interactive processes in performance and in art installations has now become the basis for developing ever more complex applications for the deployment of interactive systems as a new means of expression in art works today.

6.5.4.2 TECHNIQUES

The author found her version of visual music by being compelled to explore in the visual domain the music technology techniques pertaining to sound. Thus, the technological techniques that were enabled in the computer audio interfaces became a metaphorical operative tool for the author. The layering of audio files to create new sounds, the offsetting of that layering of each sound layer to create reverberation effects were the means by which the author enjoyed in manipulating sound. The placement of grains at different durations across the frequency and amplitude range of the aural spaces made available in sound design hardware and software became the basis for an interest in an aesthetic equivalent of such processes in the visual domain. It was not until the author used the software Isadora that she was able to get a visual equivalent of sonic grains in space to visual grains in space. However, some particle system techniques have also generated the type of granular approach to image information that the author seeks when wishing to create textural effects. The music technology techniques were translated into image and video editing techniques. Composing with sounds in the computer through complex layering and mixing were translated into the complex layering of imagery and composing with images, granular images and visual spaces.

6.5.4.3 UNIVERSAL MACHINE AND MEDIUM

Several artists and commentators mentioned in this thesis looked towards a type of universal machine or medium that could output both visual elements and musical elements at the same time. Many of the colour organ inventors wished for such a mechanism that would more easily connect visuals and sound so that they could be performed in artistically meaningful ways. The experiments with optical sound — where scientists and artists used visual art techniques in drawing lines, shapes and geometric forms onto the soundtrack thus generating sound directly from visual shapes and forms — brought us a step closer to a medium that could create sound and visuals from the same fundamental forms. The video synthesis inventors and artists approximate most closely to a universal medium in recognising that the electric video and audio signal had similar properties (4.6.4). These could be exploited to facilitate a type of interference communication, whereby the output of an audio signal could be applied to the input of a video signal resulting in an interference in the image. Controlling that interference to make artistically meaningful imagery, however, was not as easy to do. The development of computer software, programming languages and the ability to get devices to communicate with each other, using various protocols of communication between devices, has ended up being the current universal medium required to enable the invention of systems and devices to enable the performance of images and sound in a more direct relationship. All of this, nonetheless, is still far from providing a simple and easy-to-use device to do a direct translation of image information and sound information with a single interface. Typically, several protocols, coding languages and hardware equipment has to be assembled and configured. That music and visual art modalities are capable of being represented as digital data, as Miller Puckette noted and used as the basis of the building of Pure Data (PD) and his open source visual programming language for multimedia, now enables communications between and with each other more readily achievable. This is as much of a universal medium that one could ask for, for now.

6.5.4.4 LANGUAGE OF VISUAL MUSIC

The artistic language of visual music does not constitute a singular or general domain of art. Its artistic language, rather, comes from the particular and specific blends of visual to music conceptions of the artist, along with the artist's interaction with the means that they are using and the type of techniques they use or devise to interact with the means. For example, a computer programmer could build a device that takes the colour of an image and convert it into a particular frequency for the purposes of creating a visual music work based on exploring this technique. Another visual music approach that could be taken is by a studio painter with a skill in fine-art painting who is interested in the evolution of textures in the imagery and their artistic resonance with the timbres of the music. Alternatively, a music composer can transfer their music composition language to the pictorial domain, following similar music composition processes

applying it to visual parameters and to visual elements. The filmmaker who is skilled in animation techniques brings to bear their command of motion, framing and temporal animation of visual elements to visual music. This filmmaker could explore either themselves or in collaboration with musicians and composers, a musical equivalent to pictorial events. Some animation works are scored after they are made. The author's 'Duel Tones' (2016) was scored after the work was completed in close collaboration with the composer (who happened to be the author's daughter).

6.6   FINDING VISUAL MUSIC IN ITS 20TH CENTURY HISTORY

'Visual music' is a term that has been consistently used throughout the 20th century to describe various forms and methods of creating visual images in artistic works that seek out ways to connect these images with music. In its historical developments, this artistic practice evolved from a search to make visible the invisible nature of musical sound phenomenon and the invisible structural components of musicianship through the use of visual art means and methods to make these musical phenomenon and components 'appear', 'visible'. The scientific experiments and techniques that were able to make sound visible as a visual pattern did create interesting visual music results in what could be described as a seeing sound visibility. Oscillographs, chaldni plates could all be used to make sound visible. Making musical sound phenomenon or musicianship visible, however, does not necessarily make the visual result a work of art. Many artists, nevertheless, used these 'seeing sound' phenomenon, enabled through these scientific processes and devices, to become the actual subject matter of their work as is the case in the films of Mary Ellen Bute and John Whitney Snr. An essential factor for making music visible or visual in art practice is that the visual of music is explored in an artistically expressive way. It is this expressive aspect of working with a visual music that is of importance and that Kandinsky touched upon in his theories of the inner and outer aspect of an artwork where the outer part takes shape as a result of the interaction of the artist's need to express the inner aspect of the forms of art. In this way, the form and content are merged *through* the expressiveness of the artist *with* the means of expression.

The expressive aspect of a visual music approach to art means that the seeing sound, or the making music visible, or the visual music activity is artist-led. This belongs to the artist's desire to express something in and with their art. This, however, is also means-led in that the artist's work with the artistic means available and that are at their disposal with which to work. An artist could just as easily choose to work with music instruments, electroacoustic sound, painting forms, or writing poetry. These are the means, but at essence all art comes from the interaction of the artist with the chosen means. It is this aspect of the artist choosing the means with which to work and to which they are drawn that is of most significance in visual music. The artist could choose to work with one single means to express form, or they could decide to choose several means. In

painting, the freedom to choose the forms and to adjust existing forms, where necessary, led to the advent of abstraction in painting and thus to abstraction as a new form of expression for the visual arts. In abstract painting in the twentieth century, the painter was influenced by the music composer who could shape the musical material according to their artistic need to do so and to change the forms of music, if necessary, in order to express and create artistic forms in their work. Schoenberg's invention of a whole new system of music based on atonality was deemed by Stravinksy to have occurred because of this artistic drive to make the forms that best suits the artist's vision of the whole of the work. Kandinsky could be said to be the inventor of abstraction in visual art as a result of his desire to place the artist at the centre of the activity of choice, material use and means in the creation of an art work. As a result, Kandinsky instigated a whole new form of visual art akin to the change from tonality and atonality that took place in music composition around the same time.

The means of expression in relation to the identification of a visual music in painting can be constituted from a concerted effort to derive a painting language from the language of music, musicianship and music composition as this assists painting appeal more to the inner aspects of visual art and its visual resonances with the inner aspects of human nature. Because they could not find the language of expression for the types of art works and the processes they used in the construction and composition of their art works, both Klee and Kandinsky looked to music and music's terminology for a language of use in painting. Of course, just because Kandinsky called his shapes, colours and relationships between the visual forms he created in his paintings 'sounds' does not make them sounds, but as a language of expression, sounds is a useful category for depicting his intention and view of the image object and form in his painting. The forms consisted of outward appearances and inner content. Colour assisted in creating the inner content, and so, they created vibratory and resonant effects in their relationships to other colours in the picture and in their relationship to the viewer's eye and experience of the picture. Terms, such as 'composition', nonetheless, are useful general categories for conceiving of the process of making a visual music work. The artist chooses to engage with music and that engagement becomes one of the forms of expression and the means of expression takes place in the painting. This results in new forms, new contents as the artist adjusts, changes existing forms, styles and conventions in relation to the use of their chosen means. The artist can invent new forms, if they feel it is necessary to do so. This is evidenced in the identification of the visual music quest in painting. The music that is made visible is both a visible form of music in terms of forms and colours and a visual expression of music. The paintings that explore significant relationships with music exist on a continuum between these two broad approaches, from the making visible, to the expressive aspects of music. A painter might focus on crafting the visible patterns of musical tone and another might focus on the expressive qualities of colour relationships in analogy with the

expressive qualities of tones in a music composition. The visual artist determines what colours and forms to use, and where to put these in the picture. The composer chooses what tones to use, and where to put them in the music composition.

For visual music, then, the artist does not have to stay bound to a single domain of art, nor needs to follow the conventions and rules of that domain. The artist can select means from several domains and choose their own forms of combination, cross-fertilisation, integration of these means according to what they are drawn to using. In the twentieth century, such combined arts, as was possible with some colour organ inventions and with the moving image technologies of film, video and computer video, resulted in the exploration of combining visuals and music in art works comprising a visual and music element together. The means of expression now in these technologies facilitated the combining of two separate arts into one shared artistic expression and into the simultaneous presentation of the two arts. This facilitated a new form of visual music expression, but it was one that was now mediated by the twentieth century technologies of photography, telephony, phonography, film, optical sound, radio, television, video, computer video, computer music, and digital media.

The application of a visual music expression is not limited to an art work. A visual music expression can be utilised in many applications, such as in the design of an ambient environment in public buildings. A visual music expression can also be used as a technique in another art work such as in a theatre or dance performance in which the scenography can consist of a visual music expression where the video images and music are in a close expression. Artists who categorise their work as visual music are engaged in a visual music expression. However, so too for artists who use other nomenclature for their work, and who explore similar techniques, processes and results, are also engaged in a visual music expression.

Although the means for making visual music might change and the forms of visual music evolve as to be expected with new means, there are unchanging elements to visual music. The unchanging aspect of visual music is that visual artists, composers, inventors, scientists, engineers and now computer scientists wish to connect in meaningful ways a visual art and a music for artistic purposes. The technology has not quite reached the ease of use and output of visuals and music as Castel imagined in his description of a harpsichord recital accompanied by the presentation of artistic renditions of visual colours, shapes, and cherubs throughout the space of the performance. Yet, as new technologies for combining images and sounds develop, it is only a matter of time before such a performance can be played and take place.

BIBLIOGRAPHY

120years.net (n.d.) 'The 'Optophonic Piano', Vladimir Rossiné, Russia and France. 1916'. [image]
        Available at: http://120years.net/the-optophonic-pianovladimir-rossinesoviet-union1916/
        [Accessed 12 Dec. 2018].
Abbado, A. (1988) 'Perceptual Correspondences of Abstract Animation and Synthetic Sound',
        Leonardo. Supplemental Issue, 1, pp. 3-5.
Abbado, A. (2017) *Visual Music Masters. Abstract Explorations: History and Contemporary Research.*
        Italy: Skira.
About eContact (2017) 'About eContact! The cec's online journal for electroacoustic practices', [online]
        Available at: https://econtact.ca/about.html [Accessed 11 Dec. 2018].
Abstract Cinema (1993) [Documentary] UK: Keith Griffiths.
Artsonfilm.wmin.ac.uk (1993) 'Abstract Cinema'. [online] Available at:
        http://artsonfilm.wmin.ac.uk/filmsuk.php?a=view&recid=230 [Accessed 11 Dec. 2018].
Adm.ntu.edu.sg. (2012) 'International Symposium on Visual Music'. [online] Available at:
        http://www.adm.ntu.edu.sg/Research/Centre%20for%20Asian%20Art%20and%20Design/Page
        s/International-Symposium-on-Visual-Music.aspx [Accessed 6 Dec. 2018].
Afanasieff, V. (n.d.) 'Valentin Afanasieff painter and musician'. [online] Available at:
        http://afanasieff.ru/ [Accessed 11 Dec. 2018].
Aichele, K. P. (1993) 'Paul Klee and the Energetics-Atomistics Controversy', *Leonardo,* 26(4), pp. 309-
315.
Albers, J. (2006) *Interaction of Color.* Revised and expanded ed. New Haven, Conn.; London: Yale
        University Press.
Albert, C. and Philippe, V. (2001) 'Castel, Louis-Bertrand', *Oxford Music Online*. [online] Available at:
        https://doi.org/10.1093/gmo/9781561592630.article.05118 [Accessed 9 Dec. 2018].
Albright, D. (2002) 'Series Editor's Foreword: The Need for Comparison among the Arts', in Leggio, J.
        (ed.) *Music and Modern Art*. New York and London: Routledge.
Albright, D. (ed.) (2002b) *Modernism and Music: An Anthology of Sources*. Chicago: University of
        Chicago Press.
Allert, B. (1996) *Languages of Visuality: Crossings Between Science, Art, Politics, and Literature.*
        Wayne State University Press.
Altieri, C. (1984) 'Picasso's Collages and the Force of Cubism', *The Kenyon Review*, 6(2), pp. 8–33.
Alves, B. (2005) 'Digital Harmony of Sound and Light', *Computer Music Journal,* 29(4), pp. 45-54.
Alves, B. (2010) 'Correspondences and Complementarity in Visual Music', in *Proceedings of the 12th
        Biennial Symposium of Arts and Technology*, p. 9.
Alves, B. (2012) 'Consonance and Dissonance in Visual Music', *Organised Sound,* 17(02), pp. 114-119.
Andrew, H. A. *H-Chroma Quantitative Tone Chroma.* [online] Available at: http://www.h-
        pi.com/theory/huntsystem7.html [Accessed 9 Dec. 2018].
Anfan, D. (2005) 'Summer of Love. Liverpool, Frankfurt and Vienna', *The Burlington Magazine* 147
        (1232, Italian Art), pp.768–70.
Anonymous (1931) 'Color Music Made Directly from Sound of Instruments', *The Science News-Letter,*
        20(539), pp. 90-90.
Appollinaire, G. (1913) *Pure Painting,* in R. Ellmann, C. Feldelson (eds.) (1965) *The Modern Tradition:
        Backgrounds of Modern Literature*. Oxford: Oxford University Press, pp. 112-119.
Appollinaire, G. (1914) 'Coloured Rhythm', *Paris-Journal*, in Russett, R. and Starr. C. (1976).
Arfini, M. (2013) 'Abstract Film as Viewable Music. Early Experiments of Hans Richter, Walther
        Ruttmann and Oskar Fischinger', *Music in Art*, 38 (1-2), pp. 213-221.
Argüelles, J. (1969) 'Paul Signac's "Against the Enamel of a Background Rhythmic with Beats and
        Angles, Tones and Colors, Portrait of M. Félix Fénéon in 1890, Opus 217', *The Journal of
        Aesthetics and Art Criticism*, 28(1), 49-53.
Aristotle (353 B.C.) *On Sense and the Sensible*. [online] Available at:
        http://classics.mit.edu/Aristotle/sense.1.1.html [Accessed 21 Jan. 2014].
Armstrong, A. (2009) 'Explorations in Light, Affinities of Color and Music', *American Arts Quarterly,*
        26(1).
Arnheim, R. (1966) 'Art Today and the Film', *Art Journal,* 25(3), pp. 242-244.

Arnheim, R. (1974) 'Colors: Irrational and Rational', *Journal of Aesthetics & Art Criticism,* 33(2), pp. 149-154.

Arnheim, R. (1988) 'Symmetry and the Organization of Form: A Review Article', *Leonardo,* 21(3), pp. 273-276.

Arnheim, R. and Fischler, R. (1981) 'On the Application of the Golden Ratio in the Visual Arts', *Leonardo,* 14(4), pp. 349-350.

Arts sonores (n.d.) *artsonores - Médiathèque - Ina.fr.* [online] Available at: https://fresques.ina.fr/artsonores/liste/recherche/Film%20experimental/s#sort/-pertinence-/direction/DESC/page/1/size/10 [Accessed 8 Dec. 2018].

Arts sonores. (n.d.a) 'artsonores - Jacques BRISSOT, *Objets animés*', *Ina.fr*. [online] Available at: https://fresques.ina.fr/artsonores/fiche-media/InaGrm00807/jacques-brissot-objets-animes.html [Accessed 9 Dec. 2018].

Arts sonores. (n.d.b) 'artsonores - Raymond HAINS*, Etude aux allures', Ina.fr*. [online] Available at: https://fresques.ina.fr/artsonores/fiche-media/InaGrm00805/raymond-hains-etude-aux-allures.html [Accessed 9 Dec. 2018].

Arts sonores. (n.d.c) 'artsonores - Piotr KAMLER, *Etude 65', - Ina.fr*. [online] Available at: https://fresques.ina.fr/artsonores/fiche-media/InaGrm00831/piotr-kamler-etude-65.html [Accessed 9 Jan. 2019].

Arts sonores. (n.d.d) 'artsonores - Piotr KAMLER, *Lignes et Points', Ina.fr*.' [online] Available at: https://fresques.ina.fr/artsonores/fiche-media/InaGrm00839/piotr-kamler-lignes-et-points.html [Accessed 9 Dec. 2018].

Aumont, J., Pierre Ulmann, S. and Groves, V. (2016) 'Mickey Mouse Anniversary Show (*La fabuleuse histoire de Mickey*)', *Art in Translation,* 8(1), pp. 92-94.

Ausubel, K. (1983) 'Woody Vasulka – Interview'. [online] Available at: http://www.vasulka.org/archive/Interviews/1AusubelVasulka.pdf [Accessed 8 Aug. 2018].

Badger, W. G. (1926) 'Colour-Music: An Early Experiment', *The Musical Times,* 67(1005), pp. 995-996.

Baggech, M. (1998) *An English Translation of Olivier Messiaen's Traité de Rhythm, De Couleur, Et D'Ornithologie, Volume 1.* Unpublished PhD Thesis. Norman, Olkahoma Doctor of Musical Arts, The Graduate Faculty of the School of Music.

Baker, C. C. (2013) 'MINDtouch: Embodied Mobile Media Ephemeral Transference', *Leonardo,* 46(3), pp. 221-224.

Balaban, M. and Elhadad, M. (1999) 'On the Need for Visual Formalisms in Music Processing', *Leonardo,* 32(2), pp. 127-134.

Balázs, B. (1924) 'Visible Man, or the Culture of Film', trans. R. Livingstone, in Carter, E. (ed.) (2010) *Bela Balázs: Early Film Theory*. New York and Oxford. Bergahn Books.

Balázs, B. (1948) '*Theory of the Film*; *Character and Growth of a New Art*', trans. E. Bone, (1952). London: Dennis Dobson.

Ballet mécanique. (1924) [DVD] Directed by F. Léger and D. Murphy. Unseen Cinema.

Baranoff-Rossine, W. (n.d.) 'Optophonic Piano'. [online] https://baranoff-rossine.com/. Available at: https://baranoff-rossine.com/optophonic-piano/ [Accessed 12 Dec. 2018].

Barthes, R. (1977) 'Image, Music, Text', *The Journal of Aesthetics and Art Criticism*, 37, p. 220.

Batchelor, P. (2015) 'Acousmatic Approaches to the Construction of Image and Space in Sound Art', *Organised Sound*, 20(2), pp. 148–159.

Battier, M. (2007) 'What the GRM brought to music: from musique concrète to acousmatic music', *Organised Sound*, 12(3), pp. 189–202.

Beauregard, G. T., Subramanian, S. K. and Kellock, P. R. (2010). Creating a new music video by intercutting user-supplied visual data with a pre-existing music video. US Patent 7,716,572, viewed 23 October 2018, retrieved from Google Patents.

Beck, S. (1970) *Direct Video: Electronic Artform for Colour Television*. [online] Available at: http://www.vasulka.org/archive/Artists1/Beck,Stephen/DirectVid.pdf [Accessed 12 Aug. 2018].

Beck, S. (n.d.) *Beck-Tech Company. Stephen Beck Personal Collection and Archives – Video Art, Film and Media*. [online] Available at: http://www.vasulka.org/archive/Artists1/Beck,Stephen/1.pdf [Accessed 12 Aug. 2018].

Beck, S. (n.d.b) *Beck Digital Video Weaver. A "Visual Processor" for Color Television Display*. [online] Available at: http://www.vasulka.org/archive/Artists1/Beck,Stephen/VidWeaver.pdf [Accessed 12 Aug. 2018].

Becker, L. (1945) 'Synthetic Sound and Abstract Image', *Hollywood Quarterly*, 1(1), pp. 95–96

Bell, C. (1914) *Art*. New York: Frederick A. Stokes Company.

Bell, C. (1995) '"The Aesthetic Hypothesis," from Art', in A. Neill & A. Ridley (eds.). *The Philosophy of Art: Readings Ancient and Modern*. New York: McGraw-Hill, pp. 98-110.

Belik, J. (1988) 'Creation through a Machine: Kinetic Art', *Leonardo*, 21(3), pp. 243–246.

Ben-Tal, O. and Berger, J. (2004) 'Creative Aspects of Sonification', *Leonardo,* 37(3), pp. 229-232.

Benjamin, W. (1936) 'The Work of Art in the Age of Mechanical Reproduction', trans. H. Zohn, in Arendt, H. (ed.) (1969) *Illuminations Walter Benjamin.* New York: Schocken/Random House. [online] Available at: https://www.marxists.org/reference/subject/philosophy/works/ge/benjamin.htm [Accessed 12 Aug. 2018].

Bergman, A. (1990) *Auditory Scene Analysis: The Perceptual Organization of Sound*. Cambridge, Massachusetts: The MIT Press.

Bergstrom,I. & Lotto, R. B. (2009) 'Harnessing the Enactive Knowledge of Musicians to Allow the Real-Time Performance of Correlated Music and Computer Graphics', *Leonardo,* 42(1), pp.92 93.

Berleant, A. (1979) 'The Visual Arts and the Art of the Unseen', *Leonardo,* 12(3), pp. 231-235.

Berman, G. (1999) 'Synesthesia and the Arts', *Leonardo,* 32(1), pp. 15-22.

Bernard, J. W. (1986) 'Messiaen's synaesthesia: The correspondence between color and sound structure in his music.', *Music Perception*, 4(1), pp. 41–68.

Bernheimer, A. W. (1978) 'Reflectographs: Nonfigurative Artworks Made Using Photographic Materials', *Leonardo,* 11(3), pp. 177-179.

Bernstein, J. M. (2002) 'Readymades, Monochromes, Etc.: Nominalism and the Paradox of Modernism', *Diacritics,* 32(1), pp. 83-100.

Berry, V. T. and Shelton, V. (1999) 'Watching Music: Interpretations of Visual Music Performance', *Journal of Communication Inquiry,* 23(2), pp. 132-151.

Bertelsen, O. W., Breinbjerg, M. and Pold, S. (2009) 'Emerging Materiality: Reflections on Creative Use of Software in Electronic Music Composition', *Leonardo,* 42(3), pp. 197-202.

Betancourt, M. (2004) *Visual Music Instrument Patents*. Wildside Press LLC.

Betancourt, M. (2007a) 'Synchronous Form in Visual Music', *Offscreen Magazine,* 11, pp. 9–12.

Betancourt, M. (2007b) 'A Taxonomy of Abstract Form Using Studies of Synesthesia and Hallucinations', *Leonardo,* 40(1), pp. 59-48.

Betancourt, M. (2011) *Mary Ellen Bute's Synchronization of Sound and Image*. [online] Available at: https://cinegraphic.net/article.php/20110306084109137 [Accessed 12 Dec. 2017].

Birren, F. (1969) 'Psychological Implications of Color and Illumination', *Illuminating Engineering,* (May 1969), pp. 397-402.

Bishop, B. (1893) *A Souvenir of the Color Organ, with Some Suggestions in Regard to the Soul of the Rainbow and the Harmony of Light, with Marginal Notes and Illuminations by the Author*. New York: The De Vinne Press.

Bizzaro, N. (2011) 'Pierre Schaeffer's contribution to audiovisual theory', *Worlds of Audio Vision – 2011*. [online] Available at: http://www-5.unipv.it/wav/index.php?option=com_content&view=article&id=77&lang=en [Accessed 12 Dec. 2018].

Blake, E. M. and Wilfred, T. (1948) 'Letters Pro and Con', *The Journal of Aesthetics and Art Criticism,* 6(3), pp. 265-276.

Blanc-Gatti (n.d.) *Blanc-Gatti, Charles Jules Ernest*. [online] http://www.sikart.ch/KuenstlerInnen.aspx?id=9639023 [Accessed 12 Dec. 2018].

Blower, J. (2016) 'A New Art: The Visual Music of Film', *Art in Translation,* 8(1), pp. 47-52.

Boshsa, N.C. (1810) *Di tanti palpiti*, [Music Score]

Bonačić, V. (1974) 'Kinetic Art: Application of Abstract Algebra to Objects with Computer-Controlled Flashing Lights and Sound Combinations', *Leonardo*, 7(3), pp. 193–200.

Bonds, M. E. (2014) *Absolute music: the history of an idea.* Oxford and New York: Oxford University Press.

Bordwell, D. (1980) 'The Musical Analogy', *Yale French Studies*, (60), pp. 141–156.

Bornstein, M. H. (1975) 'On Light and the Aesthetics of Color: Lumia Kinetic Art', *Leonardo,* 8(3), pp. 203-212.

Bowlt, J. E. (1976) 'The Blue Rose: Russian Symbolism in Art', The Burlington Magazine, 118 (881), pp. 566-57.

Bowlt, J. E. (1980) 'Constructivist Graphic Design in the USSR between 1917 and the Present', *Leonardo*, 13(1), p. 86. [online] Available at: http://www.jstor.org/stable/10.2307/1573888.

Bowlt, J. E. and Misler, N. (eds.) (2002) *Experiment: A Journal of Vassili Kandinsky in Russian Art: A study of 'On Spiritual in Art'*. Newtonville, MA: Oriental Research Partners.

Bragdon, C. (1910) (1922) *The Beautiful Necessity*: *Seven Essays on Theosophy and Architecture.* Rochester: Manas Press. [online] Available at: http://www.gutenberg.org/cache/epub/12648/pg12648-images.html [Accessed 17 Dec. 2018].

Bragdon, C. (1915) *Projective Ornament*, Rochester, New York: Manas Press.

Bragdon, C. (1938) *More Lives than One*, New York: A.A. Knopf.

Braque, G. (1912) 'Violin: "Mozart Kubelick', [image] Available at: https://www.metmuseum.org/art/collection/search/500393?oid=500393 [Accessed 17 Dec. 2018].

Brenner, A. (1977) 'The Structuralism of Claude Levi-Strauss and the Visual Arts', *Leonardo,* 10(4), pp. 303-306.

Brent-Smith, A. (1926) 'Some Reflections on the Work of Scriabin', *The Musical Times*, 67(1001), pp. 593–595.

Brill, L. M. (1980) 'Wavefronts Theatre of Performing Lights: On Light Shows with Music and Dance', *Leonardo,* 13(4), pp. 307-309.

Brougher, K, Strick, J., Wiseman, A., Zilczer, J. (eds.) (2005) *Visual music : 1905-2005*. New York: Thames & Hudson.

Brougher, K. (2005) 'Visual Music Culture' in Brougher, K, Strick, J., Wiseman, A., Zilczer, J. (eds.) (2005) *Visual music : 1905-2005*. New York: Thames & Hudson.

Brown, R. H. and Richard, H. B. (2012) 'The Spirit inside Each Object: John Cage, Oskar Fischinger, and "The Future of Music"', *Journal of the Society for American Music,* 6(01), pp. 83-113.

Bruhn, S. (2001) 'A Concert of Paintings: "Musical Ekphrasis" In the Twentieth Century.', *Poetics Today*, 22(3), p. 551.

Burt, (2014) 'Review – Pierre Schaeffer: In Search of a Concrete Music (Translated by Christine North and John Dack)', *SoundBytes Magazine*. [online] Available at: http://soundbytesmag.net/pierreschaefferconcretemusic/ [Accessed 11 Dec. 2018].

Bute, M. (1953) 'New Film Music for New Films', *Film Music*, Vol 12.4 (March-April). https://brbl-dl.library.yale.edu/vufind/Record/4161861?image_id=15061304

Bute, M. (1954) 'Abstronics: An Experimental Filmmaker Photographs the Esthetics of the Osciilograph', Hart, H. ed. *Films in Review*, 5(6). [online] Available at: http://www.centerforvisualmusic.org/ABSTRONICS.pdf [Accessed 11 Dec. 2018].

Bute, M. (1985) 'Reaching for Kinetic Art', in R. Haller (ed.) *Field of Vision,* 13 (Spring 1985). Island Cinema Resources. [online] Available at: http://www.centerforvisualmusic.org/Bute_KineticArt.pdf [Accessed 11 Dec. 2018].

Bértola, E. d. (1972) 'On Space and Time in Music and the Visual Arts', *Leonardo,* 5(1), pp. 27-30.

Cahn, S. M. and Meskin, A. (eds.) (2008) *Aesthetics: a comprehensive anthology.* Malden, MA: Blackwell Pub.

Caillaud, B. and Duchesne, P. (1997) 'Sonagraphic Art', *Leonardo,* 30(1), pp. 67.

Cage, J. (1951) *Imaginary Landscape No.4.* Edition Peters, no. 6718.

Caloutsis, V. (1970) 'Kinetic Art: The Kinoptic System', *Leonardo,* 3(4), pp. 433-434.

Campen, C. (1999) 'Artistic and Psychological Experiments with Synesthesia', *Leonardo,* 32(1), pp. 9-14.

Campen, C. and Froger, C. (2003) 'Personal Profiles of Color Synesthesia: Developing a Testing Method for Artists and Scientists', *Leonardo,* 36(4), pp. 291-294.

Carroll, N. (1998) 'The Essence of Cinema?', *Philosophical Studies: An International Journal for Philosophy in the Analytic Tradition,* 89(2/3), pp. 323-330.

Carvalho, A. and Lund, C. (eds.) (2015) *The Audiovisual Breakthrough*. Berlin: Fluctuating Images.

Carter, C. (1976) 'Painting and Language: A Pictorial Syntax of Shapes', in *Leonardo,* 9, pp. 111-118.

Cassidy, D. M. (1988) 'Arthur Dove's Music Paintings Of The Jazz Age', *American Art Journal*, 20(1), pp. 4–23.

Castel, L. (1725) 'Clavecin pour les yeux, avec Part de peindre les sons, et toutes sortes de pièces de musique*', Mercure de France.* November, 2552–2577.

Castel, L. (1740) *L'optique des couleurs : fondée sur les simples observations & tournée sur-tout à la pratique de la peinture, de la teinture, & des autres arts colorists.* [online] Available at: https://archive.org/details/gri_c00033125008507283/page/n441 [Accessed 11 Dec. 2018].

Castello Branco, P. (2010) 'Pure sensations? from abstract film to digital images', in *Animation,* 5(1), pp. 25-40.

Ceglie, F. (2007) 'The Concept of Synaesthesia in the Late Nineteenth and Early Twentieth Century', *History & Philosophy of Psychology,* 9(2), pp. 57-61.

Ceiarteuntref.edu.ar. (2019). 'Understanding Visual Music Symposium - UVM 2013 | Centro de Experimentación e Investigación en Artes Electrónicas.' [online] Available at: http://ceiarteuntref.edu.ar/uvm_symposium [Accessed 6 Dec. 2018].

Centerforvisualmusic.org (2011) 'VM Collections and Archives: Special Collections - Visual Music Alliance Collection.' [Online] Available at: http://www.centerforvisualmusic.org/CVMVMA.htm [Accessed 11 Dec. 2018].

Chadabe, J. (2002) 'Music and Life', *Leonardo,* 35(5), pp. 559-565.

Chalmers, (1993) *Divisions of the Tetrachord: A Prolegomenon to the Construction of Musical Scales.* Frog Peak Music.

Charnay, Y. (1982) 'A New Medium for Expression: Painting with Liquid Crystals', *Leonardo,* 15(3), pp. 219-221.

Chasalow, E. (2007) 'Boston Cyberarts Festival: Visual Music Marathon', *Computer Music Journal*, 31(4), pp. 71–87.

Chaudon, L. (1786) *Historical and Critical Memoirs of the Life and Writings of M. de Voltaire.* [online] Google Books. Available at: https://books.google.ie/books?id=kToFAAAAYAAJ&vq=p36&pg=PR1#v=onepage&q=p36&f=false [Accessed 11 Dec. 2018].

Checefsky, B. (2018) 'Leopold Survage - Colored Rhythm (BRUCE CHECEFSKY)'. [video file] Retrieved from: https://youtu.be/38hhi-lTrkI [Accessed 10 Dec. 2018].

Chion, M. (1994) *Audio-vision: sound on screen*, ed., and trans. C. Gorbman (1994). New York: Columbia University Press.

Chion, M. (1995) *Guide to Sound Objects*, trans. Dack J. and North C (2009). Available at: https://monoskop.org/images/0/01/Chion_Michel_Guide_To_Sound_Objects_Pierre_Schaeffer_and_Musical_Research.pdf.

Chion, M. (2013) 'Sensory Aspects Of Contemporary Cinema', in J. Richardson *et al* (eds.) *The Oxford Handbook of New Audiovisual Aesthetics*. Oxford and New York: Oxford University Press.

Chilvers & Glades-Smith (1998) *A Dictionary of Modern and Contemporary Art*. Oxford: Oxford University Press.

Chipp, H. B. (1958) 'Orphism and Color Theory.', *The Art Bulletin*, 40(1), pp. 55–63.

Christensen, T. (2002) *The Cambridge History of Western Music Theory.* Cambridge: Cambridge University Press.

Christensen, T. and Rameau, J.-P. (2014) 'Eighteenth-Century Science and the "Corps Sonore:" The Scientific Background to Rameau's "Principle of Harmony" ', *Journal of Music Theory*, 31(1), p. 23.

Chua, D. K. L. (1999) *Absolute Music and the Construction of Meaning.* Cambridge: Cambridge University Press.

Cinepainting, (n.d.) [online] Available at: http://musicalisme.fr/gb/le-musicalisme/la-cinepeinture/ [Accessed 11 Dec. 2018].

Ciurlionis, M. (1908) 'Sonata No. 5 (Sonata of the Sea). Allegro. Andante. Finale', [image] Available at: http://www.ciurlionis.lt/ciurlionis-paintings-and-prints [Accessed 17 Dec. 2018].

Ciurlionis, M. (1908b) 'Fugue, From the diptych "prelude. Fugue"', [image] Available at: http://ciurlionis.eu/paveikslas/fuga-preliudas-fuga/ [Accessed 17 Dec. 2018].

Clementi, A. (2009) 'Commentary on My Music', *Contemporary Music Review,* 28(6), pp. 507-511.

Coleman, C. (1987) 'Exploring New Forms in the Visual Arts through the Use of Electronic Tools: Videography and Computer Graphics', *Leonardo,* 20(3), pp. 235-240.

Collins, N. (2008) 'Leigh Landy "Understanding the Art of Sound Organization" and "The Music of Sounds"', *Organised Sound*, 13(3), pp. 273–276.

Collins, N. (2011) 'Live Coding of Consequence', *Leonardo,* 44(3), pp. 207-230.

Collopy, F., Fuhrer, R. M. and Jameson, D. (1999) 'Visual music in a visual programming language', *Proceedings 1999 IEEE Symposium on Visual Languages*, 1947, pp. 111–118.

Collopy, F. (2000) 'Color, Form, and Motion: Dimensions of a Musical Art of Light', *Leonardo,* 33(5), pp. 355-360.

Collopy, F. (2001) 'Improvisational Lumia: Painting along with Musicians', *Leonardo,* 34(4), pp. 353.

Collopy, F. (2004) *Three Centuries of Color Scales*. [image] Rhythmiclight.com. Available at: http://rhythmiclight.com/1998/archives/ideas/colorScales.gif [Accessed 11 Dec. 2018].

Collopy, F. (2007) 'Visual Music as a Performing Art', *Offscreen*, 11(8–9), pp. 1–4.

Composing Motion (2011), 'Submissions for Organized Sound – Issue: Composing Motion – A Visual Music Retrospective'. [online] Available at: https://www.degem.de/call-submissions-for-organized-sound-issue-composing-motion-a-visual-music-retrospective-2/ [Accessed 17 Dec. 2018].

Conrad, D. (1999) 'The Dichromaccord: Reinventing the Elusive Color Organ', *Leonardo,* 32(5), pp. 393-398.

Cook, M. (2011) 'Visual Music in Film, 1921–1924: Richter, Eggeling, Ruttman', in C. De Mille (ed.) *Music and modernism, c. 1849-1950.* Cambridge Scholars Publishing, pp. 206-228.

Cook, D. (1972) 'On Kinetic Art with Electric Light', *Leonardo,* 5(4), pp. 379.

Cook, D. (1975) 'Kinetic Art: The Luminetic System: With and without Sound', *Leonardo,* 8(1), pp.1-5.

Cope, N. (2012) *Northern Industrial Scratch: The History and Contexts of a Visual Music Practice.* PhD Thesis. University of Sutherland [online] Available at: https://sure.sunderland.ac.uk/3287/ [Accessed 19 Dec. 2018].

Cork, R. (1999) 'From "Art Quake" to "Pure Visual Music" Roger Fry and Modern British Art, 1910-1916' in C. Green, (ed.) *Art Made Modern Roger Fry's Vision of Art*. London: Courtauld Gallery.

Corra, B. (1912) 'Abstract Cinema — Chromatic Music', in U. Apollonio (ed.) (1973) *The Documents of 20th-Century Art: Futurist Manifestos*. London: Thames and Hudson.

Coulter, J. (2007) 'The Language of Electroacoustic Music with Moving Images', *EMS: Electroacoustic Music Studies Network*. De Montfert/Leicester.

Cowan, M. (2013) 'Absolute Advertising: Walter Ruttmann and the Weimar Advertising Film', *Cinema Journal*, 52(4), pp. 49–73.

Cox, C. (2011) 'Beyond Representation and Signification: Toward a Sonic Materialism', *Journal of Visual Culture,* 10(2), pp. 145-161.

Crawford, J. C. (1980) 'Music and Visual Color', *Leonardo,* 13(4), pp. 349.

Cross Modal Perception. (n.d.) [online] Cross Modal Perception. Available at: https://www.psy.ox.ac.uk/research/crossmodal-research-laboratory [Accessed 11 Dec. 2019].

Cristiá, C. (2012) On the Interrelationship between Music and Visual Art in the Twentieth and Twenty-first Centuries: A Possible Typology Derived from Cases Originated in Argentinean Artistic Field.' *TRANS-Transcultural Music Review.*

Cuba, L. (n.d.) 'Biography (Larry Cuba)'. [online] Available at: https://people.well.com/user/cuba/Biography.html [Accessed 11 Dec. 2018].

Cuba, L. (n.d.b) 'Larry Cuba' [online] Available at: https://en.wikipedia.org/wiki/Larry_Cuba [Accessed 11 Dec. 2018].

Cuba, L. (1983) 'Artists interfacing with technology: Basic concepts of digital creation. *Proceeding SIGGRAPH '83 Proceedings of the 10th Annual Conference on Computer Graphics and Interactive Techniques.* USA, pp. 311-313.

Cubitt, S., Palmer, D. and Tkacz, N. (eds.) (2006) *Digital Light.* Open Humanities Press CIC.

Cubbitt, S. (2015) *The practice of light: a genealogy of visual technologies from prints to pixels*, *New Review of Film and Television Studies*. MIT Press.

Curnow, W. and Horrocks, R. (1984) *Figures of motion: Len Lye selected writings.* Auckland (N.Z.): Auckland University Press: Oxford University Press.

Cytowic, R. E. (2002) *Synesthesia: A Union of the Senses (2nd Edition).* Cambridge, USA: MIT Press.

Dack, J. (2013) 'Collage, montage and the composer Pierre Henry: The real, the concrete, the abstract in sound art and music', *Journal of Music Technology and Education*, 6(3), pp. 275–285.

Dack, J. & North, C. (2006) 'Translating Pierre Schaeffer: Symbolism, Literature and Music', *EMS: Electroacoustic Music Studies Network*, Beijing 2006.

D'Arbeloff, N. (1975) 'Collage, Montage, Assemblage: History and Contemporary Techniques by Norman Laliberté, Alex Mogelon (review)', *Leonardo,* 8(1), pp. 84.

Danchev, A. (ed.) *100 Artists' Manifestos: From the Futurists to the Stuckists*. Penguin Modern Classics.

Dannenberg, R. B. (2005) 'Interactive Visual Music: A Personal Perspective', *Computer Music Journal,* 29(4), pp. 25-35.

Daniels, D. (2017) 'Absolute Sounding Images: Abstract Film and Radio Drama of the 1920s as Complementary Forms of a Media-Specific Art', in Rogers, H. and Barham, J. () *The Music and Sound of Experimental Film*. Oxford: Oxford University Press.

Daniels, D. (2004) 'Forerunners of media art in the first half of the twentieth century'. [online] Available at: http://www.medienkunstnetz.de/themes/overview_of_media_art/forerunners/ [Accessed 19 Dec. 2018].

Daniels, D. (2004) 'Television-Art or anti-art? Conflict and cooperation between the avant-garde and the mass media in the 1960s and 1970s', Available at: http://www.medienkunstnetz.de/themes/overview_of_media_art/massmedia/ [Accessed 19 Dec. 2018].

Daniels, D. (2009a) 'From Visual Music to Intermedia Art' in Daniels, D. *et al.* (2009b) *See this Sound. Versprechungen von Bild und Ton. Promises in Sound and Vision,* Linz: Lentos Kunstmuseum Linz.

Daniels, D. *et al.* (2009b) *See this Sound. Versprechungen von Bild und Ton. Promises in Sound and Vision,* Linz: Lentos Kunstmuseum Linz.

Daniels, D. and Naumann, S. (eds.) (2010) *Audiovisuology. Compendium: An Interdisciplinary Survey of Audiovisual Culture*. Cologne: Verlag der Buchhandlung Walther König.

Daniels, D. (2011) 'Prologue: Hybrids of art, science, technology, perception, entertainment, and commerce at the interface of sound and vision', in Daniels, D. and Naumann, S. (eds.) (2011b) *Audiovisuology. Essays: Histories and Theories of Audiovisual Media and Art.* Cologne: Verlag der Buchhandlung Walther König, pp. 8-28.

Daniels, D. and Naumann, S. (eds.) (2011b) *Audiovisuology. Essays: Histories and Theories of Audiovisual Media and Art.* Cologne: Verlag der Buchhandlung Walther König.

Daniels, D. & Naumann, S. (eds.) (2015), *Audiovisuology, A Reader, Vol. 1: Compendium, Vol. 2: Essays.* Cologne: Verlag der Buchhandlung Walther König.

Darrigol, O. (2010a) 'The Analogy between Light and Sound in the History of Optics from the Ancient Greeks to Isaac Newton. Part 1', *Centaurus,* 52(2), pp. 117-155.

Darrigol, O. (2010b) 'The Analogy between Light and Sound in the History of Optics from the ancient Greeks to Isaac Newton. Part 2', *Centaurus,* 52(3), pp. 206-257.

Darklight-filmfestival.com (2000) 'Press Quotes', Darklight Digital Film Festival. [online] Available at: https://web.archive.org/web/20001204180200/http://www.darklight-filmfestival.com:80/site/pages/press/press.htm [Accessed 11 Dec. 2018].

Darklight-filmfestival.com (2000b) 'Light 1 Saturday 27 May', Darklight Digital Film Festival. [online] Available at: https://web.archive.org/web/20010415120606/http:/www.darklight-filmfestival.com:80/site/pages/screenings/Light1.htm [Accessed 11 Dec. 2018].

De Mille, C. (ed.) (2011) *Music and Modernism, c. 1849-1950.* Cambridge: Cambridge Scholars Publishing.

De Paulis, D. (2015) 'OPTICKS and Visual Moonbounce in Live Performance', *Leonardo,* 49(5), pp. 438-439.

Degenaar, M. and Gert-Jan C., L. (2005) 'Molyneux's Problem'. [online] Plato.stanford.edu. Available at: https://plato.stanford.edu/archives/win2017/entries/molyneux-problem [Accessed 11 Dec. 2018].

DeMarinis, P. (1996) 'Gray Area', *Leonardo,* 29(4), pp. 270-272.

Dennis, B. (1966) 'Metamorphosis in Modern Culture: The Parallel Evolution of Music and Painting in the Twentieth Century', *Tempo,* (78), pp. 12–21.

Dennis, M. (1907) '(intro Roger Fry) 'Cézanne'' in Harrison, C., *et al.* (1999) *Art in Theory 1900-2000: An Anthology of Changing Ideas.* Oxford: Blackwell, pp. 40-47.

Detheux, J. (2007) 'Visual Music Marathon: Musical Fine Art Animation Benchmark', *Animation World Network.* [online] Available at: https://www.awn.com/animationworld/visual-music-marathon-musical-fine-art-animation-benchmark [Accessed 11 Dec. 2018].

Detheux, J. (2007b) Liaisons, programme note in (dir.) Miller, D. H. (2007) *Visual Music Marathon.* Available online: http://t-m-a.de/cynetart/archive/cynetart07/programmubersicht/visuals-music/?lang=en [Last accessed 07/06/2019].

DeWitt, T. (1987) 'Visual Music: Searching for an Aesthetic', *Leonardo,* 20(2), pp. 115-122.

DeWitt, T. (1989) 'Dataism', *Leonardo. Supplemental Issue*, 2 Computer Art in Context: SIGGRAPH '89 Art Show Catalog (1989), pp. 57-61.

Dicker, B. (2016) 'Editorial: "Starting, Stopping and Synthesizing Cinematographic Art"', in 'A New Art: The Visual Music of Film' in Blower, J. (2016) trans., *Art in Translation,* 8(1), pp. 1-10.

Dickerman, L. and Chlenova, M. (eds.) (2012), *Inventing Abstraction.* New York: Thames & Hudson.

Dickinson, J. 'System vs. self. The artistic and pedagogical legacy of Paul Klee and its continued significance for compositional practice today', *International Conference On Analysing Popular Music*, University of Liverpool, Liverpool, UK.

Dickinson, J. (2016) *Musical-pictorial symbiosis: an intermedial approach to the analysis of selected musical readings of Paul Klee's art.* Unpublished PhD Thesis, Bath Spa University [Online] Available at: http://researchspace.bathspa.ac.uk/8228/

Diderot, D. (1749) 'Letter on the blind', *Early Philosophical Works*, pp. 68–141. [online] Available at: http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Letter+on+the+Blind#0.

Diebold, B. (1921) 'New Art' in Goergen, J. (1989) *Walter Ruttmann: Eine Dokumentation.* Berlin: Freunde der Deutschen Kinemathek.

Diebold, B. (1921) 'A New Art: The Visual Music of Film', trans. J. Blower (2016), in Dicker, B. (ed.) (2016) *Art in Translation,* 8(1), pp. 47-52.

Diebold, B. & Blower J. (2016) A New Art: The Visual Music of Film, Art in Translation, 8(1), pp, 47-52.

Diebold, B. and Elliott, R. G. (1932) 'The Future of Mickey Mouse (The Animated Film as a New Cinema Art)', in Dicker, B. (ed.) & Blower, J. trans. (2016) *Art in Translation,* 8(1), pp. 53-61.

Dijksterhuis, J. (1961) *The Mechanization of the World Picture.* Clarendon Press.

Dolan, E. (2013) 'Lessons at the ocular harpsichord. In The Orchestral Revolution: Haydn and the Technologies of Timbre' (pp. 23-52). Cambridge: Cambridge University Press.

Dömling, W. (1994) 'Reuniting the Arts: Notes on the History of an Idea', *19th-Century Music*, 18(1), pp. 3–9.

Donguy, J. (2001) 'Machine Head: Raoul Hausmann and the Optophone', *Leonardo,* 34(3), pp. 217-220.

Donnelly, K. J. (2013) 'Extending Film Aesthetics Audio Beyond Visuals' in Richardson, J., Gorbman, C. and Vernallis, C. (eds.) (2013) *The Oxford Handbook of New Audiovisual Aesthetics.* Oxford and New York: Oxford University Press, pp. 357–371.

Donnelly, K. J. (2015) 'Accessing the Mind's Eye and Ear: What Might Lab Experiments Tell Us About Film Music?', *Music and the Moving Image*, 8(2), pp. 25–34.

Douglas, D. P. (2012) 'Wave Space Painting with Science', *Leonardo,* 45(3), pp. 207-210.

Dow, A. W. (1903) *Composition: A Series of Exercises in Art Structure for the Use of Students and Teachers.* New York: The Baker and Taylor Company.

Dow, A. W. and Masheck, J. (1997) *Composition: A Series of Exercises in Art Structure for the Use of Students and Teachers.* University of California Press.

Downey, J. (1969) 'Electronically Operated Audio-Kinetic Sculptures, 1968', in *Leonardo,* 2(4), pp. 403–406.

Düchting, H. (1997) *Paul Klee: Painting Music*. Munich: Prestel.

Duck, M. J. (1988) 'Newton and Goethe on colour: Physical and physiological considerations', *Annals of Science*, 45(5), pp. 507–519.

Duit, R. (1991) 'On the role of analogies and metaphors in learning science', *Science Education,* 75(6), pp. 649-672.

Dukhan, I. and Lodder, C. (2016) 'Visual Geometry: El Lissitzky and the Establishment of Conceptions of Space–Time in Avant-garde Art', *Art in Translation,* 8(2), pp. 194-220.

Duncan, E. H. (1980) 'Aesthetics for Contemporary Artists', *Leonardo,* 13(4), pp. 328-331.

Dunn, J. and Clark, M. A. (1999) ' "Life Music": The Sonification of Proteins', *Leonardo,* 32(1), pp. 25-32.

Durfee, R. (n.d.) 'The Vasulkas'. [online] Available at: http://www.vasulka.org/archive/Artists2/Durfee,Roy/TheVasulkas.pdf [Accessed 5 Dec. 2018].

Dömling, W. (1994) 'Reuniting the Arts: Notes on the History of an Idea', *19th-Century Music,* 18(1), pp. 3-9.

Eaglefield Hull, (1916)

Ecal.ch. (n.d.). Exhibition "Vertiginous Parallels" at the Gallery *l'elac*. [online] Available at: https://www.ecal.ch/en/2582/elac-gallery/exhibitions/exhibition-vertiginous-parallels-at-the-gallery-l-elac [Accessed 5 Dec. 2018].

Edmonds, E. and Pauletto, S. (2004) 'Audiovisual Discourse in Digital Art', *ACM SIGGRAPH 2004 Art gallery*, pp. 116–119.

Eisenbeis, M. (1990) 'Synthesis: Visual Arts in the Electronic Culture, International Seminar with Experimental Workshop (1988)', *Leonardo,* 23(1), pp. 133-134.

Elder, R.B. (1993) *Harmony and Dissent: Film and Avant-garde Art Movements in the Early Twentieth Century*. Wilfred Laurier University Press.

Elder, R.B. (2007) 'Hans Richter and Viking Eggeling: The Dream of Universal Language and the Birth of The Absolute Film', *Avant Garde Critical Studies*, 23(1), pp. 3–35.

Elder, R.B. (2007) 'Hans Richter and Viking Eggeling: The Dream of Universal Language and the Birth of The Absolute Film', *Avant-Garde Film*. Amsterdam and New York: Rodopi, pp. 3-55.

Elder, R.B. (2008) (2010) *Harmony and Dissent: Film and Avant-garde Art Movements in the Early Twentieth Century*, Wilfred Laurier University Press.

Elder, R.B. (2013) *Dada, Surrealism and the Cinematic Effect*. Waterloo, Ontario, Canada: Wilfried Laurier University Press.

Elert, G. (1998-2014a) *Color. The Physics Hypertextbook™*. [online] Available at: http://physics.info/color/ (Accessed: 21/01/2014.

Elert, G. (1998-2014b) *The Nature of Light. The Physics Hypertextbook™*. [online] Available at: http://physics.info/light/ (Accessed: 21/01/2014.

Ellis, P., van Leeuwen, L. and Brown, K. (2008) 'Visual-music vibrations', *Digital Creativity,* 19(3), pp. 194-202.

Emery, L. and Morriss, R. (1986) '"Kinesone I": A Kinetic Sound Sculpture', *Leonardo,* 19(3), pp. 207-210.

Emmer, M. (1994) 'Art and Visual Mathematics', *Leonardo,* 27(3), pp. 237-240.

Eskilson, S. (2003) 'Thomas Wilfred and Intermedia: Seeking a Framework for Lumia', *Leonardo,* 36(1), pp. 65-68.

Etienne Bertrand, W. (1972) 'Images of Trajectories of Mobiles by Means of Photographs and Cinema: Metaforms', *Leonardo,* 5(4), pp. 301-306.

Étude aux allures - 01 janvier 1960 - (Artsonores - Ina) (2012). Available at: http://www.ina.fr/fresques/artsonores/fiche-media/InaGrm00201/etude-aux-allures.html. [Accessed 11 Dec. 2018].

Evans, B. (1988) 'Establishing a Tonic Space with Digital Color', *Leonardo, Supplemental Issue*, 1, pp. 27–30.

Evans, B. (1990) 'Temporal Coherence with Digital Color', *Leonardo. Supplemental Issue*, 3, pp. 43–49. Available at: http://www.jstor.org/stable/1557894.

Evans, B. (1992) 'Number as Form and Content: A Composer's Path of Inquiry', *Leonardo,* 25(3/4), pp. 303-311.

Evans, B. (1992) 'Elemental Counterpoint with Digital Imagery', *Leonardo Music Journal*, 2(1), pp. 13–18. Available at: http://www.jstor.org/stable/1513203.

Evans, B. (2005) 'Foundations of a Visual Music', *Computer Music Journal,* 29(4), pp. 11-24.

Evarts, J. (1968) 'The New Musical Notation: A Graphic Art?', *Leonardo,* 1(4), pp. 405-412.

Experiments in Motion Graphics (1968) [Documentary], Available at https://www.youtube.com/watch?v=VUupWQdMFDw

Facos, M. and Mednick, T.J. *The Symbolist Roots of Modern Art.* London and New York: Routledge.

Fedotov, V. M. (1995) 'Polyphony in the Paintings of M. K. Čiurlionis', *Leonardo,* 28(1), pp. 53-56.

Fiala, J. (1980) 'On My Work with the Pioneer of Kinetic Electric Light Art, Zdenek Pesanek (1896-1965): A Memoire', *Leonardo*, 13(3), pp. 182–185.

Field, G. (1817) *Chromatics: Or, the Analogy, Harmony, and Philosophy of Colours.* [online] Google Books. Available at: https://books.google.ie/books?id=jYQ5AAAAcAAJ&printsec=frontcover#v=onepage&q&f=false [Accessed 11 Dec. 2018].

Field, G. (1835) *Chromatography, or, A Treatise on Colours and Pigments, and of Their Powers in Painting.* [online] Available at: https://archive.org/details/gri_c00033125008687523/page/n6 [Accessed 11 Dec. 2018].

Fischer, T., Irons, I. and Fischer, R. (1961) 'Patterns in Art and Science: Their Creation, Evolution, and Correspondence', *Studies in Art Education*, 2(2), pp. 85-100.

Fischer, F. (1992) 'Meiji Painting from the Fenollosa Collection', *Philadelphia Museum of Art Bulletin* 88(375), pp. 1-24.

Fischinger, O. (1947) 'My Statements are in my Work', in Stauffacher, F. ed. (1947) *Art in Cinema,* Art in Cinema Society and San Francisco Museum of Art.

Fischinger, O. (1950) 'Véritable Creation', *Le Cinéma À Knokke-Le-Zoute*, pp. 35-37. [online] Available at: http://centerforvisualmusic.org/Fischinger/TrueCreation.htm [Accessed 19 Dec. 2018]. English version.

Föllmer, G. (2004) 'Audio Art'. [online] Available at: http://www.medienkunstnetz.de/themes/overview_of_media_art/audio/ [Accessed 19 Dec. 2018].

Forsberg, W. (2013) 'God Must Have Painted Those Pictures: Illuminating Auroratone's Lost History', *INCITE Journal of Experimental Media,* Fall 2013(4). [online] Available at: http://www.incite-online.net/forsberg4.html#5 [Accessed 11 Dec. 2018].

Foster, S.C. (ed.) (1998) Hans Richter: Activism, Modernism and the Avant-Garde. Cambridge, Massachusets: The MIT Press.

Fox-Gieg, N., *et al.* (2012) 'Editorial', *Organised Sound,* 17(02), pp. 97-102.

Frank, P. and Ox, J. (1986) 'Comments on "Computer-Aided Correlation of Musical and Visual Structures"', *Leonardo,* 19(3), pp. 270.

Franke, H. W. (1971) 'Computers and Visual Art', *Leonardo,* 4(4), pp. 331-338.

Franke, H. W. (1986) 'Comments on Computers, Music and the Moving Image', *Leonardo,* 19(4), pp. 355-356.

Franke, H. W. (1987) 'The Expanding Medium: The Future of Computer Art', *Leonardo,* 20(4), pp. 335-338.

Fransseen, M. (1991) 'The Ocular Harpsichord of Louis-Bertrand Castel. The Science and Aesthetics of an Eighteenth-Century *Cause Célebre*', *Tractrix Yearbook for the History of Science Medicine Technology and Mathematics,* 3, pp. 15-77.

Frémiot, M. (1994) 'Music, Visual Arts and Mathematical Concepts', *Leonardo,* 27(3), pp. 253-255.

Friscia, A. (1988) 'The Kinetichrome and Its Use of Polarized Light', *Leonardo,* 21(2), pp. 145-149.

Frith, C. and Law, J. (1995) 'Cognitive and Physiological Processes Underlying Drawing Skills', *Leonardo,* 28(3), pp. 203-205.

Frothingham, (1957) *Laocoon: an essay upon the limits of painting and poetry.* New York: Noonday Press.

Fry, R. (1911) 'Post-Impressionism., *The Fortnightly Review*, January – June 1911, vol. 95, pp. 866-7. [online] Available at: http://fortnightlyreview.co.uk/2017/10/post-impressionism/ [Accessed 14 Dec. 2018].

Fry, R. (1912) 'The French Group', *Second Post-Impressionist Exhibition*, London: Grafton Galleries. [online]. Available at: https://bibliotheque-numerique.inha.fr/viewer/35311/?offset=#page=20&viewer=picture&o=search&n=0&q=visual%20music [Accessed 17 Dec. 2018].

Fry, R. (1913) 'Allied Artists Association', *The Nation*, 2 August 1913.

Frye, J. J. (1870) 'Colour and Sound', *The Musical Times and Singing Class Circular*, 14(325), p. 406.

Fuhrer, J. V. (2002) *System and method for artistically integrating music and visual effects.* United States Patent, US 6,395,969 B1

Fuxjäger, A. (2012) 'Translation, Emphasis, Synthesis, Disturbance: On the Function of Music in Visual Music', *Organised Sound,* 17(02), pp. 120-127.

Gabriel, H. (1977) 'Op Art Pictures in Plastic', *Leonardo,* 10(2), pp. 133-134.

Gage, J. (1990) 'Color in Western Art: An Issue?', *The Art Bulletin,* 72(4), pp. 518-541.

Gage, J. (1993) *Colour and Culture. Practice and Meaning from Antiquity to Abstraction.* London: Thames & Hudson.

Gage, J. (1999) (2000) (2006) *Colour and Meaning: Art, Science and Symbolism.* London: Thames & Hudson.

Gagnon, J. (2004) 'Collecting, Preserving and Archiving the Media Arts', *Foundation Daniel* Langlois, pp. 1–2. [online] Available at: http://www.mediaarthistory.org/refresh/Programmatic key texts/pdfs/Gagnon.pdf [Accessed 17 Dec. 2018].

Galeyev, B. M. (2005) 'Mikhail Matyushin's Contribution to Synthetic Art', *Leonardo,* 38(2), pp. 151-154.

Galeyev, B. M. (1976) 'Music-Kinetic Art Medium: On the Work of the Group 'Prometei' (SKB), Kazan, U.S.S.R', *Leonardo,* 9(3), pp. 177-182.

Galeyev, B. M. (1988) 'The Fire of "Prometheus": Music-Kinetic Art Experiments in the USSR', *Leonardo,* 21(4), pp. 383-396.

Galeyev, B. M. (1988b) 'At the Sources of the Idea of "Visual Music" in Russia', *Leonardo*, 21(4), pp. 392-396

Galeyev, B. M. (1991a) 'Musical-Kinetic Art in the USSR', *Leonardo,* 24(1), pp. 41-47.

Galeyev, B. M. (1991b) 'The New "Laokoön": A Periodic System of the Arts', *Leonardo,* 24(4), pp. 453-456.

Galeyev, B. M. (1994) 'Farewell Prometheus Readings: Light-Music in the Former Soviet Union', *Leonardo,* 27(4), pp. 351-352.

Galeyev, B.M. (1995) 'Mikhail Matyushin's Contribution to Synthetic Art', *Leonardo,* 38(2), pp. 151-154.

Galeyev, B.M. and Vanechkina, I. L. (2001) 'Was Scriabin a Synesthete?', *Leonardo,* 34(1), pp. 357-361.

Galeyev, B. M. (2003) 'Evolution of Gravitational Synesthesia in Music: To Color and Light!', *Leonardo,* 36(2), pp. 129-134.

Galeyev, B. M. (2007) 'The Nature and Functions of Synesthesia in Music', *Leonardo,* 40(3), pp. 285-288.

Galeyev, B. M. (n.d.) 'From amateur performances to academy institute (1962-1999 in retrospect)'. [online] http://www.prometheus.kai.ru/. Available at: http://www.prometheus.kai.ru/start_e.htm [Accessed 20 Dec. 2018].

Gardiner, I. (2007) 'Oskar Fischinger', *Music, Sound & the Moving Image.* Liverpool University Press, pp. 117-118.

Garner, W. (1978) 'The Relationship between Colour and Music', *Leonardo*, 11(3), pp. 225–226.

Garrett, A. (1972) 'On Space and Time in Art', *Leonardo,* 5(4), pp. 329-331.

Garro, D. (2012) 'From Sonic Art to Visual Music: Divergences, convergences, intersections', *Organised Sound,* 17(02), pp. 103-113.

Garro, D. (2014) 'From "Concert" to "Screening": Visual Anecdotes in Electroacoustic Music Presentations', *Proceedings of the Electroacoustic Music Studies Network Conference: Electroacoustic Music Beyond Performance*, (June), pp. 1–7.

Garro, D. (2014b) 'On the Brink of (In)visibility: Granulation techniques in Visual Music', *eContact! 15.4 – Videomusic: Overview of an Emerging Art Form*, 15(4). Montréal: *Communauté électroacoustique canadienne* / Canadian Electroacoustic Community.

Gayou, E. (2007) 'The GRM: landmarks on a historic route', *Organised Sound* 12(3), pp 203-211.

George, S. (2005) 'The Art of Lumia'. [online] Photonlightguitars.com. Available at: http://www.photonlightguitars.com/digitallumia.html [Accessed 11 Dec. 2018].

Gerstner, K. (1986) *The Forms of Color: The Interaction of Visual Elements.* Cambridge, Mass.; London: MIT Press.

Gessinger, J. (1996) 'The Ocular Harpsichord of Louis-Bertrand Castel', in Allert, B. (ed.) *Languages of Visuality: Crossings Between Science, Art, Politics, and Literature*: Wayne State University Press, pp. 49-72.

Gessner, R. (1961-2) 'An Introduction to the Ninth Art: A Definition of Cinema', *Art Journal*, 21(2), pp. 89-92.

Gideon, E. (1994) 'From Art and Science to Perception: The Role of Aesthetics', *Leonardo,* 27(3), pp. 207-209.

Gluck, R. J. (2012) 'Electric Circus, Electric Ear and the Intermedia Center in Late-1960s New York', *Leonardo,* 45(1), pp. 50-7.

Godøy, R. I. (2003) 'Motor-Mimetic Music Cognition', *Leonardo,* 36(4), pp. 317-319.

Goergen, J. (2012) 'Oskar Fischinger in Germany 1900 to 1936', in Keefer, C. and Guldemond, J. (2013) *Oskar Fischinger (1900-1967): Experiments in Cinematic Abstraction.* Nederlands Filmmuseum, Stichting. Reprint, 1st edition.

Goethe, J.W. (1807/08) *Theory of Color: Didactic Section* in Miller, D. (eds.) trans. (1988) *Goethe: The Collected Works*. New York: Princeton University Press.

Goldberg, T. and Schrack, G. (1986) 'Computer-Aided Correlation of Musical and Visual Structures', *Leonardo,* 19(1), pp. 11-17.

Golding, J. (2000) *Paths to the absolute : Mondrian, Malevich, Kandinsky, Pollock, Newman, Rothko, and Still*. Princeton N.J.: Princeton University Press.

Gombrich, E. H. (1994) 'Review Reviewed Work(s): Colour and Culture, Practice and Meaning from Antiquity to Abstraction by John Gage', *The Burlington Magazine*, 136(1093), pp. 243–244.

Goodstein, J. R. and Bugé, C. H. (1986) *The Frank J. Malina Collection at the California Institute of Technology : guide to a microfiche edition*. [online] Available at: http://resolver.caltech.edu/CaltechBOOK:1986.002. [Accessed 6 Dec. 2017].

Gosveg, M. (2011) 'A Concrete Cinema?', [Blog] *Curating the Moving Image. [online]* Available at: https://web.archive.org/web/20120315133207/2011.curatingthemovingimage.org/blog/2011/03/16/3075/ [Accessed 6 Dec. 2017].

Graf, A. *et al.* (2007) *Avant-Garde Film*, Amsterdam - New York: Rodopi.

Grant-Ryan, P. (1987) 'Why "Leonardo?" Past, Present and Future', *Leonardo,* 20(4), pp. 397-399.

Gray, C. (1960) 'The Russian Contribution to Modern Painting', *The Burlington Magazine,* 102(686), pp. 205-211.

Greenberg, C. (1940) 'Towards a Newer Laocoon', in Harrison, C. and Wood. P. (eds.) (1999) *Art in Theory 1900-2000: An Anthology of Changing Ideas*. Oxford: Blackwell, pp. 554-560.

Grierson, M. (2005) *Audiovisual Composition*. Unpublished PhD Thesis. University of Kent at Canterbury.

Grierson, M. (2007) *Audiovisual Composition*. [online] Available at: https://web.archive.org/web/20070324134554/http://intothepill.net/soundrugs/article_grierson.pdf [Accessed 6 Dec. 2017].

Griffiths, K. (dir.) (1993) 'Abstract Cinema', Arts Council of Great Britain. [Documentary] Transcript available at: https://search.alexanderstreet.com/preview/work/bibliographic_entity%7Cvideo_work%7C3346123 [Accessed 6 Dec. 2017].

Grohmann, W. (1928). Zehn Jahre Novembergruppe. [Berlin] Kunst der Zeit.

Grohmann, (1954) in Maur, K. (1999) *The sound of painting: music in modern art. Pegasus library* Munich; London: Prestel.

Grunenberg, C. and Harris, J. (2005) *Summer of Love: Psychedelic Art, Social Crisis and Counterculture in the 1960s*. Liverpool University Press.

Guerrieri, M. (2017) *Mary Hallock Greenewalt's Illuminated Music*. [online] Available at http://daily.redbullmusicacademy.com/2017/09/mary-hallock-greenewalt-feature [Accessed 6 Dec. 2018].

Guicciardini, N. (2013) 'The Role of Musical Analogies in Newton's Optical and Cosmological Work', *Journal of the History of Ideas,* 74(1), pp. 45-67.

Guildemond, *et al.* (2013) 'Oskar Fischinger. An Introduction' in Keefer, C. and Guldemond, J. (2013) *Oskar Fischinger (1900-1967): Experiments in Cinematic Abstraction.* Nederlands Filmmuseum, Stichting. Reprint, 1st edition.

Guthmann, A. S. d. (1972) 'Kinetic Art: Animation of Color for Cinema Film', *Leonardo,* 5(3), pp. 239-241.

Haller, R. (ed.) (1998) *First Light*. New York: Anthology Film Archives

Haller, R. (1998b) Jim Davis: Visions of Convergence, *First Light*. New York: Anthology Film Archives. [online] Available at: http://www.roberthaller.com/firstlight/jim.html [Accessed 6 Dec. 2018].

Hallock-Greenewalt, M. (1918) *Light: Fine art the sixth*: *A Running Nomenclature to Underly the use of Light as a Fine Art.* Philadelphia: Nobel Press. [online] Available at: https://archive.org/details/lightfineartsixt00gree [Accessed 6 Dec. 2018].

Hallock-Greenewalt, M. (1946) *Nourathar: The fine art of light color playing.* Philadelphia: Westbrook Publishing Company.

Hankins, T. L. (1994) 'The Ocular Harpsichord of Louis-Bertrand Castel; Or, The Instrument That Wasn't', *Osiris,* 9, pp. 141-156.

Harley, M. A. (1998) 'Music of Sound and Light: Xenakis's Polytopes', *Leonardo,* 31(1), pp. 55-65.

Harrison, C. and Wood. P. (eds.) (1999) *Art in Theory 1900-2000: An Anthology of Changing Ideas*. Oxford: Blackwell.

Harrison, J. and Simon, B.C. (1994) 'Synaesthesia: An Account of Coloured Hearing', *Leonardo,* 27(4), pp. 343-346.

Hasegawa, Y. (2002) 'Selections for the Tenth New York Digital Salon', *Leonardo,* 35(5), pp. 550-558.

Hattler, M. (2014) Audiovisual Abstractions Dissertation University of East London. PhD Thesis. Available at: http://hdl.handle.net/10552/4249 [Accessed 6 Aug. 2018].

Haus, G. and Morini, P. (1992) 'TEMPER: A System for Music Synthesis from Animated Tessellations', *Leonardo,* 25(3/4), pp. 355-360.

Havránek, V. 'Who was F.J. Malina?', *International Festival for art, science and new technologies*, Prague, Czech Republic, 08/11/2008 - 11/11/2008. Prague, Czech Republic, 8-15.

Henry, M. (2009) *Seeing the Invisible: On Kandinsky.* London: Continuum.

Henry, R. (1969) 'Horizontally Oriented Rotating Kinetic Painting', *Leonardo,* 2(3), pp. 239-250.

Herissone, R. (2000) *Music Theory in Seventeenth-Century England.* Oxford University Press.

Hero, B. (1975) 'Paintings Based on Relative Pitch in Music', *Leonardo,* 8(1), pp. 13-19.

Hero, B. (1978) 'Drawings Based on Laser Lissajous Figures and the Lambdoma Diagram', *Leonardo,* 11(4), pp. 301-303.

Higgins, D. (2001) 'Intermedia', *Leonardo,* 34(1), pp. 49-54.

Higgins, S. (1999) 'Technology and Aesthetics: Technicolor cinematography and design in the late 1930s', *Film History*, 11(1), pp. 55–76.

Hill, A. (1968) *DATA: Directions in Art, Theory and Aesthetics.* Greenwich, CT: New York Graphic Society Ltd.

Hill, A. (2010) 'What is Electroacoustic Audio-Visual Music ? Nomenclature and Cognition What is Electroacoustic Audio- Visual Music ?', in Wolf, M. and Hill, A. (eds.) *Proceedings of Sound, Sight, Space and Play.* Postgraduate Symposium for the Creative Sonic Arts. De Montfort University Leicester. pp. 2–4.

Hill, A. (2013) *Interpreting Electroacoustic Audio-visual Music*. PhD Thesis. [online] Available at: http://www.ahillav.co.uk/Research/Research.html [Accessed 6 Dec. 2018].

Hill, C. (1992) 'Interview with Woody Vasulka'. [online] Available at: http://www.vasulka.org/archive/Contributors/ChrisHill/InterviewWoodyVasulka.pdf [Accessed 6 Aug. 2018].

Hill, C. (1995) 'Program 5: Performance of Video-Imaging Tools', in Hill, C. ed. (1995) *REWIND A Guide to Surveying the First Decade: Video Art and Alternative Media in the U.S., 1968-1980*, Chicago: Video Data Bank, pp. 54-63.

Hill, C. ed. (1995b) *REWIND A Guide to Surveying the First Decade: Video Art and Alternative Media in the U.S., 1968-1980*, Chicago: Video Data Bank.

Hill, J. (1970) 'My Plexiglas and Light Sculptures', *Leonardo,* 3(1), pp. 9-17.

Hodin, J. P. (1951) 'Contemporary Art; Its Definition and Classification', *College Art Journal,* 10(4), pp. 337-354.

Hoenich, P. K. (1968) 'Kinetic Art with Sunlight: Reflections on Developments in Art Needed Today', *Leonardo,* 1(2), pp. 113-120.

Holbrook, J. (1834) *A familiar treatise on the fine arts, painting, sculpture, and music.* Kessinger Publishing.

Holsopple, J. L. (2003) *Toward a Poetic of Visual Music*, *Technology*. PhD Thesis. European Graduate School.

Holzier, D. (n.d). 'Vector Synthesis'. [online] Available at: http://macumbista.net/?page_id=4869 [Accessed 18 Dec. 2018].

Hope, M.J. (ed.) (1891) *Novalis: His Life, Thoughts, and Works*. A.C. McClurg. [online] Available at: https://archive.org/details/novalishislifet00hopegoog/page/n4 [Accessed 18 Dec. 2018].

Horricks, R. (2010) *Art That Moves: The Work of Len Lye*, Auckland University Press.

Hortusmusicae.blogspot.com. (2012) '*Los colores de la música*: *Olivier Messiaen y Charles Blanc-Gatti*'. [online] Available at: http://hortusmusicae.blogspot.com/2012/05/los-colores-de-la-musica-olivier.html [Accessed 18 Dec. 2018].

https://hsp.org/ (n.d) 'Mary Elizabeth Hallock Greenewalt and the Sarabet'. [online] Available at: https://hsp.org/blogs/fondly-pennsylvania/mary-elizabeth-hallock-greenewalt-and-the-sarabet [Accessed 11 Dec. 2018].

Hull, A. E. (1916) 'Scriabin's Scientific Derivation of Harmony versus Empirical Methods', in *Proceedings of the Musical Association*. Taylor & Francis, Ltd. on behalf of the Royal Musical Association, pp. 17–28.

Husserl, E. (1964) 'Philosophy as Rigorous Science', in Edmund Husserl, Phenomenology and the Crisis of Philosophy, trans. by Quentin Lauer (New York: Harper & Row), pp. 71–147 (pp. 110–11).

Hutschinson, N. (2012) *Colour Music in the new age: de-mystifying De Maistre*. [online] Web.archive.org. Available at: https://web.archive.org/web/20121020205813/http://home.vicnet.net.au/~colmusic/colour.htm [Accessed 6 Dec. 2018].

Hunt, A. *et al.* (1998) 'A generic model for compositional approaches to audiovisual media', *Organised Sound*. 3(3), pp. 199–209.

Hyde, J. (2012) 'Musique Concrète Thinking in Visual Music Practice: Audiovisual silence and noise, reduced listening and visual suspension', *Organised Sound,* 17(02), pp. 170-178.

Hyde, J. (2013) 'Oskar Fischinger's Synthetic Sound Machine', in Keefer, C. and Guldemond, J. (eds.) *Oskar Fischinger (1900-1967): Experiments in Cinematic Abstraction.* Amsterdam and Los Angeles: EYE Filmmuseum and Center for Visual Music.

Hyde, J. (2014) 'Editorial' *eContact! 15.4 – Videomusic: Overview of an Emerging Art Form*, 15(4). Montréal: *Communauté électroacoustique canadienne* / Canadian Electroacoustic Community.

Ikeshiro, R. (2012) 'Audiovisual Harmony: The realtime audiovisualisation of a single data source in Construction in Zhuangzi', *Organised Sound,* 17(02), pp. 148-155.

Imgardt, D. (1906) 'Zhivopis I revoliutsiia' (Painting and Revolution), *Zolotoe rum,*5 (1906): 59, in Bowlt, "Esoteric Culture and Russian Society'.

Ina.fr, I. (n.d.a). *Pierre Schaeffer à propos de la musique concrète*. [online] Ina.fr. Available at: https://www.ina.fr/video/I05028438 [Accessed 8 Dec. 2018].

Ina.fr, I. (n.d.b). *Jacques Brissot - Fer chaud*. [online] Available at: https://www.ina.fr/video/CPF86630617/fer-chaud-video.html [Accessed 9 Dec. 2018].

Institute, G. R. (2011) *G: an avant-garde journal of art, architecture, design, and film, 1923-1926*. London: Tate Publishing in association with the Getty Research Institute.

International Symposium on Visual Music (2012). Available at: http://www.adm.ntu.edu.sg/Research/Centre%20for%20Asian%20Art%20and%20Design/Pages/International-Symposium-on-Visual-Music.aspx. Available at: http://musicweb.ucsd.edu/pfiles/Chinary%203.pdf. [Accessed 17/1/2019].

IotaCenter (n.d.b.) About the Iota Center. Available at: http://iotacenter.org/about-iota-center/ [Accessed 17/1/2019].

Ittelson, W. H. (2007) 'The Perception of Nonmaterial Objects and Events', *Leonardo,* 40(3), pp. 279-283.

Itten, J. and Birren, F. (1970) *The elements of color: a treatise on the color system of Johannes Itten based on his book The art of color.* Wokingham: Van Nostrand Reinhold.

Itten, J. and Van Hagen, E., trans. (1973) *The art of color: the subjective experience and objective rationale of color.* 2nd edn. New York and London: John Wiley.

Itten, J (1963) (1975) *Design and form: the basic course at the Bauhaus.* Revised edn. London: Thames and Hudson.

Jablonsky, S. (1979) 'Graphic Artworks Based on Music: Musigraphs', *Leonardo,* 12(4), pp. 308-310.

James, D. E. (2005) 'Expanded Cinema in Los Angeles: The Single Wing Turquoise Bird', *Millennium Film Journal*, 43/44 (Summer 2005).

Jameson, D.D. (1844) *Colour-Music*, London: Smith, Elder and Co., 65, Cornhill.

Jennings, G. (2015) *Abstract video : the moving image in contemporary art*. California: University of California Press.

Jensenius, A. R. (2013) 'Some Video Abstraction Techniques for Displaying Body Movement in Analysis and Performance', *Leonardo,* 46(1), pp. 53-43.

Jentzsch, W. (2014) 'Interactive processes between images and sounds', *Japanese Society for Sonic Arts*. Tokyo: JSSA. [online] Available at: http://wilfried-jentzsch.de/wordpress/wp-content/uploads/2013/01/Jentzsch_JSSA2014.pdf [Accessed 14 March, 2019].

Jewanski, J. (2001) 'Colour and Music', *Grove Music Online. Oxford Music Online.*, [electronic version] Available: Oxford University Press [Accessed 14 March, 2014].

Jewanski, J. (1997) 'Die Farblichtmusik Alexander Lászlós', *Zeitschrift für Kunstgeschichte,* 60(1), pp. 12-43.

Jewanski, J. (1999) 'What is the color of the tone?', *Leonardo,* 32(3), pp. 227-228.

Jewanski, J. & Sidler, N. (2006) 'Eine neue Kunstform-die Farblichtmusik Alexander Laszlo'. Bern: Peter Lang Verlag.

Jewanski, J. (2009) 'Colour-Light Music' [online] http://www.see-this-sound.at. Available at: http://www.see-this-sound.at/works/494.html [Accessed 11 Dec. 2018].

Jewanski, J. (2010) 'Color-Tone Analogies: A Systematic Presentation of the Principles of Correspondence', in Daniels, D. and Naumann, S. (eds.) (2010) *Audiovisuology. Compendium: An Interdisciplinary Survey of Audiovisual Culture*. Cologne: Verlag der Buchhandlung Walther König, pp. 339-347.

Jewanski, J. (2011a) 'Color-Tone Analogies', in D. Daniels, *et al.* (2009) *See this Sound.* Linz: Lentos Kunstmuseum Linz.

Jewanski, J. (2011b) 'Color Organs', in D. Daniels, *et al.* (2009) *See this Sound.* Linz: Lentos Kunstmuseum Linz.

Jewanski, J. (2012) 'The Visions of Oskar Fischinger and Alexander László in 1935/36 about a New Way of Visualizing Music', In: Keefer, C. *et al.* Oskar Fischinger (1900-1967), pp. 135-138.

Johnson, C. G. and Cardalda, J. J. R. (2002) 'Introduction: Genetic Algorithms in Visual Art and Music', *Leonardo,* 35(2), pp. 175-184.

Johnson, M. (1987) *Body in the Mind: the bodily basis of meaning, imagination, and reason.* Chicago; London: University of Chicago Press.

Jones, R. and Nevile, B. (2005) 'Creating Visual Music in Jitter: Approaches and Techniques', *Computer Music Journal,* 29(4), pp. 55-70.

Jones, S. (2003) 'Synthetics: A History of the Electronically Generated Image in Australia', *Leonardo,* 36(3), pp. 187-195.

Jones, T. D. (1972) *The Art of Light and Color: featuring mobile color expression, lumia, kinetic light, with instructions for the creation of dramatic color and light instruments.* New York ; London : Van Nostrand-Reinhold.

Jones, T. and Crawford, J. C. (1980) 'Music and Visual Color', *Leonardo*, 13(4), p. 349.

Jordon, E. 'Norman McLaren: His Career and Techniques', *The Quaterly of Film Radio and Television*, 8(1). University of California Press.

Junod, P. (1998) 'Blanc-Gatti, Charles Jules Ernest'. [online] Sikart.ch. Available at: http://www.sikart.ch/KuenstlerInnen.aspx?id=9639023 [Accessed 18 Dec. 2018].

Junod, P. (2017) *Counterpoints: Dialogues between Music and the Visual Arts,* trans. S. Brown. Reaction Books.

Jäger, G. (1998) 'Animato: The Work of Art in the Age of Potential Electronic Manipulation. Audio-Visual Paraphrases of the Painting "K XVII" (1923)', *Leonardo,* 31(3), pp. 179-181.

Kaes, A. (2012) 'The Absolute Film' in Dickerman, L. and Chlenova, M. (eds.) (2012) *Inventing Abstraction*. New York: Thames & Hudson.

Kagan, A. (1983) *Paul Klee: Art & Music.* New York: Cornell University Press.

Kagan (1995b) 'Ut Pictura Musica to 1860', *Absolute Art*. St. Louis: Grenart Books, pp. 73-99.

Kaduri, Y. (2016) 'Introduction: Audiovisual Spaces of Physical Comprehension' in Kaduri, Y. (ed.) *The Oxford Handbook of Sound and Image in Western Art*. New York: Oxford University Press.

Kaduri, Y. (ed.) (2016) *The Oxford Handbook of Sound and Image in Western Art*. New York: Oxford University Press.

Kandinsky, W. (1911) 'Arnold Schoenberg and Vassily Kandinsky, Correspondence' in Albright, D. (ed.) *Modernism and Music: An Anthology of Sources.* Chicago and London: University of Chicago Press.

Kandinsky, W. (1912) 'On the Spiritual in Art' in Lindsey, K.C. and Vergo, P. (eds.) (1982) *Kandinsky: Complete Writings on Art.* Boston: G.K. Hall.

Kandinsky, W. (1912) 'Sounds' in Lindsey, K.C. and Vergo, P. (eds.) (1982) *Kandinsky: Complete Writings on Art.* Boston: G.K. Hall.

Kandinsky, W. (1912) 'The Blaue Reiter Almanac [*Der Blaue Reiter*]' in Lindsey, K.C. and Vergo, P. (eds.) (1982) *Kandinsky: Complete Writings on Art.* Boston: G.K. Hall.

Kandinsky, W. (1913) 'Painting as Pure Art [*Malerei als reine Kunst*], *Der Sturm*' in Lindsey, K.C. and Vergo, P. (eds.) (1982) *Kandinsky: Complete Writings on Art.* Boston: G.K. Hall.

Kandinsky, W. (1920) 'Program for the Institute of Artistic Culture' [*Programma Instituta Khudozhestvennoi Kultury*] (Moscow, 1920) in Lindsey, K.C. and Vergo, P. (eds.) (1982) *Kandinsky: Complete Writings on Art.* Boston: G.K. Hall.

Kandinsky, W. (1921) 'Plan for the Physico-psychological Department of the Russian Academy of Artistic Sciences', in Harrison, C. and Wood. P. (eds.) (1999) *Art in Theory 1900-2000: An Anthology of Changing Ideas*. Oxford: Blackwell, pp. 301-303.

Kandinsky, W. (1936) 'Abstract Painting ["*Absrakte Malerei"] Kroniek van hedendaagsche Kunst en Kultur*', Lindsey, K.C. and Vergo, P. (eds.) (1982) *Kandinsky: Complete Writings on Art.* Boston: G.K. Hall.

Kandinsky, W. (1972) *Concerning the Spiritual in Art.* Sadlier, M.T.H. trans, *et al*. New York: Dover Publications.

Kandinsky, W. (1979) *Point and Line to Plane*. Dearstyne, H. and Rebay, H. trans. Reprint. New York: Dover.

Kane, B. (2007) '*L'Objet Sonore Maintenant*: Pierre Schaeffer, sound objects and the phenomenological reduction', *Organised Sound*, 12(1), pp. 1-10.

Kane, B. (2012) 'Acousmate: History and de-visualised sound in the Schaefferian tradition', *Organised Sound,* 17(02), pp. 179-188.

Kane, B. (2013) 'Book review.' Review of North, C. and Dack, J, trans. (2012) *Pierre Schaeffer, In Search of a Concrete Music*. Berkeley: University of California Press. *Organised Sound*, 18(3), pp. 346–348.

Kane, B. (2014) 'Pierre Schaeffer, the Sound Object, and the Acousmatic Reduction', in Kane, B. *Sound Unseen: Acousmatic Sound in Theory and Practice*, Oxford: Oxford University Press, pp. 15–41.

Kane, B. (2014b) *Sound Unseen: Acousmatic Sound in Theory and Practice*, Oxford: Oxford University Press.

Kane, C. (2013) 'The Electric "Now Indigo Blue": Synthetic Color and Video Synthesis Circa 1969', *Leonardo,* 46(4), pp. 360-366.

Kant, I. (1784) *An Answer to the Question: "What is Enlightenment?".* Project Gutenberg Consortia Center Collection.

Kapuscinski, J. (1998) 'Basic Theory of Intermedia Composing with Sounds and Images', *Monochord. De musica acta, studia et commentarii,* Vol. XIX, *ss.* 43-50. [online] Available at: http://jaroslawkapuscinski.com/pdf/composing-sound-images.pdf [Accessed 18 Dec. 2018].

Kargon, J. (2011) 'Harmonizing These Two Arts: Edmund Lind's "The Music of Color"', *Journal of Design History,* 24(1), pp. 1-14.

Karinthi, P. Y. (1991) 'A Contribution to Musicalism: An Attempt to Interpret Music in Painting', *Leonardo,* 24(4), pp. 401-405.

Karlstrom, P. J. ed. (1996), *On the Edge of America : California Modernist Art, 1900–1950.* Los Angeles : University of California Press.

Karwoski, T. F., Odbert, H. S. and Osgood, C. E. (1942) 'Studies in Synesthetic Thinking: II. The Role of Form in Visual Responses to Music', *The Journal of General Psychology,* 26(2), pp. 199-222.

Katherine, L. (2004) 'Color Intervals: Applying Concepts of Musical Consonance and Dissonance to Color', *Leonardo,* 37(2), pp. 127-132.

Keefer, C (2005). 'Space Light Art — Early Abstract Cinema and Multimedia, 1900–1959', *White Noise*. [Catalogue]. Melbourne : ACMI — Australian Centre for the Moving Image.

Keefer, C. and Ox, J. (2005) 'On Curating Recent Digital Abstract Visual Music'*, in Abstract Visual Music Catalog.* New York: New York Digital Salon.

Keefer, C. (2013) 'Optical Expression: Oskar Fischinger, William Moritz and Visual Music. An Edited Guide to the Key Concerns' in Keefer, C. and Guldemond, J. (eds.) *Oskar Fischinger (1900-1967): Experiments in Cinematic Abstraction.* Amsterdam and Los Angeles: EYE Filmmuseum and Center for Visual Music.

Keefer, C. and Guldemond, J. (eds.) (2013) *Oskar Fischinger (1900-1967): Experiments in Cinematic Abstraction.* Amsterdam and Los Angeles: EYE Filmmuseum and Center for Visual Music.

Keefer, C. (2015) 'Visual Music's influence on Contemporary Abstraction' in Jennings, G. and Mondloch, K. (eds.) *Abstract Video: The Moving Image in Contemporary Art.* California: University of California Press.

Keefer, C. (n.d.). *Oskar Fischinger: Raumlichtkunst.* [online] Available at: http://weinstein.com/exhibitions/oskar-fischinger-raumlichtkunst/

Key, M. (1899) 'A New System of Art Education: Arranged and Directed by Arthur W. Dow', *Brush and Pencil*, 4(5), pp. 258–271. [online] Available at: http://journalstar.com/brush-and-shine/image_ceddd78a-5b80-5323-a580-80fcf57138b1.html. [Accessed 11 Dec. 2018].

Kim, T. (2018) 'Reflection of light as a methodology for new lumia', Conference Presentation, Seeing Sound 2018 – Bath Spa University.

'Kinetic Art: Third Conference on 'Light and Music', Kazan, U.S.S.R., 27 June-4 July, 1975', (1976) *Leonardo,* 9(3), pp. 238-239.

Kircher, A. (1646) *Ars magna lucis et umbrae.* [online] http://www.bibliotheque-numerique-cinema.fr/notice/?i=33087 [Accessed 11 Dec. 2018].

Kirn, P. (2015) 'Watch the Clavilux, an ethereal light organ from 100 years ago', in *CDM Create Digital Music*. [online] Available at: http://cdm.link/2015/08/watch-clavilux-ethereal-light-organ-100-years-ago/ [Accessed 11 Dec. 2018].

Klee, P. (1924) 'from *On Modern Art*' in Harrison, C. and Wood. P. (eds.) (1999) *Art in Theory 1900-2000: An Anthology of Changing Ideas*. Oxford: Blackwell, pp. 343-350.

Klee, P. (1923) (1973) *The Nature of Nature*, in Spiller, J (ed.) and Norden, H. trans. (1973) *Paul Klee - notebooks. Vol.2, The nature of nature*. London: Lund Humphries.

Klee, P. (1953) *Pedagogical Sketchbook,* trans. S. Moholy-Nagy. New York: Praeger.

Klee, P. (1956) *The Thinking Eye,* trans, Humphries, L. (1961) *Paul Klee Notebooks, Volume 1, The Thinking Eye.* London: Wittenborn.

Klee, P. (1964) *The Diaries of Paul Klee 1898-1918.* Translated by F. Klee. California: University of California Press.

Klee, P. (1970) *Paul Klee Notebooks, Volume 2, The Nature of Nature*, trans. Norden, H. (1973). London: Lund Humphries.

Klee, P. (October 3, 2013) *Paul Klee: Creative Confession (Artist's Writings).* Kindle Edition edn.: Tate Publishing.

Klein, A. B. L. (1926) *Colour-Music. The Art of Light.* London: Lockwood.

Klein, A. B. L. (1937) *Coloured light, an art medium, being the 3d ed. enl. of* "*Colour-music*"*.* London: The Technical Press, Ltd.

Kline, M. (1953) *Mathematics in Western culture*. New York: Oxford University Press.

Koleychuk, V. F. and Polyakoff, V. (1994) 'The Evolution of My Kinetic Work', *Leonardo,* 27(5), pp. 395-398.

Korot, B. (1988) 'Language as Still Life: From Video to Painting', *Leonardo,* 21(4), pp. 367-370.

Korsgaard, M. B. (2013) 'Music Video Transformed', in Richardson, J., Gorbman, C. and Vernallis, C. (eds.) (2013) *The Oxford Handbook of New Audiovisual Aesthetics*. Oxford and New York: Oxford University Press.

Koshkina, V. (2018) 'From the Space Program to Soviet Video Art: The Film Experiments of Bulat Galeev', *Russian Literature*, 96-98(February-May), pp. 195-220.

Kristeller, P. O. (1951) 'The Modern System of the Arts: A Study in the History of Aesthetics Part I', *Journal of the History of Ideas,* 12(4), pp. 496-527.

Kristeller, P. O. (1952) 'The Modern System of the Arts: A Study in the History of Aesthetics (II)', *Journal of the History of Ideas,* 13(1), pp. 17-46.

Kuehni, R. G. & Schwarz, A. (2008) *Color Ordered: A Survey of Color System from Antiquity to the Present.* New York: Oxford University Press.

Kuehni, R.G. (2003) *Color Space and its Divisions: Color Order from Antiquity to the Present.* New Jersey and Canada: John Wiley & Sons, Inc.

Kuehni, R.G. (2008) *Philipp Otto Runge's Color-Sphere. A Translation, with Related Materials and an Essay.* iscc-archive.org. [online] Available at: http://www.iscc-archive.org/pdf/RungeFarben-Kugel.pdf [Accessed: 4 Aug. 2018].

Kulle, D. (2014) 'Der absolute Film. Dokumente der Medienavantgarde (1912–1936)', *Historical Journal of Film, Radio and Television,* 34(1), pp. 146-148.

Kursell, J. (2013) 'Experiments on Tone Color in Music and Acoustics: Helmholtz, Schoenberg, and *Klangfarbenmelodie*', *Osiris*, 28(1), pp. 191–211.

Lakoff, G. (1987) *Women, fire, and dangerous things: what categories reveal about the mind.* Chicago; London: University of Chicago Press.

Lambert, N. (2003) *A Critical Examination of 'Computer Art'.* PhD Thesis, University of Oxford. [online] Available at: http://computer-arts-society.com/static/cas/computerartsthesis/index.html [Accessed: 4 Apr. 2018].

Lambert, N. (2011) 'From Imaginal to Digital: Mental Imagery and the Computer Image Space', *Leonardo,* 44(5), pp. 439-443.

Land, R. I. (1968) 'Non-Verbal 'Discussion' Using Music and Kinetic Painting', *Leonardo,* 1(2), pp. 121-123.

Land, R. I. (1969) 'Computer Art: Color-Stereo Displays', *Leonardo,* 2(4), pp. 335-344.

Land, R. I. (1972) 'Kinetic Art: The Chromara, a Lumia Technique', *Leonardo,* 5(2), pp. 103-109.

Landy, L. (2007) *Understanding the Art of Sound Organization*, London: The MIT Press.

Landy, L. (n.d.) Journal home Organised Sound. [Online] Available at: https://www.cambridge.org/core/journals/organised-sound (Accessed: 2/04/2014).

Langer, S.K. (1964) 'Abstraction in Art', *The Journal of Aesthetics and Art Criticism*, 22(4), pp. 379-392.

Lapelletrie, F. (2008) 'Life of Frank Joseph Malina', *International Festival for art, science and new technologies*, Prague, Czech Republic, pp.16-27.

Laposky, B. F. (1969) 'Oscillons: Electronic Abstractions', *Leonardo,* 2(4), pp. 345-354.

Larry, J. and Daruska, D. (1979) 'Oskar Fischinger: An Interview with Elfriede Fischinger', *Zeotrope: The Publication of Commerical and Experimental Media.*

Laurence de Bourbon, B. and Wybo, J. L. (1986) 'Synergetic Pendulums: Imagery, Mechanics and Mathematics', *Leonardo,* 19(3), pp. 201-205.

Lawder, S. D. (1967) *Structuralism and Movement in Experimental Film and Modern Art, 1896-1925.* PhD Yale University, Fine Arts. Connecticut.

Lawder, S. D. (1975) *The Cubist Cinema*. New York: New York University Press.

Laziza, K. (1996) 'Laziza Videodance and Lumia Project: The Intersection of Dance, Technology and Performance Art', *Leonardo,* 29(3), pp. 173-182.

Leggio, J. (ed.) (2002a) *Music and Modern Art*. New York and London: Routledge.

Leggio, J. (2002b) 'Kandinsky, Schoenberg, and the Music of the Spheres', in Leggio, J. ed. *Music and Modern Art*. New York and London: Routledge.

Lenlyefoundation.com. (2018). The Len Lye Foundation - Swinging the Lambeth Walk, 1939. [online] Available at: http://www.lenlyefoundation.com/films/swinging-the-lambeth-walk/28/ [Accessed 20 Dec. 2018].

Leman, M. (2008) *Embodied music cognition and mediation technology.* London: MIT.

Lessing, G. E. (1776) *Laocoon: an essay upon the limits of painting and poetry.* Frothingham, E. trans. (1957). New York: Noonday Press

Lessing, G. E. (1957) *Laocoon: an essay upon the limits of painting and poetry.* New York: Noonday Press.

Lespressesdureel.com. (n.d.). Vertiginous Parallels – Les presses du réel (book). [online] Available at: http://www.lespressesdureel.com/EN/ouvrage.php?id=3859 [Accessed 11 Dec. 2018].

Levin, Gail. (1998) *Synchromism and American Color Abstraction, 1910-1925.* New York: George Brazillier.

Levin, G. (2000) *Painterly Interfaces for Audiovisual Performance.* M.S. Thesis. Massachusets Institute of Technology Media Laboratory.

Levin, T. Y. (2003) ' "Tones from out of Nowhere": Rudolph Pfenninger and the Archaeology of Synthetic Sound', *Grey Room*, 12(Summer), pp. 32–79.

Levine, J. (2000) 'Experimental Visual Experience Devices', *Leonardo,* 33(1), pp. 27-32.

Levinson, J. (2006) *Contemplating Art: Essays in Aesthetics.* Oxford: Clarendon.

Levinson, J. (2011) *Music, art, and metaphysics: essays in philosophical aesthetics.* Oxford: Oxford University Press.

Levon, A. G. (1995) 'Color-Thermal Associations in Music', *Leonardo,* 28(1), pp. 57-58.

Liebich, M. F. (1923) 'Sight and Sound: 'Eye-Music'', *The Musical Times,* 64(963), pp. 310-311.

Lindberg, D. C. (1986) 'The Genesis of Kepler's Theory of Light: Light Metaphysics from Plotinus to Kepler', *Osiris,* 2, pp. 4-42.

Lindsey, K.C. & Vergo, P. *et al.*, (1982) *Kandinsky, Complete Writings on Art.* Boston, Mass.: G.K.Hall.

Liu, Y. (2010) 'Visual Art as Research: Explorations with Sona Drawings', *Leonardo,* 43(2), pp. 128-131.

Lockspeiser, E. (1973) *Music and Painting: A Study in comparative Ideas from Turner to Schoenberg.* London: Cassell.

Lowengard, S. (2008, c2007) *The Creation of Color in Eighteenth-Century Europe.* Columbia University Press.

Lubar, K. (2004) 'Color Intervals: Applying Concepts of Musical Consonance and Dissonance to Color', *Leonardo,* 37(2), pp. 127-132.

Lucas, P. 'Sixties Synaesthetics'. [Screening Programme] *Visual Music. Sensory Cinema 1920s - 1970s*, Northwest Film Forum, Seattle, WA, April 14, 2014. [online] http://sprocketsociety.org/pdf/Visual-Music-Sixties-Synaesthetics-program-notes.pdf [Accessed 9 Dec. 2018].

Lucassen, T. (2008) Color Organs, *University of Twente*. [online] Available at: https://pdfs.semanticscholar.org/229e/239ab7e955886d0e553e1e50f73d2257df97.pdf [Accessed 9 Dec. 2018].

Luxonline.org.uk. (2005) 'Malcolm Le Grice'. [online] Available at: http://www.luxonline.org.uk/artists/malcolm_le_grice/ [Accessed 9 Dec. 2018].

Lye, L. & Riding, L (1935, 1938) 'Filmmaking – Movement as Language and Movement as a Medium', *Epilogue*.

Lye, L. (1984) 'The Art That Moves' in Curnow, W. and Horrocks, R. (1984) *Figures of motion: Len Lye selected writings.* Auckland (N.Z.): Auckland University Press: Oxford University Press.

Lye, L., Watkins, J., Cann, T. and Ikon Gallery. (2011) *Len Lye: The Body Electric.* Birmingham: Ikon Gallery.

Lyons, A. D. (2003) *Time Space Texture: An Approach to Audio-Visual Composition.* PhD Thesis. The University of Sydney, Australia.

MacDonald, S. (2006) *Art in Cinema: Documents Toward a History of the Film Society.* Temple University Press.

MacDonald-Wright, S. (1924) *A Treatise on Colour.* Los Angeles, Calif., S.M.Wright (1924).

Malevich, K. (1919) 'Non-Objective Art and Suprematism', in Harrison, C. and Wood. P. (eds.) (1999) *Art in Theory 1900-2000: An Anthology of Changing Ideas*. Oxford: Blackwell, pp. 292-297.

Malevich, K. (1920) *The Question of Imitative Art*, in Harrison, C. and Wood. P. (eds.) (1999) *Art in Theory 1900-2000: An Anthology of Changing Ideas*. Oxford: Blackwell, pp. 292-297.

Malina, F. (1954) *Transparent Sinusoidal* (*Credit photo : Fabrice Lapelletrie*). [image] Available at: http://www.olats.org/pionniers/malina/bdd/oeuvre.php?oi=642 [Accessed 9 Dec. 2018].

Malina, F. (1955) *Jazz* (*Credit photo : Fabrice Lapelletrie*). [image] Available at: http://www.olats.org/pionniers/malina/bdd/oeuvre.php?oi=1201 [Accessed 9 Dec. 2018].

Malina, F. (1964) *Frank Malina, Flowers, Reflectodyne system, 1964.* [video] Youtube.com. Available at: https://youtu.be/Kenu8DZ8Xp8 [Accessed 9 Dec. 2018].

Malina, F. (1965) *The Cosmos* (*Credit photo : DR*). [image] Available at: http://www.olats.org/pionniers/malina/bdd/oeuvre.php?oi=2286 [Accessed 9 Dec. 2018].

Malina, F. (1966) *Frank-Joseph Malina, Peinture cinétique (1966).* [image] Fondation-langlois.org. Available at: http://www.fondation-langlois.org/html/e/media.php?NumObjet=68400 [Accessed 9 Dec. 2018].

Malina, F. (1966b) *Frank Malina, Sink and Source, 3-component Lumidyne system, 1966.* [video] Youtube.com. Available at: https://youtu.be/dA0DGdCOX0E [Accessed 9 Dec. 2018].

Malina, F. J. (1968a) 'Some Reflections on the Differences Between Science and Art', in Hill, A. (ed.) *DATA: Directions in Art Theory and Aesthetics*. Greenwich, Conn.: New York Graphic Society.

Malina, F. J. (1968b) 'Kinetic Painting: The Lumidyne System', *Leonardo,* 1(1), pp. 25-33.

Malina, F. (1968c) *Entrechats II (1966).* [image] dada.compart-bremen.de. Available at: http://dada.compart-bremen.de/item/artwork/669 [Accessed 9 Dec. 2018].

Malina, F. J. and Schaeffer, P. (1972) 'A Conversation on Concrete Music and Kinetic Art', *Leonardo,* 5(3), pp. 255-260.

Malina, F.J. (ed.) (1974a) *Kinetic Art: Theory and Practice. Selections from the Journal Leonardo*. New York: Dover Publications, Inc.

Malina, F. J. (1974b) 'Kinetic Painting: The Lumidyne System', in Malina, F.J. (ed.) (1974) *Kinetic Art: Theory and Practice. Selections from the Journal Leonardo*. New York: Dover Publications, Inc.

Malina, F. J. (1975) 'Electric Light as a Medium in the Visual Fine Arts: A Memoir', *Leonardo,* 8(2), pp. 109-119.

Malina, F. J. (1987a) 'Electric Light as a Medium in the Visual Fine Arts: A Memoir', *Leonardo,* 20(4), pp. 407-415.

Malina, F. J. (1987b) 'Kinetic Painting: The Lumidyne System', *Leonardo,* 20(4), pp. 400-406.

Malina, F. J. (2007) 'Kinetic Painting: The Lumidyne System', *Leonardo,* 40(1), pp. 81-90.

Malina, R. F. (1987) 'Editorial: Visual Art, Sound, Music and Technology', *Leonardo,* 20(2), pp. 103-105.

Malina, R. F. (2011) *Homage to Frank J. Malina*. [online] Olats.org. Available at: http://www.olats.org/OLATS/pionniers/homage_to_frank_j__malina.shtml [Accessed 9 Dec. 2018].

Mallary, R. (1990) 'Spatial-Synesthetic Art through 3-D Projection: The Requirements of a Computer-Based Supermedium', *Leonardo,* 23(1), pp. 3-16.

Mandelbrojt, J. (2003) 'Introduction: Intersenses and New Technologies', *Leonardo,* 36(4), pp. 311.

Mandelbrojt, J., Frémiot, M. and Malina, R. F. (1999) 'Introduction: The Aesthetic Status of Technological Art', *Leonardo,* 32(3), pp. 211-215.

Manning, P. (2012) 'The Oramics Machine: From vision to reality', *Organised Sound,* 17(02), pp. 137-147.

Mannoni, L. and Crangle, R. (2006) 'Henri Langlois and the Musée du Cinéma', *Film History,* 18(3), pp. 274-287.

Marchese, S. M. and Marchese, F. T. (1995) 'Digital Media and Ephemeralness: Art, Artist, and Viewer', *Leonardo,* 28(5), pp. 433-435.

Martinoya, C. and Joël, N. (1968) 'The 'Chromatic Abstractoscope': An Application of Polarized Light', *Leonardo,* 1(2), pp. 171-173.

Masashi, O. (2003) 'Music-Picture: One Form of Synthetic Art Education', *The Journal of Aesthetic Education,* 37(4), pp. 73-84.

Mason, W. (1958) 'Father Castel and His Color Clavecin', *The Journal of Aesthetics and Art Criticism*, 17(1), pp. 103-116

Massey, (2006) 'Organic Architecture and Direct Democracy: Claude Bragdon's Festivals of Song and Light', *Journal of the Society of Architectural Historians*, 65(4), pp. 578-613.

Mastropietro, A. (2011) 'Music Theatre as Space–Time Reversal: Aldo Clementi from 1961 to 1979', *Contemporary Music Review,* 30(3-4), pp. 212-232.

Matthew, S. (2001) 'Imaging Music: Abstract Expressionism and Free Improvisation', *Leonardo Music Journal,* 11(1), pp. 29-34.

Mattis, O. (2005) 'Scriabin to Gershwin: Colour Music from a Musical Perspective', in Brougher, K *et al. Visual Music: Synaesthesia in Art and Music Since 1900.* New York: Thames and Hudson.

Maur, K. (1999) *The Sound of Painting: Music in Modern Art.* Pegasus library Munich; London: Prestel.

Meier-Graefe, J. (1904) 'The Mediums of Art, Past and Present' in Harrison, C., *et al.* (1999) *Art in Theory 1900-2000: An Anthology of Changing Ideas*. Oxford: Blackwell, pp. 53-60.

McBurney, G. 'Colour and Music', *The Oxford Companion to Music*. New York: Oxford University Press, pp. 272-274.

McDonnell, M. (1998/1999) *An Analysis of the Concept of Harmony in the Audiovisual Composition 'Towards One''*. Master's Thesis. Trinity College, Dublin.

McDonnell, M. (2002) *Colour and Sound: Visual Music*. [online] Available at: http://homepage.eircom.net/~musima/visualmusic/visualmusic.htm

McDonnell, M. (2003) *Notes for Lecture on Visual Music* [Lecture to M.Phil in Music and Media Technologies Year 2], *Music and Image*. Trinity College, Dublin. [online] Available at: www.soundingvisual,com/visualmusic/visualmusic2003_2004.pdf [Accessed 1 Oct. 2013].

McDonnell, M. (2004) 'Visual Music Resources - 2004', [online] Available at: https://www.academia.edu/1740143/Visual_Music_Resources_-_2004 [Accessed 9 Dec. 2018].

McDonnell, M. (2007) 'Visual Music' in *Visual Music Marathon*, [Programme Catalogue], Boston.

McDonnell, M. (2007b) Author conversation with Cuba at Visual Music Marathon, Boston.

McDonnell, M. (2009) 'Visual Music' in *Visual Music Marathon*, [Programme Catalogue], New York.

McDonnell, M. (2010) 'Visual Music - a composition of the 'things themselves', in *Sounding Out 5*.

McDonnell, M. (2012) *Maura McDonnell – Visual Music Research Topic*. [slideshare] Available at: https://www.slideshare.net/webexistential/maura-mcdonnell-visual-music-research-topic [Accessed 9 Dec. 2018].

McDonnell, M. (2014a) 'Visual Music' in *eContact! 15.4 — Videomusic: Overview of an Emerging Art Form* (April / avril 2014). Montréal: Communauté électroacoustique canadienne / Canadian Electroacoustic Community.

McDonnell, M. (2014b) 'A Composition of the "Things Themselves": Visual music in practice' in *eContact! 15.4 — Videomusic: Overview of an Emerging Art Form* (April / avril 2014). Montréal: Communauté électroacoustique canadienne / Canadian Electroacoustic Community.

McDonnell, M. (2018) 'The Visual Music Imagination: The Sounding of Images and the Imaging of Sounds', in Riccò, D. and de Cordoba, M.J., eds. (2018) *MuVi. Video and moving image on synesthesia and visual music*, Granada: Ediciones Fundación Internacional Artecittà [Book + DVD]

McLaren, N. (1949) 'Begone Dull Care' in McWilliams, D. (ed.) (1991) *Norman McLaren: On the Creative Process.* Montreal: National Film Board of Canada, pp. 82-84.

McLaren, N. (1952) 'A Brief Summary Of The Early History Of Animated Sound On Film (From Available Information)' Unpublished. Montreal: National Film Board of Canada. [online] http://www3.nfb.ca/archives_mclaren/items/01.pdf [Accessed 1 Oct. 2018].

McLaren, N. (1968) 'Music', in McWilliams, D. (ed.) (1991) *Norman McLaren: On the Creative Process.* Montreal: National Film Board of Canada, pp. 29-31.

McLaren, N. (1968b) 'Cinema, An Art of Motion, in McWilliams, D. (ed.) (1991) *Norman McLaren: On the Creative Process.* Montreal: National Film Board of Canada, pp. 17-19.

McLaren, N. (1974) 'Statement on My Own Work', St. James Press Film Book Series, London. [online] Available at: http://www3.nfb.ca/archives_mclaren/items/37.pdf. [Accessed 1 Oct. 2018].

McLaren, N. (1974b) 'A Work of Art' in McWilliams, D. (ed.) (1991) *Norman McLaren: On the Creative Process.* Montreal: National Film Board of Canada, pp. 20-28.

McLaren, N. (1977) 'Interview', Norman McLaren: Exhibition and films. Scottish Arts Council: Edinburgh.

McLaren, N. (1984) 'Synchromy (1971) in McWilliams, D. (ed.) (1991) *Norman McLaren: On the Creative Process.* National Film Board of Canada, pp. 91-93.

McLaren, N, (1985) 'Boogie-Doodle' in McWilliams, D. (ed.) (1991) *Norman McLaren: On the Creative Process.* Montreal: National Film Board of Canada, pp. 58-59.

McLaren, N. (1991) 'Music' in McWilliams, D. (ed.) (1991) *Norman McLaren: On the Creative Process.* Montreal: National Film Board of Canada, pp. 29-33.

McLaren, N. (1991) 'Norman McLaren: On the Creative Process', *Journal of Heat Transfer*, 125 (June).

McMurray, P. (2007) 'Boston Cyberarts Festival: Visual Music Marathon/ The Puppet Master by Eric Chasalow', [Review] *Computer Music Journal*, 31(4), pp. 71-75.

McWilliams, D. (ed.) (1991) *Norman McLaren: On the Creative Process.* Montreal: National Film Board of Canada.

Meigh-Andrews, C. (2007) 'Peter Donebauer, Richard Monkhouse and the Development of the EMS Spectron and the Videokalos Image Processor', *Leonardo,* 40(5), pp. 463-451.

Meigh-Andrews, C. (2014) *A History of Video Art*. New York, London: Bloomsbury

Miller, D. H. (n.d.) 'Dennis H. Miller: Residue', ACM Siggraph. Art Show Archives. [online] Available at: https://digitalartarchive.siggraph.org/artwork/dennis-h-miller-residue/ [Accessed 19 Nov. 2018].

Milton, B. H. (1969) 'My Thermoformed Plastic Audio-Kinetic Light Sculpture Since 1966', *Leonardo,* 2(4), pp. 411-412.

Moholy-Nagy, L. (1925) *Malerei, Fotographie, Film* (Painting, Photography, Film).

Moholy-Nagy, L. (1932) *The New Vision: From Material to Architecture*. Hoffman, D., trans. New York: Brewer, Warren & Putnam Inc.

Mollaghan, A. (2011) *The musicality of the visual music film.* PhD Thesis, University of Glasgow [Online] Available at: http://theses.gla.ac.uk/3205/ [Accessed 19 Nov. 2018].

Mollaghan, A. (2015) *The visual music film.* Palgrave Macmillan UK.

Molnar, F. and Molnar, V. (1989) 'Noise, Form, Art', *Leonardo,* 22(1), pp. 15-20.

Moma.org. (2018) 'Léopold Survage. Colored Rhythm: Study for the Film. (1913) | MoMA'. [online] Available at:https://www.moma.org/collection/works/85509?association=series&locale=en&page=1&parent_id=37752&sov_referrer=association [Accessed 10 Dec. 2018].

Monoskop.org. (2016) 'Zolotoe runo – Monoskop'. [online] Available at: https://monoskop.org/Zolotoe_runo [Accessed 13 Dec. 2018].

Monoskop.org. (2016b) 'Viking Eggeling – Monoskop'. [online] Available at: https://monoskop.org/Viking_Eggeling [Accessed 19 Dec. 2018].

Morgan, D. (1992) 'The Idea of Abstraction in German Theories of the Ornament from Kant to Kandinsky', *The Journal of Aesthetics and Art Criticism,* 50(3), pp. 231-242.

Moritz, W. (1972) 'Three Books: On Experimental Cinema', *Film Quaterly*, 25(4), pp. 31-34.

Moritz, W. (1974) 'The Films of Oskar Fischinger', *Film Culture* 58-59-60, pp. 37 - 187.

Moritz, W. (1977) 'Fischinger at Disney - or Oskar in the Mousetrap', *Millimeter. 5. 2* (1977): 25-28, 65-67.

Moritz, W. (1977b) William Moritz on James Whitney's Yantra and Lapis. [Manuscript] CVM, Fischinger Archive and CVM. [online] http://www.centerforvisualmusic.org/WMyantra.htm [Accessed 20 Dec. 2018].

Moritz, W. (1978) 'Beyond "Abstract" Criticism', *Film Quarterly,* 31(3), pp. 29-39.

Moritz, W. (1979) 'Non-Objective Film, The Second Generation', *Film as Film, Formal Experiments in Film 1910-1975,* London: Hayward Gallery/Arts Council of Great Britain. [online] Available at: http://www.centerforvisualmusic.org/MoritzNonObjFilm.htm [Accessed 19 Dec. 2018].

Moritz, W. (1985) 'Towards a Visual Music', *Cantrillis Filmnotes,* Nos. 47/48. Melbourne, pp. 35-42.

Moritz, W. (1986) 'Towards an Aesthetic of Visual Music', *ASIFA Canada*, 14(3). Montreal: ASIFA Canada, pp. 1-3.

Moritz, W. (1996) 'Visual Music and Film-As-An-Art before 1950' in Karlstrom, P.J., ed., *On the Edge of America: California Modernist Art, 1900-1950*. Berkeley: University of California Press.

Moritz, W. (1997) 'The Dream of Color Music and the Machines That Made it Possible.', *Animation World Magazine*.

Moritz, W. (1998) 'Enlightenment' in Haller, R., ed. *First Light*, New York: Anthology Film Archives, [online] Available at: http://www.centerforvisualmusic.org/WMEnlightenment.html [Accessed 13 Dec. 2018].

Moritz, W. (1998b, 1999) 'Jordan Belson, Last of the Great Masters', *Animation Journal*. [online] Available at: http://www.centerforvisualmusic.org/BelsonAJ.htm [Accessed 19 Dec. 2018].

Moritz, W. (1998c) The Film Strip Tells All, *Animation World Magazine*, Issue 3.6. [online] Available at: https://www.awn.com/mag/issue3.6/3.6pages/3.6moritzfilms.html [Accessed 13 Dec. 2018].

Moritz, W. and O'Neill, B. 'Fallout: Some Notes on the Films of Bruce Conner', *Film Quarterly,* XXXI (3). [online] http://www.centerforvisualmusic.org/library/WMConnerFallout.htm [Accessed 20 Dec. 2018].

Moritz, W. (2004) *Optical Poetry: The Life and Work of Oskar Fischinger*, US and Canada, John Libbey, Indiana University Press.

Morton, M. and Schmunk, P. L. (2000) *The arts entwined: music and painting in the nineteenth century. Critical and cultural musicology* New York; London: Garland.

Mueller, R. E. (1991) 'Schemas: The Evolution of a Minimal Visual Art Form', *Leonardo,* 24(3), pp. 273-280.

Mueller, R. E. (1999) 'Visic: A Proposal for a True Color Music', *Leonardo,* 32(3), pp. 177-179.

Munro, T. (1957) 'Four Hundred Arts and Types of Art: A Classified List', *The Journal of Aesthetics and Art Criticism,* 16(1), pp. 44-65.

Munro, T. (1967) 'The Arts and Their Interrelations', *The Bulletin of the Cleveland Museum of Art*, pp. 97–102.

Munro, T. *et al.* (2016) 'Form in the Arts : An Outline for Descriptive Analysis Form in the Arts', 2(8), pp. 5–26.

National Film Board of Canada., & Learning Corporation of America (1971) *The Eye hears, the ear sees*. National Film Board of Canada.

Naumann, S. (2009) 'The Expanded Image: On the Musicalization of the Visual Arts in the Twentieth Century' Daniels, D. and Naumann, S. eds. (2011) *See this Sound. Audiovisuology 2. Essays.* Leipzig: Ludwig Boltzmann Institute.

Navarro, P. C. (2006) 'About image and sound', *Revista de EGA,* (11), pp. 178-184.

Newton, I. (1671) 'A Letter of Mr. Isaac Newton, Professor of the Mathematicks in the University of Cambridge; Containing His New Theory about Light and Colors: Sent by the Author to the Publisher from Cambridge, Febr. 6. 1671/72; In Order to be Communicated to the R. Society.', *Philosophical Transactions of the Royal Society,* Vol. 6:(1671), pp. 3075–3087.

Newton, I. (1672) 'A letter to the Royal Society presenting A new theory of light and colours', *Philosophical transactions of the Royal Society of London*, 7, pp. 4004–5007.

Newton, I. (1704) *'Opticks: Or, a treatise of the reflexions, refractions, inflexions and colours of light',* The Royal British Society, 1, p. 416.

Newton, I. (1952) *Opticks: or, A treatise of the reflections, refractions, inflections & colours of light. Based on the 4th ed., London, 1730.* Dover Publications.

NFB, (2006) *Technical Notes by Norman* McLaren. National Film Board of Canada. [online] Available at: http://www3.nfb.ca/archives_mclaren/notech/NT_EN.pdf. [Accessed 1 Oct. 2018].

Nicoloff, A. and Nicoloff, M. (1992) 'Reflections on Refractions: Kinetic Light-Painting-Music in the Solar Spectrum', *Leonardo,* 25(2), pp. 159-161.

Nicolson, B. (1951) 'Post-Impressionism and Roger Fry', *The Burlington Magazine*. The Burlington Magazine Publications Ltd., 93(574), pp. 11–15. Available at: http://www.jstor.org/stable/870622.

Nikša, G. (2014) 'Eye hEar. The Visual in Music', *International Review of the Aesthetics and Sociology of Music,* 45(1). Croatian Musicological Society, pp. 191-195.

Noriaki, K. and Thompson, R. (2012) 'The Formation of the Concept of "Art" and the Displacement of Realism', *Art in Translation,* 4(4), pp. 435-457.

Novalis. (1798/99) *Novalis: Notes for a Romantic Encyclopedia.* Woods, D.W. (ed. & trans.) (2007). SUNY Press.

Neubauer, B. (n.d.) 'Spirals & Morphs', [online] Available at: http://www.spiralsmorphs.de/biography.html [Accessed 6 Dec. 2018].

Neubauer, B. (1998) '*Roots: An Experiment in Images and Music*', Animation World Magazine, Issue 3.6. [online] Available at: https://www.awn.com/mag/issue3.6/3.6pages/3.6neubauerroots.html [Accessed 6 Dec. 2018].

O'Konor, L. (1971) *Viking Eggeling 1880-1925: Artist and film-maker, life and work.* The University of Michigan: Almqvist & Wiksell.

O'Leary, B. (1998) 'New Critical Methods and the Films of the First Avant Garde: Symphonie Diagonale and Entr'acte', *Film Criticism,* 22(3), pp. 22-37.

Olats.org. (2011). *Homage to Frank J. Malina*. [online] Available at: http://www.olats.org/OLATS/pionniers/homage_to_frank_j__malina.shtml [Accessed 6 Dec. 2018].

Orgeman, K. Turrell, J. *et al* (2017) Lumia: Thomas Wilfred and the Art of Light, New Haven: Yale University Press.

Ox, J. (1999) 'Introduction: Color Me Synesthesia', *Leonardo,* 32(1), pp. 7-8.

Ox, J. and Frank, P. (1984) 'The Systematic Translation of Musical Compositions into Paintings', *Leonardo,* 17(3), pp. 152-158.

Ox, J. (2015) *Manifestations of Conceptual Metaphor and Blending Theories in Science, Design, and Art*. PhD Thesis. [Online] Available at: https://www.academia.edu/13924881/Manifestations_of_Conceptual_Metaphor_and_Blending_Theories_in_Science_Design_and_Art [Accessed 19 June. 2019].

Painting with Light (2010) *Yale University Art Gallery Bulletin*, pp. 118-121.

Palombini, C. (1993) 'Pierre Schaeffer, 1953: Towards an Experimental Music', *Music & Letters*, 74(4), pp. 542-557

Palombini, C. (1993) *Pierre Schaeffer's typo-morphology of sonic objects*. PhD Thesis, Durham University. [online] Available at: Durham E-Theses Online: http://etheses.dur.ac.uk/1191/ [Accessed 19 Dec. 2018].

Payling, D., Mills, S. and Howle, T. (2007) 'Hue Music - Creating Timbral Soundscapes from Coloured Pictures', *Proceedings of the 13th International Conference on Auditory Display (ICAD2007)*, pp. 91–97. Available at: Proceedings/2007/PaylingMills2007.pdf. [Accessed 19 Dec. 2018].

Packer, R. and Jordan, K. (eds.) (2001) *Multimedia: From Wagner to Virtual Reality*. London: W.W. Norton & Company.

Packer, R. and Jordan, K (2001) 'Overture', in Packer, R. and Jordan, K. (eds.) (2001) *Multimedia: From Wagner to Virtual Reality*. London: W.W. Norton & Company, pp. xv-xxxviii.

Parris, N. G. (1979) *Adolf Hoelzel's Structural And Color Theory And Its Relationship To The Development Of The Basic Course At The Bauhaus.* Ph.D Thesis. University of Pennsylvania.

Pater, W. (1887) *The School of Giorgione* in Leggio, J. (ed.) (2002a) *Music and Modern Art*. New York and London: Routledge.

Pater, W. (1988) *The Renaissance: Studies in Art and Poetry*. Oxford, UK 1988.

Patteson, T. (2016) *Instruments for New Music, Sound, Technology, and Modernism.* University of California Press.

Patterson, Z. (2009) 'From the Gun Controller to the Mandala: The Cybernetic Cinema of John and James Whitney', *Grey Room,* (36), pp. 36-57.

Peacock, K. (1985) 'Synesthetic Perception: Alexander Scriabin's Color Hearing', *Music Perception: An Interdisciplinary Journal,* 2(4), pp. 483-505.

Peacock, K. (1988) 'Instruments to Perform Color-Music: Two Centuries of Technological Experimentation', *Leonardo,* 21(4), pp. 397-406.

Pearson, R.S. (n.d) 'The Encyclopedia: Novalis' [online] Available at: https://web.archive.org/web/20020530221423/http://rspearson.com:80/ency6.htm [Accessed 19 Nov. 2018].

Pederson, S. (2009) 'Defining the Term 'Absolute Music' Historically', *Music & Letters,* 90(2), pp. 240-262.

Pellegrino, R. A. (1983) 'Cymatic Music: Towards a Metatheory of Harmonic Phenomena: My Interactive Compositions and Environments', *Leonardo,* 16(2), pp. 120-123.

People.well.com. (n.d.) 'Two Space (Larry Cuba)'. [online] Available at: https://people.well.com/user/cuba/TwoSpace.html [Accessed 19 Nov. 2018].

Pepper, A. (1979) 'Kinetic Art: 3-Dimensional Luminous Images Projected into Volumes of Smoke (Pentrojection)', *Leonardo,* 12(4), pp. 283-288.

Pepper, D. Stephen (2001) 'Leonardo da Vinci and the Perspective of Light', *Fidelio. Journal of Poetry, Science and Statecraft.* X (1), pp. 33-53.

Perlovsky, L. (2008) 'Music and Consciousness', *Leonardo,* 41(4), pp. 420-421.

Perron, J. (2000) 'Steina'. [online] Available at: http://www.fondation-langlois.org/html/e/page.php?NumPage=7#n1 [Accessed 19 Aug. 2018].

Perrott, (2013) 'ZigZag: Reanimating Len Lye as Improvised Theatrical Performance and Immersive Visual Music', in Richardson, J., Gorbman, C. and Vernallis, C. (eds.) (2013) *The Oxford Handbook of New Audiovisual Aesthetics*. Oxford and New York: Oxford University Press.

Pesic, P. (2006) 'Isaac Newton and the mystery of the major sixth: a transcription of his manuscript 'Of Musick' with commentary', *Interdisciplinary Science Reviews,* 31(4), pp. 291-306.

Picabia, F. ed. (1917) *391*. No. 7 [cover] Available at: http://sdrc.lib.uiowa.edu/dada/391/7/pages/00cover.htm [Accessed 17 Dec. 2018].

Picasso, P. (1911) *Buffalo Bill*. [image] Available at: https://en.wikipedia.org/wiki/File:Pablo_Picasso,_1911-12,_Buffalo_Bill,_oil_on_canvas,_46_x_33_cm.jpg [Accessed 17 Dec. 2018].

Piché, J. (2003) '*De la musique et des images*'. *Publié dans CIRCUIT, Revue nord-américiane de musique du XXeme siècle*, Volume 13 *Numéro* 3. Available at: http://jeanpiche.com/Textes/images.htm [Accessed 17 Dec. 2018].

Plateau, J. and Elliott, R. G. (2016) 'On a New Type of Optical Illusion', *Art in Translation,* 8(1), pp. 11-18.

Poast, M. (2000) 'Color Music: Visual Color Notation for Musical Expression', *Leonardo,* 33(3), pp. 215-221.

Pocock-Williams, L. (1992) 'Toward the Automatic Generation of Visual Music', *Leonardo,* 25(1), pp. 29-36.

Polansky, L. (1987) 'The Future of Music', *Leonardo,* 20(4), pp. 363-365.

Polansky, L., Malina, R. F. and Mazer, E. (1990) 'Editorial: Sounds, Musics and "Leonardo"', *Leonardo,* 23(1), pp. 1-2.

Popper, F. (1995) 'The Artist and Advanced Technology', *Leonardo,* 28(1), pp. 27-33.

Popper, F. (2000) *FRANK J. MALINA - Artist and Scientist : Works from 1936 to 1963*. [online] Olats.org. Available at: https://www.olats.org/pionniers/malina/arts/monographUS.php [Accessed 9 Dec. 2018].

Popper, F. (2000b) 'Frank Malina, Artist and Scientist: Works from 1936 to 1963', *Leonardo Electronic Almanac,* 8(3).

Potter, R. K. (1945) 'Visible Patterns of Sound', *Science, New Series,* 102(2645), pp. 463-470.

Potter, R. K. (1947) 'Audivisual Music', *Hollywood Quarterly,* 3(1), pp. 66-78.

Potter, R. K. (1951) 'New Scientific Tools for the Arts', *The Journal of Aesthetics and Art Criticism,* 10(2), pp. 126-134.

Popular Mechanics (1924) 'Music is turned into glowing colour. Soundless Symphonies from Keys of Organ Projected on Screen Are Hailed as Birth of a New Art', [image] Available at: http://cdm.link/app/uploads/2015/08/light_show_0.jpg [Accessed 11 Dec. 2018].

Pravdyuk, Y. A. (1994) 'Musical Light-Painting and the Phenomenon of Form-Movement', *Leonardo,* 27(5), pp. 379-381.

Pridmore, R. W. (1992) 'Music and color: Relations in the psychophysical perspective', *Color Research & Application,* 17(1), pp. 57-61.

Prometheus.kai.ru. (n.d.). The instrument "Prometheus-1" (1962). [online] Available at: http://prometheus.kai.ru/pr1_e.htm [Accessed 20 Dec. 2018].

Puckette, M. & Sorensen, V. & Steiger, *et al.* (1996-1999), 'The Global Visual Music Project'. [online] Available at: http://visualmusic.org/gvm.htm [Accessed 9 Dec. 2018].

Puckette, M. (2002) 'Max at Seventeen', *Computer Music Journal,* 26(4), pp. 31-43.

Purkyně, J. E. and Short, D. (2016) 'Kinesiscope', *Art in Translation,* 8(1), pp. 34-40.

Putnam, S. (1929) *The Glistening Bridge: Leopold Survace and the Spatial Problem in Painting.* Covici-Friede.

Rasula, J. (2013) 'Visual Music, a Missing Link?' in S. Posman, *et al., The Aesthetics of Matter: Modernism, the Avant-Garde and Material Exchange.*

Record of the world premiere of the concert "Prometheus" on February 19, 2009 in the Ice Palace of St. Petersburg. (2009) [video], Available at: https://youtu.be/V4BG42JBa7g [Accessed 11 Dec. 2018].

Rees, A. L. (1999) *A history of experimental film and video.* London: BFI Publishing.

Reed, C. (1996) *Roger Fry Reader.* Chicago and London: University of Chicago Press.

Riccò, D. and de Cordoba, M.J. (eds.) (2007) *MuVi. Video and moving image on synesthesia and visual music*, Milan: Edizioni Poli.design. [Book + DVD]

Riccò, D. and de Cordoba, M.J. (eds.) (2012) *MuVi. Video and moving image on synesthesia and visual music*, Granada: Ediciones Fundación Internacional Artecittà [Book + DVD]

Riccò, D. and de Cordoba, M.J. (eds.) (2015) *MuVi. Video and moving image on synesthesia and visual music*, Granada: Ediciones Fundación Internacional Artecittà [Book + DVD]

Riccò, D. and de Cordoba, M.J. (eds.) (2018) *MuVi. Video and moving image on synesthesia and visual music*, Granada: Ediciones Fundación Internacional Artecittà [Book + DVD]

Richardson, J., Gorbman, C. and Vernallis, C. (eds.) (2013) *The Oxford Handbook of New Audiovisual Aesthetics.* Oxford and New York: Oxford University Press.

Richter, H. and Eggeling, V. (1920) *Universelle Sprachte.* Pamphlet.

Richter, H. (1949) 'The Avant-Garde Film Seen from within', *Hollywood Quarterly,* 4(1), pp. 34-41.

Ricther, H. (1952) 'Easel – Scroll – Film', *Magazine of Art.* February, 1952, pp. 78-86, reprinted in Russett, R and Starr, C. (1976) *Experimental Animation: Origins of a New Art.* New York: Da Capo Press.

Richter, H. (1964) *Dada Art and Anti-Art*, trans. Britt, D. (1997). London: Thames & Hudson.

Richter, H. (1972) 'Viking Eggeling', *Studio International,* 183, pp. 97-99.

Rimington, A. W. (1912) *Colour-music, The Art of Mobile Colour.* London: Hutchinson.

Rinkis, A. (1994) 'Kinetic Experiments', *Leonardo,* 27(5), pp. 391-393.

Robinson, J. ed. (1997) *Music and Meaning.* Cornell University Press.

Rodrigo, F. C. (2006) 'A Fuzzy-Logic Mapper for Audiovisual Media', *Computer Music Journal,* 30(1), pp. 67-82.

Rogers, H. (2010) *Visualising Music: Audio-Visual Relationships in Avant-Garde Film and Video Art.* LAP Lambert Academic Publishing.

Rogers, H. (2011) 'The Unification of the Senses: Intermediality in Video Art-Music', *Journal of the Royal Musical Association*, 136(2), pp. 399–428.

Rogers, H. (2013) *Sounding the Gallery: Video and the Rise of Art-Music.* Oxford: Oxford University Press.

Rogers, H. (2013b) '"Betwixt and Between" Worlds : Spatial and Temporal Liminality in Video Art-Music', in Richardson, J., Gorbman, C. & Vernalis, C. (eds.) (2013), *The Oxford Handbook of New Audiovisual Aesthetics,* New York and Oxford: Oxford University Press.

Rogers, H. (2014) 'The Musical Script: Norman McLaren, Animated Sound, And Audiovisuality', *Animation* Journal, 22.

Rogers, H. and Barham, J. (eds.) (2017) *The Music and Sound of Experimental Film.* Oxford: Oxford University Press.

Rolland, R. (1931) 'Goethe's Interest in Music', *The Musical Quarterly,* 17(2), pp. 157-194.

Rothenberg, A. (1980) 'Visual Art. Homospatial Thinking in the Creative Process', *Leonardo,* 13(1), pp. 17-27.

Rothschild, J. (1970) 'On the Use of a Color-Music Analogy and on Chance in Paintings', *Leonardo,* 3(3), pp. 275-283.

Rousseau, J-J. (1753) 'Sounds and Colours', *Essai sur l'origine des langue*, trans. Mattis, O. (2005).

Rowe, A. (2012) 'Within an Ocean of Light: Creating Volumetric Lightscapes', *Leonardo,* 45(4), pp. 358-365.

Rubin, H. E., & Katz, E. (1946) 'Auroratone Films for The Treatment Of Psychotic Depressions In An Army General Hospital', *Journal Of Clinical Psychology 2,* 2(4), pp. 333-340.

Rudi, J. (2005) 'Computer Music Video: A Composer's Perspective', *Computer Music Journal,* 29(4), pp. 36-44.

Ruttmann, W. (1919) 'Painting with Light' in Schobert, W. (ed.) (1989) *The German Avant-garde Film of the 1920's/ Der Deutsche Avant-Garde Film Der 20er Jarhre.* Goethe Institut München.

Runge, P.O. (1810) *Color Sphere,* in Stahl, G. trans. (2010) *On Vision and Colors By Arthur Schopenhauer and Color Sphere By Philipp Otto Runge.* Princeton Architectural Press.

Russell, M. & Macdonald-Wright, S. (1913) 'In Explanation of Synchromism' in Levin, Gail. (1998) *Synchromism and American Color Abstraction, 1910-1925.* New York: George Brazillier, pp. 128-29..

Russett, R. and Starr, C. (1976) *Experimental Animation.* New York: DaCapo Press.

Sabaneev, L. and Pring, S. W. (1929) 'The Relation between Sound and Colour', *Music & Letters,* 10(3), pp. 266-277.

Saint-Denis, (2014) 'Musique visuelle: De la musique au-delà des frontières du son*', eContact! 15.4 – Videomusic: Overview of an Emerging Art Form,* 15(4). Montréal: *Communauté électroacoustique canadienne* / Canadian Electroacoustic Community.

Saint-Denis, (2017) 'On Light Music Before Cinema', 'Musique visuelle: De la musique au-delà des frontières du son', in *eContact! 19.2 – Light+Sound / Lumière+son,* 19(2). Montréal: *Communauté électroacoustique canadienne* / Canadian Electroacoustic Community.

Sallis, J. (ed.) (2012) *Paul Klee Philosophical Vision: From Nature to Art.* McMullen Museum of Art, Boston College: The University of Chicago Press.

Sallis, J. (2015) *Klee's Mirror.* Albany: SUNY Press.

Saltz, D. Z. (2016) 'The Art of Interaction: Interactivity, Performativity, and Computers', *The Journal of Aesthetics and Art Criticism,* 55(2), pp. 117-127.

Sato, M. (1970a) ''La Vie': Du dessin au tableau au tableau cinetique', *Leonardo,* 3(1), pp. 71-73.

Sato, M. (1970b) ''Life': From Drawing to Painting to Kinetic Painting', *Leonardo,* 3(1), pp. 71-73.

Sawyer, C. H. (1957) 'Integration in the Arts: Comments on the M. I. T. and Harvard Reports', *College Art Journal,* 16(4), pp. 287-296.

Schaeffer, P. (1941) and Brunet, S. and Palombini, C. (eds.)(2010) '*Essai sur le radio et le cinema: Esthétique et techniques des art- relais, 1941-1942.* Paris: Editions Allia.

Schaeffer, P. (1952) *À la recherche d'une musique concrète.* Paris: Seuil. *In Search of a Concrete Music,* trans. C. North and J. Dack. (2012). Berkeley: University of California Press.

Schiller, G. (2008) 'From the Kinesphere to the Kinesfield: Three Choreographic Interactive Artworks', *Leonardo,* 41(5), pp. 431-453.

Schneider, B. (2010) 'Verkreuzte Kunste Ton-Bild-Experimente in Kunst und Technik der 1920er Jahre', in Fink, W. ed. (2010) *Ultravision Zum Wissenschaftsverstandnis der Avantgarde,* Munchen: Wilhelm Fink Verlag.

Schneider, B. (2015) 'On Hearing Eyes and Seeing Ears: A Media Aesthetics of Relationships between Sound and Image, in Daniels, D. & Naumann, S. (eds.) (2015), *Audiovisuology. A Reader, Vol. 1: Compendium, Vol. 2: Essays.* Koln, Verlag Walther Konig, pp. 608-633.

Schneider, B. (2011) 'Fritz Wilhelm Winckel. Sound/Image Transformations by Means of Television (1930)' in Daniels, D. and Naumann, S. (eds.) *Audiovisuology. Essays: Histories and Theories of Audiovisual Media and Art.* Cologne: Verlag der Buchhandlung Walther König, pp.196-197.

Schobert, W. (1993) 'Introduction' in Schobert, W. (ed.) (1989) *The German Avant-garde Film of the 1920's.* Goethe Institut München.

Schobert, W. (ed.) (1989) *The German Avant-garde Film of the 1920's.* Goethe Institut München.

Schobert, W. (ed.) (2003) *The German Avant-Garde Film of the 1920's: Der Deutsche Avant-Garde Film der 20er Jahre,* Germany.

Schöffer, N. (1985) 'Sonic and Visual Structures: Theory and Experiment', *Leonardo,* 18(2), pp. 59-68.

Schopenhauer, A. (1854) *On Vision and Colors,* in Stahl, G. trans. (2010) *On Vision and Colors By Arthur Schopenhauer and Color Sphere By Philipp Otto Runge.* Princeton Architectural Press.

Scriabin (1915) 'Opening page of Scriabin's Prometheus, with the "colour organ"', [image] Available at: https://riamlibrary.files.wordpress.com/2015/04/scriabin-promethee-opening-l.jpg [Accessed 12 Dec. 2018].

Scriabin's circle of fifths colour-tone circle. (2011) [image] Available at: https://en.wikipedia.org/wiki/Clavier_%C3%A0_lumi%C3%A8res#/media/File:Scriabin-Circle.svg [Accessed 12 Dec. 2018].

Scriabin Museum (2018) 'Colour-light device for the performance of the "Poem of Fire"'. [online] [Accessed 12 Dec. 2018] https://ru.moscovery.com/музей-скрябина/ [Accessed 11 Dec. 2018].

Scroggins, M. (1983) 'Study No. 14'. [Video] Available online at: https://vimeo.com/43130735 Accessed 11 Dec. 2018].

Scroggins, M. (n.d.) 'Biography'. [online] Available at: https://michaelscroggins.wordpress.com/about/

Sedgley, P. and Ohff, H. (1982) 'My Kinetic Artworks and Paintings (1971-1982)', *Leonardo,* 15(3), pp. 183-187.

Selz, P. (1957) 'The Aesthetic Theories of Wassily Kandinsky and Their Relationship to the Origin of Non-Objective Painting', *The Art Bulletin,* 39(2), pp. 127-136.

Sexton, J. (n.d.) 'McLaren, Norman (1914-1987)', Screenonline. [online] http://www.screenonline.org.uk/people/id/446775/index.html [Accessed 20 Dec. 2018].

Shatskikh, A. (1993) 'Malevich and Film', *The Burlington Magazine,* 135(1084), pp. 470-478.

Shaw-Miller, S. T. (2004) *Visible Deeds of Music: Art and Music from Wagner to Cage.* New Haven and London: Yale University Press.

Shaw-Miller, S. T. (2006) 'Visual Music and the Case for Rigorous Thinking.', *Art Book*, 13(1), pp. 3–5.

Shaw-Miller, S. T. (2009) 'Performance Art', in D. Daniels & S. Naumann (eds.) *Audiovisuology: Compendium.* Walther König, Koln.

Shaw-Miller, S. T. (2013) *Eye hEar The Visual in Music.* Ashgate Publishing Ltd.

Shaw-Miller, S. T. (2013b) 'Synaesthesia', in Leonard, A.S., T. (ed.) *The Routledge Companion to Music and Visual Culture*. New York and London: Routledge, pp. 13-24.

Shephard, T. and Leonard, A. (2014) *The Routledge Companion to Music and Visual Culture*. New York: Routledge.

Sidenius, W. C. and Farrell, R. M., Jr. (1982) 'Lumia Kinetic Art with Music: My Theatre of Light', *Leonardo,* 15(3), pp. 188-192.

Siedler, J. (n.d) 'Video Synthesizer Developments', audiovisualizers.com. [online] Available at: https://web.archive.org/web/20181208222204/http://www.audiovisualizers.com/toolshak/vidsynth/vsynth_intro.htm [Accessed 19 Nov. 2018].

Siglind, B. (2001) 'A Concert of Paintings: "Musical Ekphrasis" in the Twentieth Century', *Poetics Today,* 22(3), pp. 551-605.

Signac, P. (1899) 'from Eugene Delacroix to Neo-Impressionism, in Harrison, C., *et al.* (1999) '*Art in Theory 1900-2000: An Anthology of Changing Ideas*. Oxford: Blackwell, pp. 20-23.

Simonson, M. (2018) 'Visualizing Music in the Silent Era: The Collaborative Experiments of Visual Symphony Productions', *Journal of the Society of American Music*, 12(1), pp. 2-36.

Sink (2004) 'Darklight Digital Festival 2004'. [online] Available at: https://web.archive.org/web/20060220092409/http:/sink.ie:80/pages/dark.htm [Accessed 19 Dec. 2018].

Sitney, P. A. (ed.) (1978) *The Avant-Garde Film*. New York: Anthology Film Archives.

Sitney, P. A. (2002) *Visionary Film: The American Avant-Garde 1943-2000*. Oxford University Press.

Smirnov, A. (2013) *Sound in Z: Experiments in Sound and Electronic Music and Sound*, Durham: Duke University Press.

Smith, S. A., Dockum, G. J. and Dockum, G. E. (1979) 'Kinetic Art: The Mobilcolor Projectors of Charles R. Dockum (1904-1977)', *Leonardo,* 12(2), pp. 144-150.

Sonore-visuel.fr. (2016) *Cycle « Écoute voir : musique concrète et cinéma, le service de la recherche » | Sonore Visuel*. [online] Available at: http://www.sonore-visuel.fr/fr/evenement/cycle-ecoute-voir-musique-concrete-et-cinema-le-service-de-la-recherche [Accessed 8 Dec. 2018].

Sons et Lumière (2005) Exhibition. *Sons & Lumieres: A History of Sound in the Art of the 20th Century*. Paris: Centre Pompidou

Sorabji, R. (1972) 'Aristotle, Mathematics, and Colour', *The Classical Quarterly,* 22(2), pp. 293-308.

Sorensen, V. (1993) 'Maya', vibeke.info. [online] Available at: http://vibeke.info/maya/ [Accessed 20 Dec. 2018].

Sorensen, V. (1998) 'Global Visual Music Jam Session' [online] Available at: http://visualmusic.org/text/inteltalk.html [Accessed 20 Dec. 2018].

Sorensen, V. (2000) 'Identity, Poetry, Memory, Nature', visualmusic.org. [online] Available at: http://visualmusic.org/Biography/VS-LivingArch.html [Accessed 20 Dec. 2018].

Sorensen, V. (2005) 'Global Visual Music Jam Project', *Leonardo,* 38(4), pp. 316-301.

Sorensen, V. (2014) 'Conceptions of Space-Time in Illuminations, an Animated Installation', *26th Society for Animation Studies (SAS) Conference*, Toronto, Canada, June 17.

Sorensen, V. (n.d.) 'Global Visual Music, 2nd performance experiment: Lemma 2'. [online] Available at: http://www.visualmusic.org/gvm.htm [Accessed 20 Dec. 2018].

Spiegel, L. (1998) 'Graphical GROOVE: memorial for the VAMPIRE, a visual music system', *Organised Sound,* 3(3), pp. 187-191.

Spielmann, Y. (2001) 'Intermedia in Electronic Images', *Leonardo,* 34(1), pp. 55-61.

Spielmann, Y. (2004) 'Steina, Violin Power, 1978'. [online] Available at: http://www.fondation-langlois.org/html/e/page.php?NumPage=485 [Accessed 8 July. 2018].

Spielmann, Y. (2008) *Video: the Reflexive medium*. Cambridge, Mass.: MIT Press.

Spitzer, M. (2004) *Metaphor and Musical Thought* Chicago and London; The University of Chicago.

Stadnik, G. (2005) 'The Art of Lumia', photonlightguitars.com. [online] Available at: http://www.photonlightguitars.com/ [Accessed 8 July. 2018].

Stadnik, G. (n.d.) 'About Lumia', [online] Available at: http://www.photonlightguitars.com/aboutlumia.html

Stampfer, S. and Blower, J. (2016) 'Stroboscopic Discs: An Explanation', *Art in Translation,* 8(1), pp. 19-33.

Stauffacher, F. (ed.) (1947) *Art in Cinema: A Symposium on the Avantgarde Film together with Program Notes and References for Series One of Art in Cinema.* Art in Cinema Society.

Stebbing, P. D. (2004) 'A Universal Grammar for Visual Composition?', *Leonardo,* 37(1), pp. 63-70.

Stein, D. M. (1968) 'Thomas Wilfred 1889-1968', *Members Newsletter,* (2), pp. 4.

Stephen, H. (2010) 'The Emancipation of Dissonance: Schoenberg's Two Practices of Composition', *Music and Letters,* 91(4), pp. 568-579.

Stephen, M. (2009) 'Music Animation Machine'. Available at: www.musicanim.com

Stokes, C. A. (ca 1940s) 'Auratone film'. [online] Available at: https://youtu.be/uFXku4MntpY [Accessed 19 Dec. 2018].

Stokes, C. A. (1942) *Process and Apparatus for Producing Musical Rhythm in Color* Patent no. 2,292,172. [Online]. *When the Organ Played 'Oh Promise Me',* ca. 1940s. DigiBeta (Originally 16 mm), color. Directed by Stokes, C., A.: Robert W. Martens.

Strick, J. (2005) 'Visual Music' in Brougher, K, Strick, J., Wiseman, A., Zilczer, J. (eds.) (2005) *Visual Music: 1905-2005*. New York: Thames & Hudson.

Strick, J. and Rifkin, N. (2005) 'Foreward' in Brougher, K, Strick, J., Wiseman, A., Zilczer, J. (eds.) (2005) *Visual Music: 1905-2005*. New York: Thames & Hudson.

Sturken, M. (n.d.) 'Steina and Woody Vasulka', University of California, Santa Cruz. [online] Available at:http://www.vasulka.org/archive/Vasulkas1/VasulkaBioStatement/VasulkaBio/VasulkaBio.pdf [Accessed 19 Aug. 2018].

Survage, L. (1914) 'Coloured Rhythm', *Paris-Journal*, 15 July, reprinted and trans. Russett, R and Starr, C. (1976)

Survage, L. (1927) 'The Maxims of Léopold Survage' in Putnam, S. (1929) *The Glistening Bridge: Léopold Survage and the Spatial Problem in Painting*. New York: Covici-Fried, pp. 179-180.

Survage, L. (1929) 'The Plastic Synthesis of Space' (1927-28) in Putnam, S. *The Glistening Bridge: Leopold Survage and the Spatial Problem in Painting*. New York: Covici-Fried, pp. 159-162.

Susan Laikin, F. (2007) 'Engendering Abstraction: Wassily Kandinsky, Gret Palucca, and "Dance Curves"', *Modernism/modernity,* 14(3), pp. 389-406.

Tattersall, L. (2012) 'Mr. Kupka Among Verticals' in L. Dickerman & M. Chlenova (eds.) (2012) *Inventing Abstraction, 1910-1925: How a Radical Idea Changed Modern Art*. New York: Thames & Hudson, pp. 64-71.

Ter Braak, M. (1931) 'Der absolute Film'. [online] DBNL. Available at: https://dbnl.org/tekst/braa002abso01_01/braa002abso01_01_0001.php [Accessed 19 Dec. 2018].

Terry, B. (2005) 'Editor's Notes', *Computer Music Journal,* 29(4), pp. 4-4.

Teruggi, D. (2007) 'Technology and musique concrète: the technical developments of the Groupe de Recherche Musicales and their implication in musical composition', *Organised Sound*, 12(3), pp. 213–231.

The Museum of Modern Art. (2018) 'Colored Rhythm: 59 studies for the film | MoMA'. [online] Available at: https://www.moma.org/collection/works/series/37752?locale=en [Accessed 10 Dec. 2018].

Thibault, J-F. (2002, 2004) '*Le Tableau Qui Bouge:* Art in Motion 1913-1930' in Meyer-Dinkgrafe, D. (ed.) (2004) *European Culture in a Changing World: Between Nationalism and Globalism.* London: Cambridge Scholars Press, pp. 202-213.

Thom, R. (2013) 'Notes on Sound Design in Contemporary Animated Films,' in Richardson, J., Gorbman, C. and Vernallis, C. (eds.) (2013) *The Oxford Handbook of New Audiovisual Aesthetics*. Oxford and New York: Oxford University Press.

Topper, D. R. and Holloway, J. H. (1980) 'Interrelationships between the Visual Arts, Science and Technology: A Bibliography', *Leonardo,* 13(1), pp. 29-33.

Tournet-Lammer, J. (2011) 'Confronting Art, Sciences and Techniques at the ORTF Service de la Recherche 1960-1974', in *Proceedings of the International Conference Pierre Schaeffer: mediaARt*, Rijeka: Muzej modern i suvremene urnjetnosti, pp. 23-32.

Truax, B. (2011) 'Computer Graphic Works. Theo Goldberg & Barry Truax'. [DVD] Cambridge Street Publishing CSR-DVD 1101.

Truax, B. (n.d.) 'Computer Graphic Works by Theo Goldberg & Barry Truax'. [online] Available at: https://www.sfu.ca/~truax/video.html [Accessed 19 Dec. 2017].

Truax, B. (n.d.b) 'The Wings of Nike for computer image and two digital soundtracks with computer graphic images by Theo Goldberg'. [online] Available at: https://www.sfu.ca/~truax/nike.html [Accessed 19 Dec. 2017].

Troy, N. J. (1984) 'Figures of the Dance in De Stijl', *The Art Bulletin,* 66(4), pp. 645-656.

Trębacz, E. (2012) 'Depth Modulation: Composing motion in immersive audiovisual spaces', *Organised Sound,* 17(02), pp. 156-162.

Tunali, F. S. (2012) 'Glint: Audiovisual Glitches', *Leonardo,* 45(3), pp. 296-297.

Turim, M. and Walsh, M. (2013) 'Sound Events: Innovation in Projection and Installation,' in Richardson, J., Gorbman, C. and Vernallis, C. (eds.) (2013) *The Oxford Handbook of New Audiovisual Aesthetics*. Oxford and New York: Oxford University Press.

Turvey, M. (2002) 'The Avant-Garde and the "New Spirit": The Case of "Ballet mécanique"', *October* 102, pp. 35-58.

Turvey, M. (2003) 'Dada Between Heaven and Hell: Abstraction and Universal Language in the Rhythm Films of Hans Richter', *October,* (105), pp. 13-36.

Tzvetkov, M. (2001) 'A Light-Musical "Alliluia"', *Leonardo,* 34(4), pp. 353-354.

Uroskie, A. V. (2012) 'Visual Music after Cage: Robert Breer, expanded cinema and Stockhausen's Originals (1964)', *Organised Sound,* 17(02), pp. 163-169.

Valega, A.A. (2012) 'Paul Klee's Vision of an Originary Cosmological Painting' in Sallis, J. (ed.) *Paul Klee Philosophical Vision: From Nature to Art.* McMullen Museum of Art, Boston College: The University of Chicago Press.

Van Doesberg, T. (1921) *De Stijl*, no. 5, in trans. Lawder, S.D. (1975) *The Cubist Cinema*. New York: New York University Press.

Van Doesberg, T. (1925a) 'from Principles of Neo-Plastic Art' in Harrison, C., *et al.* (1999) 'Art in Theory 1900-2000: An Anthology of Changing Ideas. Oxford: Blackwell, pp. 279-282.

Van Doesberg, T. (1925b) 'Principles of Neo-Plastic Art', intro., Wingler, H.M. intro, postscript, Jaffe, L. C., trans. Seligman, J. (1968) [from German], New York: Graphic Society.

Van Mohrenschildt, D.S. (1938) 'The Russian Symbolist Movement', *PMLA*, 53(4), pp. 1193-1209.

Vanechkina I. (1979) 'On the first performance of "Prometheus" with lighting part. - In: All-Union school of younger scholars "Light and Music" (theses of papers). - Kazan: KAI Publ.', (in Russian).

Vanechkina, I. L. (1994) '"Musical Graphics" as an Instrument for Musicologists and Educators', *Leonardo,* 27(5), pp. 437-439.

Vanechkina, I. (2018) 'On the performances of A. Scriabin's "Lighting Symphony": myths and reality'. [online] http://prometheus.kai.ru. Available at: http://prometheus.kai.ru/perform_e.htm [Accessed 11 Dec. 2018].

Vanechkina, I. (n.d.). On the performances of A. Scriabin's "Lighting Symphony": myths and reality. [online] http://prometheus.kai.ru. Available at: http://prometheus.kai.ru/perform_e.htm [Accessed 11 Dec. 2018].

Varèse, E. and Alcopley (1968) 'Edgard Varèse on Music and Art: A Conversation between Varèse and Alcopley', *Leonardo,* 1(2), pp. 187-195.

Vasulka, S. (1978) 'Violin Power', *Smithsonian American Art Museum.* [online] Available at: https://americanart.si.edu/artwork/violin-power-77216 [Accessed 11 July. 2018].

Vasulka, W. (1983) 'The Commission'. [video file] Available at: http://www.vdb.org/titles/commission. [Accessed 11 July. 2018].

Veldeman, J. (2008) 'Reconsidering Pictorial Representation by Reconsidering Visual Experience', *Leonardo,* 41(5), pp. 493-497.

Vergo, P. (2005) *That Divine Order: Music and the Visual Arts from Antiquity to the eighteenth century.* New York: Phaidon.

Vergo, P. (2010) *The Music of Painting.* New York: Phaidon.

Vergo, P. (2011) 'How to Paint a Fugue', in De Mille, C. (ed.) *Music and Modernism, 1849-1950.* Cambridge Scholars Publishing.

Viora, J.-L. (1982) 'Music and Visual Colour: A Proposed Correlation', *Leonardo,* 15(4), pp. 335-336.

Visualmusic.org (n.d.) 'Original Goals (Global Visual Music Project)'. [online] Available at: http://www.visualmusic.org/gvm/b.htm [Accessed 11 Nov. 2018].

Visual Music Marathon (2007), *Visual Music Marathon,* Dennis H. Miller, Artistic Director. Boston: Programme Catalogue. [online] Available at: http://www.dennismiller.neu.edu/VMM%20program%20notes%20sketch%203.pdf [Accessed 11 July. 2018].

Visual Music Marathon (2009), *Visual Music Marathon,* Dennis H. Miller, Artistic Director. New York: Programme Catalogue.

Wagler, S. R. (1970) 'Sonovision: A Visual Display of Sound', *Leonardo,* 3(4), pp. 443-445.

Wagner, R. (1849) '"Outlines of the Artwork of the Future," *The Artwork of the Future (1849)'* in Packer, R. and Jordan, K. (eds.) (2001) *Multimedia: From Wagner to Virtual Reality.* London: W.W. Norton & Company, pp. 3-9.

Wallis, M. (1960) 'The Origin and Foundations of Non-Objective Painting', *The Journal of Aesthetics and Art Criticism*, 19(1), pp. 61-71.

Wands, B. (2002) 'Director's Statement: A Moment in Time', *Leonardo,* 35(5), pp. 467-469.

Warshawsky, W. (1913) '"Orpheism" Latest of Painting Cults', *New York Times,* October 19, 2013.

Weekend, (n.d.) 'Walter Ruttmann: Weekend (1930) 11'10"'. [video file] Available at: https://asmir.info/lib/weekend.htm [Accessed 10 Dec. 2018].

Wees, W. (1992) *Light Moving in Time.* Berkeley: University of California Press.

Weinel, J. and Cunningham, S. (2014) 'Digitized Direct Animation: Creating materials for electroacoustic visual music using 8 mm film' in *eContact! 15.4 — Videomusic: Overview of an Emerging Art Form* (April / avril 2014). Montréal: Communauté électroacoustique canadienne / Canadian Electroacoustic Community.

Weil, B. (2002) 'Art in Digital Times: From Technology to Instrument', *Leonardo,* 35(5), pp. 523-537.

Weill, K. (1925) 'Possibilities for Absolute Radio Art' in A. Kaes, N. Baer & M. Cowan (eds.) (2015) *The Promise of Cinema: German Film Theory, 1907-1933.* Oakland: University of California Press, pp. 586 – 589.

Weinberg, H. G. (1941) 'A Forward Glance at the Abstract Film', *Design,* 42(6), pp. 24-24.

Wells, A. (1980) 'Music and Visual Color: A Proposed Correlation', *Leonardo,* 13(2), pp. 101-107.

Wells, A. (1981) 'Music and Visual Color (Continued)', *Leonardo,* 14(1), pp. 83.

Wenger, R. (1997) 'Visual Art, Archaeology and Gestalt', *Leonardo,* 30(1), pp. 35-46.

Whitney, J. (1975) 'Computational Periodics'. [online] Available at: https://www.atariarchives.org/artist/sec23.php [Accessed 11 July. 2018].

Whitney, J. & J. (1978) 'Audio-Visual Music', in Sitney, P.A. ed. *The Avant-Garde Film: A Reader of Theory and Criticism,* New York: Anthology Film Archives, pp. 83-86.

Whitney, J. (1980) *Digital Harmony: On the Complementarity of Music and Visual Art*. Peterborough: McGraw-Hill.

Whitney, J. (1987) 'Comments on "Visual Music: The Search for an Aesthetic"', *Leonardo,* 20(2), pp. 205.

Whitney, J. (1991) 'Fifty Years of Composing Computer Music and Graphics: How Time's New Solid-State Tractability Has Changed Audio-Visual Perspectives', *Leonardo,* 24(5), pp. 597-599.

Whitney, J. (1992) 'A Personal Search for the Complementarity of Music and Visual Art', *The John Whitney Collection.* John Whitney [Essay for Video/DVD].

Whitney, J. (1994) 'To Paint on Water: The Audiovisual Duet of Complementarity' *Computer Music Journal,* 18 (3), pp. 45-52.

Wiedmann, A. (1979) *Romantic Roots in Modern Art. Romanticism and Expressionism: A Study in Comparative Aesthetics*, Old Woking: Gresham Press.

Wier, D. R. (1969) 'Light Shows: A Kinetic Art Technique Using Chemicals', *Leonardo,* 2(3), pp. 251-256.

Wilfred, T. (1947) 'Light and the Artist', *The Journal of Aesthetics and Art Criticism,* 5(4), pp. 247-255.

Wilfred, T. (1948) 'Composing in the Art of Lumia', *The Journal of Aesthetics and Art Criticism,* 7(2), pp. 79-93.

Wilfred, T. and Evans, J. H. (1970) 'Letter of Thomas Wilfred to J. Handel Evans', *Leonardo,* 3(4), pp. 467.

Wilke, T. (2010) 'Tacti(ca)lity Reclaimed: Benjamin's Medium, the Avant-Garde, and the Politics of the Senses', *Grey Room,* (39), pp. 39-56.

William, K. (2001) *'Besonnenheit, Ekphrasis* and the Disappearing Subject in E. T. A. Hoffmann's "*Die Fermate*"', *Criticism,* 43(3), pp. 325-339.

Wilson, D. (1989) 'The Role of Patterning in Music', *Leonardo,* 22(1), pp. 101-106.

Wilton Mason (1958) 'Father Castel and His Color Clavecin', *The Journal of Aesthetics and Art Criticism,* 17(1), pp. 103-116.

Wiseman, A. (2005) 'Expanding the Synaesthetic Paradigm', in Brougher, K, Strick, J., Wiseman, A., Zilczer, J. (2005) *Visual Music: 1905-2005*. London: Thames & Hudson.

Woods, D.W. (2007) (ed. & trans.) *Novalis: Notes for a Romantic Encyclopedia* (1798/99). SUNY Press.

Wollen, P. (1999) 'Perhaps', *October,* (88), pp. 43.

Xenakis, I. (1992) *Formalized Music: Thought and Mathematics in Composition*, New York: Pendragon Press.

Yale University Art Gallery (1963) 'A detail of Thomas Wilfred's Lumia Suite, Op. 158', [image] Available at: https://www.theartnewspaper.com/news/yale-and-moma-team-up-to-resurrect-visionary-light-works [Accessed 11 Dec. 2018].

Youngblood, G. (1970) *Expanded cinema*. Boston: E.P. Dutton.

Youngblood, G. (1970b) 'The Videosphere', in Youngblood, G. (1970) *Expanded Cinema*. Boston: E.P. Dutton.

Yumibe, J. (2009a) ''Harmonious Sensations of Sound by Means of Colors': Vernacular Colour Abstractions in Silent Cinema', *Film History,* 21(2), pp. 164-P7.

Yumibe, J. (2009b) 'On the education of the senses: synaesthetic perception from the 'democratic art' of chromolithography to modernism', *New Review of Film and Television Studies,* 7(3), pp. 257-274.

Zilczer, J. (1987) '"Color Music": Synaesthesia and Nineteenth-Century Sources for Abstract Art', *Artibus et Historiae,* 8(16), pp. 101-126.

Zilczer, J. (2005) 'Music for the Eyes: Abstract Painting and Light Art' in Brougher, K, Strick, J., Wiseman, A., Zilczer, J. (eds.) (2005) *Visual Music: 1905-2005*. New York: Thames & Hudson.

Zilczer, J. (2016) 'American Rhapsody: From Modern to Postmodern in Visual Music', in Kaduri, Y. ed., *The Oxford Handbook of Sound and Image in Western Art*. New York: Oxford University Press.

Zkm.de, (n.d.) 'Larry Cuba 16 mm films'. [online] Available at: https://zkm.de/en/16-mm-films [Accessed 11 July. 2018].

Zorin, S. (2005) 'Musical Color-Painting: In Memory of Yu. A. Pravdyuk', *Leonardo,* 38(1), pp. 61-65.

FILM, VIDEO AND VISUAL MUSIC WORKS CITED

Organised chronologically

Ruttmann, W. (1921) *Lichtspiel Opus I* [Film], Germany

Eggeling, V. (1921-22) *Horizontal-Vertickal-Messe I-III (*Horizontal Vertical Orchestra*)* [Film], Sweeden

Richter, H. (1921-25) *Film ist Ryhthm* (Film is Rhythm, later known as *Rhythm 21*) [Film], Germany

Ruttmann, W. (1923) *Opus II* [Film], Germany

Ruttmann, W. (1924) *Opus III* [Film], Germany

Léger, F and Murphy, D. (1924) *Images Mobiles* (Mobile Images, later known as *Ballet Méchanique*) [Film], France

Clair, R. and Picabia, F. (1924) *Entr'acte* [Film], France

Ruttmann, W. (1925) *Opus IV* [Film], Germany

Eggeling, V. (1925) *Symphonie Diagonale* (Diagonal Symphony*)* [Film], Sweeden

Hirschfeld-Mack, L. (1925) *Dreiteilige Farbensonatine* (Three Colour Sonatinas) [Performance], Germany

Laszlo, A. (c.1925) *Die Farblichtmusik* (Colour-Light Music) [Performance], Germany

Fischinger, O. (c. 1926) *Raumlichtmusik* (Space-Light Music) [Film and Performance], Germany

Fischinger, O. (1929-1934) *Studie* films (Study) [Film], Germany

Maholy-Nagy, L. (1932) *Tönendes ABC* (Sound ABC), [Film], Germany

Ruttmann, W. (1930) *Weekend* [Film without Images], Germany

Bute, M. (1935) *Synchromy No.2* [Film], US

Fischinger, O. (1936-43) *Allegretto* [Film], US

Bute, M. (1937) *Parabola* [Film], US

Lye, L. (1939) *Swinging the Lambeth Walk* [Film], UK

Bute, M. (1939) *Spook Sport* [Film], US

Gatti-Blanc, C. (1939) *Chromophonie* [Film], Switzerland

McLaren, N. (1940) *Boogie Doodle* [Film], Canada

Fischinger, O. (1940) worked on section of *Fantasia* [Film and Animation], US

Bute, M. (1940) *Tarantella* [Film], US

Bute, M. (1947) *Polka Graph* [Film], US

Fischinger, O. (1947) *Motion Painting* [Film], Germany

Bute, M. (1948) *Colour Rhapsodie* [Film], US

Stokes, C. (c. 1940s) *Auratone* [Film], US

McLaren, N. (1949) *Begone Dull Care* [Film], Canada

Bute, M. (1952) *Abstronic* [Film], US

Cage, J. (1951) *Imaginary Landscape No. 4* [Music], US

Lye, L. (1952) *Colour Cry* [Film], UK

McLaren, N. (1952) *A Phantasy* [Film], Canada

Hirsch, H. (1952) *Come Closer* [Film], US

Malina, F. (1954) *Transparent Sinusoidal* [Kinetic Art], US

Malina, F. (1954) *Chromie No. 1* [Kinetic Art], US

Malina, F. (1954) *Chromie No. 1* [Kinetic Art], US

Malina, F. (1955) *Illuminated Wire Mesh Moiré* [Kinetic Art], US

Malina, F. (1955) *Jazz* [Kinetic Art], US

McLaren, N. (1955) *Blinkity Blank* [Film], Canada

Whitney, James. (1957) *Yantra*. [Film] US

McLaren, N. (1957) *A Chairy Tale* [Film], Canada

Whitney, James (1957) *High Voltage* [Film] US

Whitney, John (1957) *Arabesque* [Film] US

Hains, R. (1958) *Etude aux allures* [Film and Experimental Television], France

Valensi, H. (1959-60) *La Symphonie Printaniére* [Film], PLACE

Kamler, P. (1959) *Continu-Discontinu* [Film and Experimental Television], France

Kamler, P. (1960) *Reflets* [Film and Experimental Television], France

McLaren, N. (1960) *Lines-Vertical* [Film], Canada

Brisset, J. (1960) *Objets animés* [Film and Experimental Television], France

Brisset, J. (1960) *Caustique* [Film and Experimental Television], France

Brisset, J. (1960) *Fer chaud* [Film and Experimental Television], France

Brisset, J. (1960) *Tic Tac* [Film and Experimental Television], France

Kamler, P. (1961) *Danse* [Film and Experimental Television], France

Paik, N. (1963) *Kuba TV* [Video Installation], Germany

Paik, N (1963) *Exposition of Music – Electronic Television* [Installation], Germany

Kamler, P. (1964) *Galaxie* [Film and Experimental Television], France

Brisset, J. (1964) *Dans ce jardin atroce* [Film and Experimental Television], France

Kamler, P. (1965) *Tournoi* [Film and Experimental Television], France

Galeyev, B. (1965-66) *Prometheus* [Film], Russia

McLaren, N. (1965) *Mosaic* [Film], Canada

Kamler, P. (1965) *Etude 65* [Film and Experimental Television], France

Malina, F. (1965) *The Cosmos* [Kinetic Art], US

Malina, F. (1965) *Flowers* [Kinetic Art], US

Malina, F. (1966) *Entrechats II* [Kinetic Art], US

Kamler, P. (1966) *Lignes et Points* [Film and Experimental Television], France

Whitney, James. (1966) *Lapis.* [Film] US

Kamler, P. (1966) *La Planéte verte* [Film and Experimental Television], France

Kamler, P. (1966) *Délicieuse Catastrophe* [Film and Experimental Television], France

Malina, F. (1966) *Three Figures I* [Kinetic Art], US

Malina, F. (1967) *La Maresillaise* [Kinetic Art], US

McLaren, N. (1967) *Pas de Deux* [Film], Canada

Kamler, P. (1968) *Meutre* [Film and Experimental Television], France

Kamler, P. (1968) *Araignéléphant* [Film and Experimental Television], France

Siegel, E. (1968) *Einstine* [Video], US

Galeyev, B. (1969) *Eternal Movement* [Film], Russia

Vasulka, S. and W. (1969) *Participation* [Video], US

Vasulka, S. and W. (1970) *Calligrams* [Video], US

Vasulka, S. and W. (1970) *Decay I* [Video], US

McLaren, N. (1972) *Syncrhomy* [Film], Canada

Sandin, D. (1973) *Five-minute Romp through the IP* [Video], US

Cuba, L. (1974) *First Fig* [Film], US

DeWitt, T. (1974) *Philharmonia* [Video], US

O'Neill, P. (1974) *Sangus Series* [Film], US

Vasulka, W. (1974) *C-Trend* [Video], US

Vasulka, S. and W. (1974) *Soundsize* [Video], US

Galeyev, B. (1975) *Small Triptich* [Film], Russia

Kamler, P. (1975) *Le Pas* [Film and Experimental Television], France

Sorensen, V. (1975) *Temple* [Video], US

Beck, S. (1976 or 78) *Video Weavings* [Video], US

Sorensen, S. (1976) *VideOcean* [Video], US

Cuba, L. (1977) worked on section of *Star Wars* [Film], US

Le Grice, M. (1977) *Arbitrary Logic* [Video], UK

Patel, I. (1977) *Bead Game* [Film], Canada/India

Petty, S. (1978) *Furies* [Film], US

Cuba, L. (1978) *Two Space* [Film], US

Vasulka, S. (1978) *Violin Power* [Video], US

Galeyev, B. and Vanechkina, I. (1981/86) *Space Sonata* [Video], Russia

Sorensen, V. (1981) *Voyage* [Video], US
Sorensen, V. (1982) *Little Wing* [Video], US
Vasulka, W. (1983) *The Commission* [Opera], US
Scroggins, M. (1983) *Saturnus Alchimia* [Video], US
Scroggins, M. (1983) *Study No. 7* [Video], US
Sorensen, V. (1983) *Rejuvination* [Video], US
Cuba, L. (1985) *Calculated Movements* [Film], US
Vasulka, S. and W. (1986) *Voice Windows* [Video], US
Goldberg, T and Truax, B. (1985) *Divan* [Computer Video], US
Brakhage, S. (1986) *Night Music* [Film], US
Goldberg, T and Truax, B. (1987) *The Wings of Nike* [Computer Video], US
Brakhage, S. (1988) *Rage Net* [Film], US
Sorensen, V. (1988) *Concurrence* [Video], US
Goldberg, T and Truax, B. (1989) *Beauty and the Beast* [Computer Video], US
Whitney, John (1989-93) *Moondrum* [Film] US
Maxwell, S. (1989) *Please Don't Stop* [Film], US
Galeyev, B. and Vanechkina, I. (1989) *The Temple (in the kith style)* [Video], Russia
Galeyev, B. and Vanechkina, I. (1989) *The Temple (in the style of Joan Miro)* [Video], Russia
Galeyev, B. and Vanechkina, I. (1989) *Ballad for Bernt (in the style of W. Kandinsky)* [Video], Russia
Galeyev, B. and Vanechkina, I. (1989) *Harmonia Viva (in the style of Salvidor Dali)* [Video], Russia
Galeyev, B. and Vanechkina, I. (1990) *Dance of vertical line* [Video], Russia
Galeyev, B. and Vanechkina, I. (1990) *Dance of white vertical line* [Video], Russia
Galeyev, B. and Vanechkina, I. (1991) *Frogs Symphony* [Video], Russia
Goldberg, T. and Truax, B. (1991) *Pacific Dragon* [Computer Video], US
Galeyev, B. and Vanechkina, I. (1990) *Russian Terminator* [Video], Russia
Goldberg, T. and Truax, B. (1992) *Song of Songs* [Computer Video], US
Goldberg, T. and Truax, B. (1992) *Night of the Conjurer* [Computer Video], US
Kapuscinski, J. (1992) *Mondrian Variations* [Video], Poland, US
Sorensen, V. (1992) *MAYA* [Video], US
Neubauer, B. (1996) *Roots* [Film], Germany
Neubauer, B. (1997) *Moonlight* [Film], Germany
Sorensen, V. and Puckette, M (1996-1999) *The Global Visual Music Project* [Art Technology Research Project], US
O'Brien, G. and Reynolds, H. and Dennehy, D. (1997) *Junk Box Fraud* [Video for Music Performance], Ireland
McDonnell, M. (1997) *Dazzling and Blinding* [Video], Ireland
Reeves, R. (1997) *Linear Dreams* [Film], Canada
Sorensen, V. (1997) *Lemma 1* [Performance], US
Hyde, J. (1998) *Zeotrope* [Video], UK
McDonnell, M. (1998) *Edges* [Video], Ireland
McDonnell, M. (1998) *Towards One* [Video], Ireland
Sorensen, V. (1998) *Lemma 2* [Performance], US
Maxwell, S. (1999) *Nocturne* [Film], US
Maxwell, S. (2000) *Fragment* [Film], US

APPENDIX I: COLOUR INSTRUMENT INVENTIONS

Several authors have provided lists of the colour-tone analogies and colour organ inventions since Louis-Bertrand Castel. An illustrated version, for example, is provided by Golan Levin (1994) and a more general list of 'audio-visual installations, utopian projects and machines' is supplied by Philippe Junod (2017). The following table lists the various inventions pertaining to playing colour in a manner of playing music – an instrumentation of mobile colour. It has been put together from a number of sources, including the research of the author into the colour organs (Galeyev, 1988; Peacock 1988; Levin, 1994; Maur, 1999; McDonnell, 2002; Betancourt, 2004; Collopy, 2004; Vergo, 2005, 2010; Elder, 2008; Smirnov, 2012; Junod, 2017; Lucassen, 2008).

Year	Inventor	Invention
1527	Giuseppe Archimboldo	Musical notation in colours and a zither to play them
1591	Mauro Cremonese	Clavecin de Mauro/ Gravicembolo
1725*	Louis-Bertrand Castel	Clavecin oculaire/ Ocular Harpsichord
1739*	Lorenz Christoph Mizler	Generalbass-Machine
1743	Johann Gottlob Kruegger	Farbeneclavecymbel
1769	Edme-Gilles Guyot	Musique oculaire/ Oculer music
1781	Philippe Jacques Loutherbourg	Eidophysikon
1788	K. von Exkartshausen	FarbenKlavier
1789	Erasmus Darwin	Argand oil lamp projection
1791	Karl von Eckartshaussen	Colored-liquid clavichord
1819	David Brewster	Kaleidoscope
1844	D.D. Jameson	Colour music instrument
1879*	Frederick Kastner	Pyrophone
1877*!	Bainbridge Bishop	Colour organ [The instruments for displaying color]
1889	Louis Favre	Clavier de couleurs/ Colour organ
1893	William Schooling	Projec de clavier de couleurs/ plans for colour organ
1893	Alexander Wallace Rimmington	Colour-organ [Method of and apparatus for producing colour effects]
1900 !	E.G. Lind	Projet d'instrument/ Plans for an instrument
1901	James M. Loring	Musical chromoscope
1901	Ernst Ruhmer	Photographophone

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1903	Edmond Tardif	Phonochrome
1908	Arnalda Ginna & Bruno Corra	Colour organ
1911	Alexander Scriabin*	Home "light instrument"
1912	Orgues Lumineuses	Abel Gance
1912	Fournier d'Albe	Optophone
*1912**	Vladimir Baranoff Rossiné	Optophonic Piano. Demonstrated 'optophon' in 1919
1915	Preston Miller & Modest Altschuler	Chromola (for Scriabin's *Prometheus, The Poem of Fire* performance)
*1917**	Claude Bragdon	Luxorgan
1919	Louis Artus	Chromophone
1919	Charles F. Wilcox	Method of producing musical compositions through the medium of colour
1919	Henry Fitch Taylor	Means for detaining colour combinations
1921	Adrien-Bernard Klein	Colour projector
1921 !	Alexander Burnett Hector	Colour projector for stage [Apparatus for producing color music]
1917 !	Alexander Burnett Hector	Production of colour music and other luminous effects on apparatus therefor
1922 !	Alexander Burnett Hector	Producing color music and other spectacular luminous effects
1926 !	Alexander Burnett Hector	Apparatus for producing color music and other spectacular luminous effects
*1916**	Morgan Russell	Study for kinetic light machine
1919	Thomas Wilfred	First clavilux
1922	Richard Lowstrom	Projector
1920s	Staunton MacDonald-Wright	Kinetic light machine plans, color organ
1921	Arthur C. Vinageras	Chromopiano
*1924**	Zdeněk Pešánek	Colour keyboard. Spectrophone
1925	Sandor (Alexander) László	Sonchromatoscope
1920	Mary Hollock-Greenewalt	Rheostat
1920	Mary Hollock-Greenewalt	Illuminating means
1921	Mary Hollock-Greenewalt	Notation for inducting lighting effects
1923	Leon Theremin	Illumovox (instrument to control the colour of a light beam during a musical performance)
1927	Mary Hollock-Greenewalt	Associating light and music

1928	Mary Hollock-Greenewalt	Means for controlling light
1929	Mary Hollock-Greenewalt	Instrument for light and colour play
1929	Mary Hollock-Greenewalt	Control system for light and coluor players
1931	Mary Hollock-Greenewalt	Current translating mechanisms
1931	Mary Hollock-Greenewalt	Lighting appliance
1932	Mary Hollock-Greenewalt	Motor-actuated switches
1934	Mary Hollock-Greenewalt	Light color instrument
1919	Maude Maple Miles	Applicance for displaying colors
1922	Raoul Hausmann	Optophone
1922	Ludwig Hirschfeld-Mack	Reflektorische Farblichtspiele (Colour-light plays)
1922	Kurt Schwertfeger	Colour-light plays
1927	Hazel H. Adler	Device for selecting colors
1927	Alexander E.O. Munsell	Color piano
1928	G.I. Gidoni	Light grandpiano
1924	Loyd A. Jones	Apparatus for Producing Kaleidoscopic Designs
1924	Wilhelm Schmeer	Key instrument for examining color music
1930	Laszlo Moholy-Nagy	Lichtrequisit (Light-Space Modulator)
1930s	George L. Hall	Musichrome
1930s	Leon Theremin	A version of the Terpsitone (with automatic coloured light accompaniement
1930	Baron Anatol Vietinghoff-Scheel	Chromatophon
1930 ! *1930* *1933*	Thomas Wilfred	Clavilux [Light – projection display] Light – Projection Display Light – Projection Display
1931	Richard M. Craig	Radio color organ
1934	Charles Blanc-Gatti	Chromophonic orchestra
1932*	Fred Bentham	Light console and compton organ for colour music
1932	Clinton W. Hough	System for projecting light in variant colours
1934	N.M. Varzin-Riazhsky	Device to accompany gramophone recordings with light pictures
1934	Leningrad State Optical Institute	Kinemachrome system
1936	Charles Dockum	Mobilcolour IV
1938	Ernest Nenfleat	Light Projection Display Means

1942	Cecil Stokes	Process and apparatus for producing musical rhythm in colour
1945	W. Christian Sidenius	Colour organ
1950	Charles Dockum	MobilColor projector
	Achille Ricciardo	Teatro del Colore
1953	Gordon Pask & McKinnon Wood	Musicolour Machine
1955 !	Oskar Fischinger	Lumigraph [Device for producing light effects]
1956	Nicholas Schöffer	Musiscope
1957	E.A. Murzin	ANS – photo-electronic music synthesizer
1960	Hermann Goepfert	Optophonium
1960	Lloyd G. Cross	Sonovision
1960*	Stanton MacDonald-Wright	Synchrome Kineidoscope
1962	Frank Malina	Chromie
1963	Frank Malina	Lumidyne, Reflectodyne
1966	Richard I. Land	Chromara
1974*	Laurie Spiegel	VAMPIRE
1983	Alexandre Vitkine	Sonoscope
1994	Louis Boffard & Daniel Paquette	Sonochromovideo, chromosonographs for piano oculaire
2000	Jack Ox & David Britton	The 21s Century Virtual Reality Color Organ
2001	Rodney Graham	Phonokinetoscope
2004	Natalia Sidler	Farblichflugel

Dates with an * denote that in the sources, different dates are presented for the date of the invention. Dates with ! denote the date of a patent application acceptance.

Appendix II: Maura McDonnell – 'Dazzling and Blinding' (1997)

OVERVIEW - A VISUAL *CONCRÈTE* EQUIVALENT TO MUSIC *CONCRÈTE*

Subtitle: '*The surface as a changing field of coloured textures and an interpretation of music gestures in an analogy with the dynamic, timbre and rhythms of music*.'

TITLE OF WORK – 'DAZZLING AND BLINDING'

The fixed media video work '*Dazzling and Blinding*' (McDonnell, 1997) is a short forty-five second abstract moving image piece created in 1997 that was set to an extract of a recording of the music composition '*Verblendungen*' by Kaija Saariaho (Saariaho, 1984) for orchestra and computer tape. The title was taken from the English translation of the music's title.

ARTISTIC IDEAS AND KEY INFLUENCES – MUSIC CONCRÈTE IDEAS IN VISUAL FORM

The motivation for the creation of the visuals was to mimic the techniques and the operative processes used by computer music technology to manipulate recorded sounds. These operative processes and techniques from audio editing were translated into a method of working with images in digital video editing software in the computer. In an analogy with the music technology processes, existing digital images of natural objects were to be manipulated into new images using similar processes. Therefore, artistic ideas were initially led by an interest in the use of technology and by a curiosity to experiment with the potential of editing to create new imagery through recombining multiple tracks of images. The artistic impulses, however, were also analogical. There were two analogies taken from music technology approaches to working with sound and music that were explored in the visual part of this piece, one that was technological and the other conceptual.

Technology-led analogies pertaining to the operations made available in the computer software interfaces for manipulating the digital information of sound in the computer — such as: simple operations of copy and paste; duplicating a track multiple times; merging the sounds of multiple tracks to create new sounds; varying the pitch through time stretching; reversing sounds and many sound editing techniques — were compared to the operative processed available in the digital video platform. For example, similar methods available in digital video were: multiple layers could contain separate footage items or images; layers could be duplicated, copied to any point in time, reversed, cut, superimposed, mixed by using colour blending, masking and keying techniques; or layers could be arranged and assembled side by side. Both the audio editor and the video editor in the computer comprised non-linear timelines, making such movability of audio or video information in time possible. Without having knowledge of film or video editing, the operational concepts from sound editing were translated intuitively into a way of operating with image and video files that were imported and manipulated in analogous ways. In Table 1,

comparisons are made between the audio and video editing techniques and the similar operative processes observed between audio and video editing (see Table 1).

The application of such manipulation techniques in digital audio often creates an entirely new sound. The original sound acts as a source material for the generation of a new sound. It was exciting to think that an image could be operated on as if it were a sound object and that this process resulted in endless possibilities of creating new manifestations of colours and forms and textures, through the use of this technology led method and technique. The author conceived of the techniques and methods used to build new imagery from source and found footage material to be the equivalent of a music *concrète* in the visual domain. The image was viewed as an object in itself that had no longer any reference to its original representation, or to its original source, but to be worked with in terms of its potential to create colours, light, shade, new forms and abstract textures. The new image had new meanings, that meaning coming from its new artistic contexts.

Table 5 Visual *concrète* techniques – similarities between audio and video editing techniques

Similar operative processes in audio editing and video editing	
Audio	**Video**
Tracks	Layers
Non-linear timeline	Non-linear timeline
Multiple channels of audio - tracks	Multiple footage items - layers
Cut, copy, paste, reverse	Cut, copy, paste, reverse
Mix tracks	Blend layers
Arrange and organise sound events in stereo space and in time	Arrange and organise image elements in the space of the frame and in time
Apply filters and 'process' sound	Apply filters and effects and 'process' colour

The analogy of image to sound in terms of manipulation through technology drove the artistic goals in the piece. Both music and image were deemed to have similar qualities and characteristics pertaining to movement and rhythm. This movement and rhythm acted at the macro-level and were easily recognisable, such as, the movement of an object across the screen in the video and the movement of the melodic line in the music, and its upwards or downwards trajectory and contours. At the micro-level, due to an understanding of sound as grain and sinewave, and as vibratory phenomenon, the micro-motions and rhythmic effects that underpin the temporal evolution of timbre were emulated with a temporal manipulation of the imagery at

the level of the pixel. Short source video recordings (commonly known as 'found footage') were chosen that had qualities of temporal and rhythmic movement in it. It did not matter what that source was, but it was the quality, speed and evidence of a variety of motions and movements that was sought. They were manipulated into new abstract images, but the essential quality of rhythm and movement remained, creating an interesting trace with the original source.

MUSICAL QUALITIES – LAYERS OF SOUND

The music was a very important foundation for the setting of the images. What was studied in the music was not the score but a 'listening-to' the sounds and 'coming-to-know' the sounds and the composition extract as a whole. The sounds and the sound events acted as things in themselves with their already fixed temporal evolutions of pitches, timbres, melodies and rhythms. Other events were noted and came to be known too; these events were invisible, but were felt and perceived subjectively, such as, the motions and gestures that were perceived through experiencing the music through repeated listening. The music had to become known and made familiar. The short extract chosen from the music recording became the timeline for the timing of the changes and events in the images. Another analogy operated here, where the images and their events, and their changes and transformations, were threaded together with the already existing events in the music. The music suggested treatments for the images. Associations and ideas formed as to how to make correspondences between the music and the images. The music was conceived as having several simultaneous and separate layers, there was an overall long evolving timbral layer, which was the computer tape part of the music and, at other times, there were the sounds of extended piano sounds. The tape part suggested a base layer of sound with a sensation of vibration and a long duration that was perceived as operating throughout the extract as if it was a background sound from which all the other sounds emerged into the orchestration of the music. Tying an analogous background imagery that could exhibit similar micro-motions and temporal fluctuations of image material to the perceived background taped sound was explored through experimentation. An artistic idea formed in which a continuous field of colour and texture with minutiae motions was desired for this visual part. Once this ground was set – a matching of a similarly timbral-like motion in the music background to a similarly crafted temporal imagery – the piece evolved quickly. The parts of the whole were crafted. Small motifs of melodies and rhythms that suggested a sensation of 'upwardness' were matched by the animation of images moving upwards. Quieter, more sparse music passages were matched to dark black backgrounds with slower and subtle motions applied to fluctuating white lines that sometimes suggested forms and, at other times, suggested texture. A diagonal stretched imagery that animated diagonally from top to bottom was matched to a dense music passage of fluctuating

timbres and rhythms that suggested sunlight breaking through forest trees and a kind of scattering and dispersion of sound material.

Music acted as a highly structured timeline from which to build the motions and evolution of imagery and also as a sensorial response which was also sought to emulate with imagery. It is interesting to examine Saariaho's score and the notation instructions for the markings for various classes of sounds, for example, a continuous motion curve denotes both particular extended techniques for the piano part, where the pianist must 'stroke the strings with timpani mallets on the indicated pitch area, to produce a continuous soft tone field,' this notation was also used to denote pitched string material sounds in the tape parts (see Figures 72 to 74).
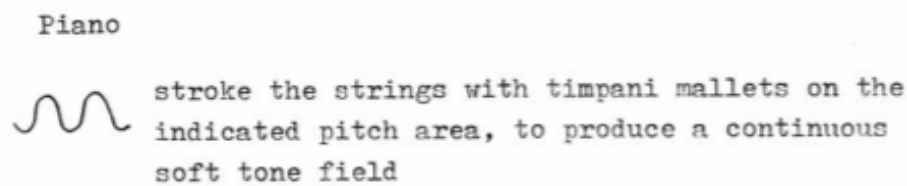

Figure 73 - 'Verbenglunden' - notation for an extended piano technique
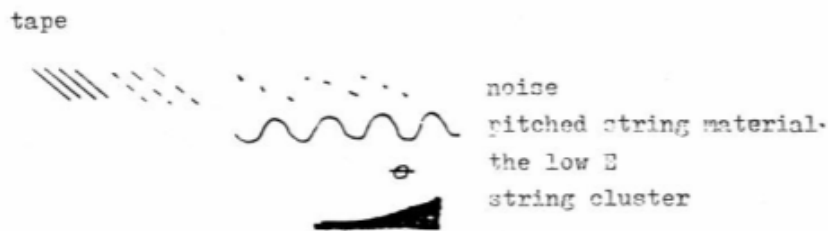

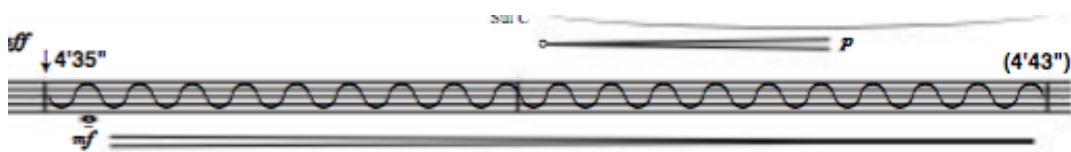Figure 74 - ' Verbenglunden' - Tape notation marks explained in the score

Figure 75 - Pitched string material for tape part indicated in the score for 'Verbenglunden'. Source: REF

It is interesting that the pitched string material in the tape part of the score is represented by a continuous harmonic motion. The description of the technique for the piano, which describes a continuous soft tone field, is analogous to the creation of a 'timbral-like' background image consisting of minute motions in a fixed surface.

BACKGROUND MUSIC TEXTURE – BACKGROUND MICRO-MOTION IMAGE

Source imagery was chosen for its speed of movement and its use of the screen space. A short found footage video-recording clip of a musician playing a very fast piece of music using a stride piano technique was manipulated and started to get the results desired. Colour effects were applied as well as reshaping the video footage into a circular shape, using Polar Co-ordinate techniques. Many manipulations were experimented with, until the desired rhythmic and motion effects were reached. The result was a greeny fixed surface that consisted of subtle motions of textures (see 2. in Figure 4), which, to the author, was analogically and metaphorically close to the sensory quality of musical timbre.
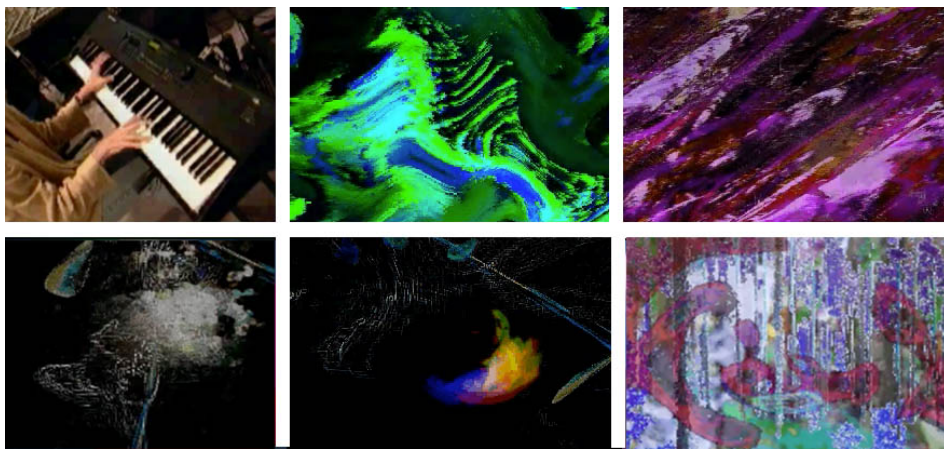

Figure 76 – Frames from 'Dazzling and Blinding' L-R: 1. Frames from the original stride piano video clip; 2. Manipulation of the clip to emulate the timbre of the tape part of the music by creating a micro-motion field of colours and textures; 3. Further manipulations to create directional textures; 4. Black scene matched to quiet music.

MULTIPLE LAYERS AND COLOUR KEYING

A video and image-editing technique that evolved was to layer multiple images in simultaneous timelines in adobe premiere 2.0 (1998) and use colour-keying and opacity blending of the layers to enable parts of a layer to peep through another layer. This is of course a form of superimposition and compositing in video and film editing. What is different, however, is that the compositing was done to create interesting interactions of colour and to look for colour results. It is also analogous to the blending that can be done with channels of sound in a sound editor, whereby the result is a new sound consisting of the merging of sound information to such a close extent that one no longer recognises the separate channels of sound. This 'blending' of layers technique was experimented with extensively and, at some points, in the master timeline, there were up to twenty layers interacting through this method. This resulted in very dense textures that created scatterings of colour and fast changing form effects over the whole surface of the frame (see Figure x).

Figure 77 L-R: 1. The final composite image of subsequent layers; 2. One layer consisting of a synthetic image crafted digitally; 3. Another layer consisting of a view upwards into trees; 4. Another layer with a view of tress.

This process was crafted in the vertical dimension. At one point in time, the layers would be worked with to obtain a desired colour and colour field effect that could only exist in the interaction of the multiple layers through the keying out of specific colours in each of the layers. This often resulted in unknown and unforeseen results in the previous and subsequent frames of the layered footage, but results that were considered to be exciting and relevant for the most part.

TEMPORAL COLOUR RHYTHMS AND MOTIONS

Although many of the source footage were still image found footage items, the multiple layer technique created a variety of colour effects. Animation was applied to the scaling and position of individual layers in the spatial frame at different points of time. The software provides one with a frame view; so, arranging image objects and layers spatially was a case of dragging the later around in the frame view. This was keyframed and, at another point in time, the images in the layers were assembled spatially by dragging and arranging in the frame view. The software was able to interpolate between the values set for scaling and position in a process referred to in animation as 'tweening' or 'in-betweening'. Such simple geometric motions applied to multiple image sources and clips in multiple layers, created new textures and motions that arose only through this editing and transformation of footage in layers. The result was a mobile colour that was tied to the pixel surface of the frame. The software calculates each pixel 's new colour information on a frame-by-frame basis using various forms of mathematical operations such as add, subtract, multiply. Each blend mode has its own set of calculations that operate on the colour and brightness information of the pixel. This technique resulted in what could be described as a painterly image, or a form of motion painting, because the surface as it were came alive through this pixel-by-pixel, frame-by-frame series of changes. Artistically, however, the images were arranged and blended at specific frames and the calculations available in the computer conducted the interpolation of the pixel values in the in-between frames. The result was a mixture of manual artistic choices and computational calculations by the software in its interaction with the technology and medium of the computer screen surface to re-present the frames in time.

Musique concrète techniques have been translated into a method for working with images. The original source image has been used as an autonomous independent object. It is not being used for its original representational content, but as a source for creating a new form and content. In a manner similar to the painters exploring new content at the turn of the twentieth century, the various types of content examined are: the speed and pace of movement and change within a static element of a frame in a moving image; the reflection of light and its position within a frame; the relationship between the light and dark tonal regions in an image; the balance of colours and their relationships side-by-side. One could say that the perceptual and sensory qualities within an image are worked with. Many images were gathered of natural objects, consisting of video recordings and photographs of nature and each were categorised into these main categories of examination as mentioned above. From these images, the very qualities examined became the foundation for a way of working with these images as objects. The final images that you see in the final frame have been constructed from these categories. These new constructed images are a new reality and belong to the world of the art work.

VISUAL MUSIC RELATIONSHIPS

This first piece was a step into the unknown in terms of relating the images to the music, the initial interest was to work with music technology ideas and *musique concrète* techniques pertaining to applying similar operative processes to video and image files. The music was to be a sound-track to support the images. As the piece evolved, however, the music became an essential foundational aspect in terms of inspiration, structure in space and time and temporal plan, and became one of the main parts of the work, but it was a music shared with moving images in a phenomenological sense. Music had gestural qualities of movement, direction, speed, pace, upwardness, quietness, loudness etc. that were felt by the author. These gestural aspects of music, as well as an interest in the micromotions of the timbre of the tape part of the music, were conceived as a hidden type of structure that underpinned the sounds' behaviours and their interactions with each other and their relationship with the whole of the work both in and through time. There were sounds that could be perceived separately but also sounds that seemed to merge and become one timbre. There were senses of melodic material through time that then seemed to morph to rhythmic material to become then part of a whole timbre, a unit of sound. So too in the images, there were images that could be perceived as separate objects in the frame but also, at times, objects and separate images seemed to merge and morph into each other, colours and their movements created forms that changed and transformed, appeared and disappeared, merged and separated from the whole of the frame. The analogies were very strong in the creation of this work that the author

could not distinguish between what was a sound or what was an element of image, deciding to perceive both as material. The material that was moulded into creating one unified work of sounds and images.

MUSICAL PAINTERLY SURFACE

The action of the visuals takes place in the surface of the projection or screen on which the visuals are played. The conception of the frame as a surface, in particular as a type of musical responsive surface, is a very different conception of the film or video frame as a piece of recorded natural reality that has a sense of space and a logic that belongs to the natural world of our environment. We, as viewers, orient ourselves to this environment and make sense of the spatial logic presented to us. In this piece, the frame itself acts like a painting surface that has its own logic that belongs to that particular surface. It is not a real world logic. The logic belongs to the colours and forms crafted in it and to the unfolding of the music in a close relationship with these colours and forms. One could call this surface a type of musical painting surface. The painterly surface is musical in its close expression with the music of the sound track or music performance. The surface is also musical because it has an analogy with the invisible and hidden forces in music's unfolding, and these are its rhythm, direction, pace, and speed. All such actions take place in this surface and are its main concern. To encounter this as an artwork means an audience is both engaged with a musical listening to a lively contemplative painting.

BUILDING COMPLEX LAYERS OF MEANING BY FOCUSING ON SIMILAR MOTIONS.

The musical aspect most mirrored by the visual composition is music's timbre. The behaviour of the orchestral instruments and the tape part as scored by Saariaho creates shimmering (see Figure 1,2,3). The shimmering is taking place in both the visual and the music. The spirit of the music lives in the spirit of the visual through a matching of motion effects between the two domains. The crafting of the visual was done by hand and endless editing and merging of layers, so that a very complex surface is created of which multiple shimmering colour, minutiae forms are interacting as if they were in concert with all that is taking place in the music.

Right click image to play in word document. Click image to play in pdf document
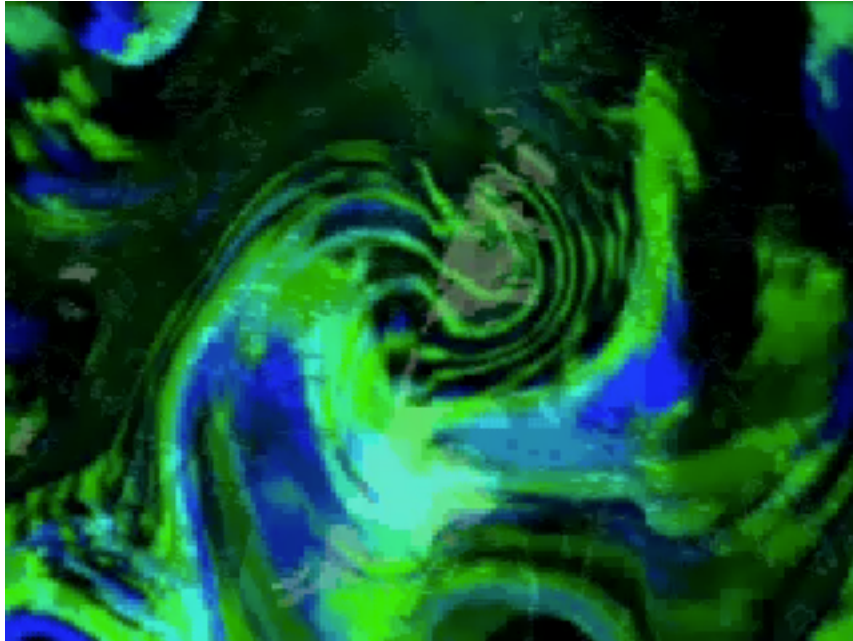
Title: Dazzling and Blinding
Year: 1997
Visuals: Maura McDonnell
Music: Extract from '*Verblendungen*' by Kaija Saariaho (1984)
Duration: 45 seconds
Format: Quicktime, 320 by 240

Appendix III: Maura McDonnell – 'Edges' (1998)

OVERVIEW - A MONTAGE OF MOTION FRAGMENTS

Subtitle: *The drama and emotion of music and words explored in the manipulation and montage of spatial and temporal fragments of video recorded images*

TITLE OF WORK – 'EDGES'

The fixed media video work '*Edges*' (McDonnell, 1998b) is a four and a half minute abstract moving-image piece created in 1998 that was set to a re-mix of several extracts from computer music compositions by composer Barry Truax from his CD, 'Digital Soundscapes' (Truax, 1987). The extracts were taken from: 'Solar Ellipse' and 'Riverrun'. The title of this visual music piece comes from a short poem '*Edges*' by the author that was written specifically for this piece and spoken at a very low volume near the end.

ARTISTIC IDEA – A CRAFTED WORLD - DIGITAL SOUNDSCAPE WITH DIGITAL VISUALSCAPE

The motivation for creating this piece was to explore artistic interpretations of a conceptual idea. The concept explored is in relation to the human being's place in the — what was considered then at the time as new — digital information age and how one's sense of identity was being disrupted to such an extent that it was hard to know where the boundaries of being a person could be found. For the author, the new digital tools for music making and moving-image making was enabling the possibilities for the creation of new aural-visual worlds that had their own reality, albeit a completely imaginative one. Digital tools for art and meaning making were breaking down barriers between the arts but it was changing the human being too. The poem was crafted to capture such sentiments and ideas. The images suggested by the poem, such as a person walking through a tunnel, not knowing where their boundaries were, in terms of their identity and the world around them, in a strange dream-like world, became the basis for choices made as to the subject matter of the images to work with (see Poem: Edges below).

Images were recorded with a digital video camera according to images suggested by the poem. These images were then manipulated in Adobe After Effects 2.0 in order to create short motifs that depicted the stages of the poem. They were re-worked using similar layering, blending and merging techniques as discovered in creating 'Dazzling and Blinding', but with the additional power of keyframing of effects available in adobe after effects. The music was created from a mix of short excerpts from Truax's music and they were also selected according to how they fit with the overall concept arising from the poem. When the images were captured and organised into layers and timelines and manipulated, they suggested new visualscapes, they were new 'real' places that occupied the temporal and spatial dimension of the viewing screen area and had the capability to affect us by appealing to our senses in a similar manner to how our senses engage

when we navigate the natural world. These 'places' in the work could not be called landscapes or seascapes, nor could they be understood in terms of a logical story-telling narrative; they consisted, rather, of scenes of colour, moving lines, strange arrangements of images, and multiple images in the same frame, which the author referred to as visualscapes. The result was a virtual visual world, never seen before, that made sense only to our sense of vision and our capacity to enter into an imaginary world through looking into or at the screen. It was, nevertheless, a world we could come to know.

INTERPRETING THE MUSIC

MUSICAL QUALITIES – A DIGITAL SOUNDSCAPE

Barry Truax's digital soundscape music compositions were considered to have a visceral, physical and powerful sensation for the author. Timbres of multiple pieces of time and frequency information, scattered for long durations across all the frequency domains, created a reaction where one had to just suspend and immerse oneself in the aural world. To the author, Truax's music suggested psychological states and other worldly dreamlike places and a movement and passage through these over time. What was of interest was the dramatic tension in the music, and the '*feltness*' of its gestures. The music was chosen then as being able to contribute another layer of meaning to the overall concept of identity that was being explored thematically. Similar to 'Dazzling and Blinding', however, this piece worked with the drama and events in the music as the structural organising principle for the timing of events taking place in the imagery. Again, this was not a strict mapping of music event to image event, but a matching of gesture, mood or dramatic tension. The music then suggested imaginary real places, motions, pacing, direction and mood.

'Solar Ellipse', one of the extracts of Truax's music, consists of sounds that have been composed to travel in an epicycle, 'where a spinning sound image (revolving four times per second) travels around an elliptical "orbit" similar to planetary motion' (Truax, 1988). Such spinning in the sound was matched by a form of cross motion technique devised by the author explained below and illustrated in table 2.

IMAGES

SPATIAL ORGANISATION OF MULTIPLE NESTED COMPOSITIONS AT PIVOTAL FRAMES

The composition of the frame was an important consideration in this piece. The original recorded video footage was planned in order to capture objects and a protagonist with attention to the composition of the frame, thus placing them in variations of being both up-close in the frame to being at a distance. The intention was to explore the possibility of creating dynamics of scale.

Some frames were close-ups of walls and faces; others were of movements across a surface of ivy and leaves on an ivy-clad wall to create a type of river-like texture. Recorded video footage was compiled into compositions in Adobe After Effects. After Effects enables one to build the imagery in compositions, providing access to multiple layers. One technique used extensively was to nest several compositions inside each other. Each composition comprising multiple layers of footage items and multiple effects and colour blending. After some time experimenting with these techniques to create complex motion textures, these were then used as layers in a new composition where the layers were spatially arranged into a quasi-3D setting. The intention was to suggest inner worlds. Compositions were blended to create interaction of colour between layers and thus bring forward new types of motion and new forms that arise in the new motion. The visual world then seems to be alive as it evolves and transforms as a result of all the complex layers interacting together. Markers in time were used to pin-point exact motions in the music of the soundtrack and to create a matching of motion idea in the visual element. The sense of spinning in the music was matched, for example, with the use of a circular warp effect that was keyframed and animate to slowly curl and uncurl. This was applied to images of the protagonist, thus enacting a transformation of a recognisable human form into its use as a visual object no longer referencing reality but being capable of such digital transformations in the space of the new visualscape (see Figure 78 no.5).
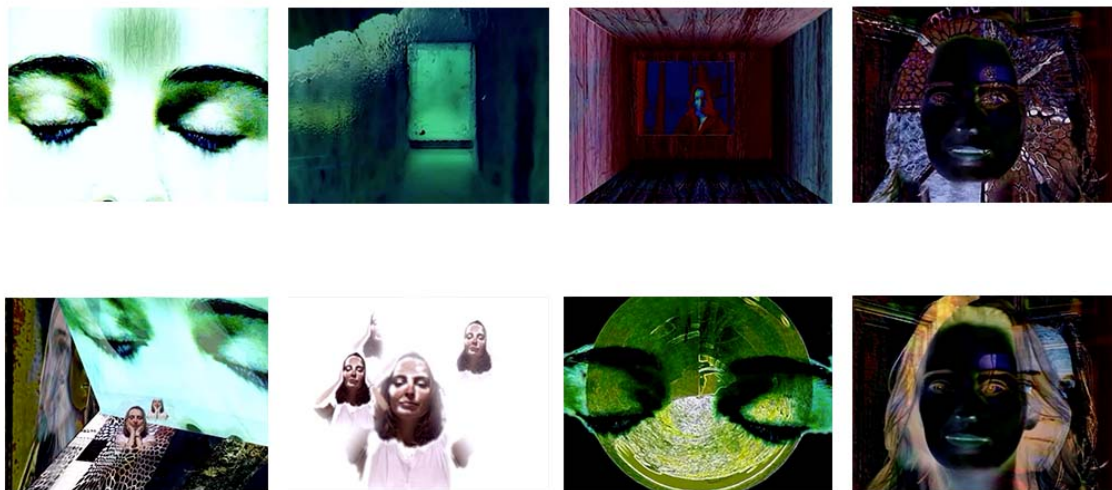

Figure 78 Frames from 'Edges' depicting composite compositions. L-R-T-B: 1. Tree in head; 2. Simultaneous contrary motion; 3. Spatial construction; 4. Layer constructions; 5. Multiple space and time duplication of image objects; 6. Stillness and motion; 7. Composite.
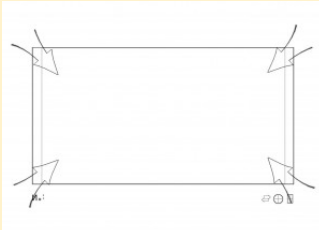
The author conceived of this digital transformation of the human form into circular warp motions as being similar to the evolution of a sound designed timbre using granular synthesis which the author had made and entitled 'Split' and in which the sound started off melodic and rhythmical

and recognisable as such but, as density and complexity was applied, the sounds started to gradually transform into the most intense distorted noise sound. The capability of the computer to enable a temporal transformation of recognisable content and to gradually manipulate and transform that content into something new gradually over time is common to both sound and image/ video editing.

The original camera recorded video footage consisted of simple movements. A pan across an ivy-leaf clad wall, a walk through a tunnel, the protagonist making movements with eyes and hands, the protagonist walking forwards or moving their head sideways. The music suggested many trajectories and paths. Through the construction process, layers of footage items were merged to create a mixture of simultaneous movements, each going in their own direction but, when mixed, creating interesting overall movement effects for the whole frame. One example of an approach to composing with motion was to create a simultaneous contrary motion from two footage items whose motions consisted of contrary directions and movements through space. Footage item 1 consisted of a zoom out from a close-up of an external object with a highly reflective surface to a broader view of the object in the scene. Footage item 2 consisted of a recording of a person walking through a tunnel, whereby natural perspective and distancing effects were created as the destination at the end of the tunnel was reached, suggesting a zoom in to a detailed wall (see Table 6 & Figure 78 no.2).

Table 6 Simultaneous contrary movements – through superimposition

Simultaneous contrary movements – through superimposition of two footage items	
Footage item 1	Footage Item 2
Zooming out of Outside Brass Ball Sculpture recording	Moving forward in tunnel towards stone wall recording
Zoom out movement – original recording Object recedes Object gets smaller More broad information is seen in the scene	Moving forward Object comes forward Object gets bigger More detail information is seen

Both of these items then had contrary motions in their content – one receding and moving further away, the other a type of *mise-en-scène* moving through a space to a close up of the end wall of the scene (see Table 5 for a comparison between the two motions).

This contrary motion was felt to emulate the multiple trajectory paths perceived in the movement of the sounds and timbres in the music (see Excerpt 1 in final section to view the excerpt from the piece 'Edges' demonstrating the simultaneous contrary motion in action in the piece).

ARCHITECTURAL CONSTRUCTIONS

A powerful facility for arranging and organising footage and clips in After Effects is the ability to geometrically transform the shape of a footage item in a layer through changing the position of the layer in the area of the frame. The layer can be skewed, rotated, scaled and using some of the plugins, the corner of the layers can be accessed to reposition the corners to a new shape. This was used extensively to construct imaginary spaces, using multiple already processed layers as walls and floors and ceilings. These spaces suggested impossible rooms and yet had the appearance of being an organised space, a kind of reality of sorts, recognisable through the use of perspective and depth in the arrangement of the layers. Rooms were crafted with layers comprising compositions of already manipulated footage, such as an animated colour effect applied to a movements across trees footage item (see Figure 6 no.3 and 5). All of these geometric positions could also be keyframed and animated over time to add another level of complexity in terms of motion.

KEYFRAMING

After Effects capability, even in this very early version of the software, could calculate and interpolate frame-by-frame changes between two sets of values set up in two frames spaced apart in time, known as keyframing. It is an animation technique that can be applied to graphical content, video content and generative content. It was used, in particular, to animate colour changes over time on a range of layers in the respective timeline. The hue and saturation of a layer was animated over time. This action was completed on several layers and then blended using keying filters that are normally used for bluescreen keying for compositing recorded live action images with a different background in post-production. The method of using keyframing was to arrange all the layers to be worked on in a timeline and to subsequently work on the colour interactions between all these layers using several plug-in colour effects available in the software. All the values that were chosen for these effects in this particular frame were keyframed. Then scrolling through the timeline, other frames were chosen to make some kind of change to these values and the effects were re-worked on this frame at that point in time. After Effects performed the interpolation of these values, according to the duration between the two sets of keyframed frames, and calculated the changes in the correct amount of steps aligned to the frame rate of the

composition. Compositions could be previewed and then re-worked until the desired effect was created.

One of the limits encountered in this work was the fact that most of the recorded footage was of a short duration. A library of video recordings was collected, each of these were a maximum of two seconds long. They were digitized through an analogue to digital video converter capture card and had to be stored then on the computer. At the time, this was due to the limitation of the storage mediums available for capturing and storing video footage. The computer had a 2GB hard drive. Hence, the workaround was to work with short fragments and to rely on assembling and organising them in time and blending and merging them in time.

Footage, once in the video-editing software, became layers in the timeline. Each layer had its own timeline, and so, the assembling of multiple layers took place. Several layers, consisting of the same original footage item content, could be presented at different points in time and thus staggering the entry point of each version of the footage, creating a type of counterpoint or echo of the original footage item. This created an interesting spatial rhythmic montage. So, where an image plays in time, the same image is superimposed and plays at a different point of time, thus creating a cross-over of the images, at several other points in time. For this piece, it was used in the spatial construction scene (see Figure 6 no.3) and can also be viewed below (Play Edges Excerpt 2).

ANALYSIS

AN INTEGRATED ART WORK

The poem was the starting point for the piece. Images and music were selected for their affinity with the meanings in the poem. In this way, this piece has a similar desire to merge the arts as Philipp Otto Runge desired in his planned work *Seasons of the Day* (2.2.4), referred to in chapter two of this thesis, which was to comprise poetry, paintings and music accompaniment. This was a digital integrated art work, of which the capability of mixing many medias and arts was a source of inspiration for the piece.

THE FRAME'S MULTIFUNCTIONAL ROLE AS PICTURE-MAKING SPACE AND FINAL IMAGE

A technique that evolved in the crafting of the imagery in this piece was the multiple ways to view the frame. In filmmaking, the frame is one whole unit of picture in a succession of many frames, and each are full units of picture. Hence, the visual composition was constructed at each frame as a unique picture, independent, whole and autonomous as an image in its own right. The frame, however, had all sorts of other properties made available in the digital video software environment. First, it was a type of stage/board/canvas, by which one could arrange and position

either full frame images or smaller independent image elements and position them as if positioning objects on a table, preparing to paint a still life painting. The frame, in this instance, was a kind of container into which to put image objects. At the same time, the frame in the computer and in the medium of the screen by which one accessed the operations of the computer was a raster grid that had within it all the mathematics of a Cartesian space, an x-y area consisting of a grid of pixel information. Since each pixel contained colour and brightness information, in each square of that grid each pixel could thus be accessed by the filters and plugins coded into the software application source code. In this way, the frame, acted like a surface that could be animated at each pixel. The frame could, therefore, act as a type of flat 2D surface. As the software enabled the mixing of many simultaneous layers, the frame acts as a kind of mixing desk where one positioned, resized and created a blending of layers, more akin to the creation of a collage of fragments. Layers could be resized and rescaled to a completely different shape from its original source. Masks could be applied to block out parts of an image and thus change the shape of the original source, allowing layers below to show through. The frame was also a unit of time, and so, carried within it motion trajectories into the space of the frame or motion position paths across the surface of the frame. Each element in the frame had its own timeline and its own trajectory, thus setting up a multiplicity of interacting visual elements in space and time and a whole plethora of interacting actions and dynamics. For the viewer, they see the final image and their attention is caught to what form or colour or texture or motion path of a visual element catches their eye or interest. There are, then, multiple readings of the visual composition for each viewing, not to mention the myriad of ways that the images can be connected to the music information taking place at the same time.

VISUAL MUSIC RELATIONSHIPS

The dynamics in the music, such as loudness and softness, and the various types trajectories through these dynamics, were an important consideration for the visual compositions. For example, subtle changes over time of dynamics or sudden changes or multiple dynamics across a range of simultaneous and successive sound materials were noted. Other musical dynamic elements, such as the density of the sound or its sparseness, was also noted. These were worked with in the visuals on an event by event basis. Not all dynamics had a visual equivalent, but at salient points in the music there were points of change or transformation in the visual elements in the frame. The trajectories in the music as deliberately crafted by Truax were matched by trajectories in the images. The array of motions, staggered in space and time, created a type of orbital trajectory in the space of the frame. There were similarities, then, in the sense of motion, direction, velocity and density of image and sound material. The images and their trajectories, however, were not mapped in a very precise manner, but were put together because their behaviours and motions were similar in gesture. It was hoped that treating the visual to multiple

simultaneous motions that, at certain points in time, the motions would synchronise and, at other times, the motions would appear to belong together, and so, rely more on the human-beings capacity to connect and associate aural vision information as belonging together. Even if, at times, no matching occurs or no associations of aural and visual material occur, it was expected, nonetheless, that a person viewing the piece can come to know this new aural visual world in repeated encounters with the art work.

POEM: EDGES

(1998)

Maura McDonnell

The poem written to explore the concepts in this work, was also recorded with the author narrating it. It was mixed into the sounds near the end of the piece and can hardly be heard, except for the odd line here and there.

Where do I end

and the world begins.

I think that I am separate

unconnected

I look separate

I have edges …

but I am not

I and the world are more connected

I am not contained within my edges.

I continuously flow into the atoms of air

Into the murky background.

The world continuously flows

through me

through my skin

into my head my thoughts

I am the world

and the world is me.

Right click image to play in word document. Click image to play in pdf document

Excerpt 1 – Excerpt demonstrating simultaneous contrary motion (see also Table 1)
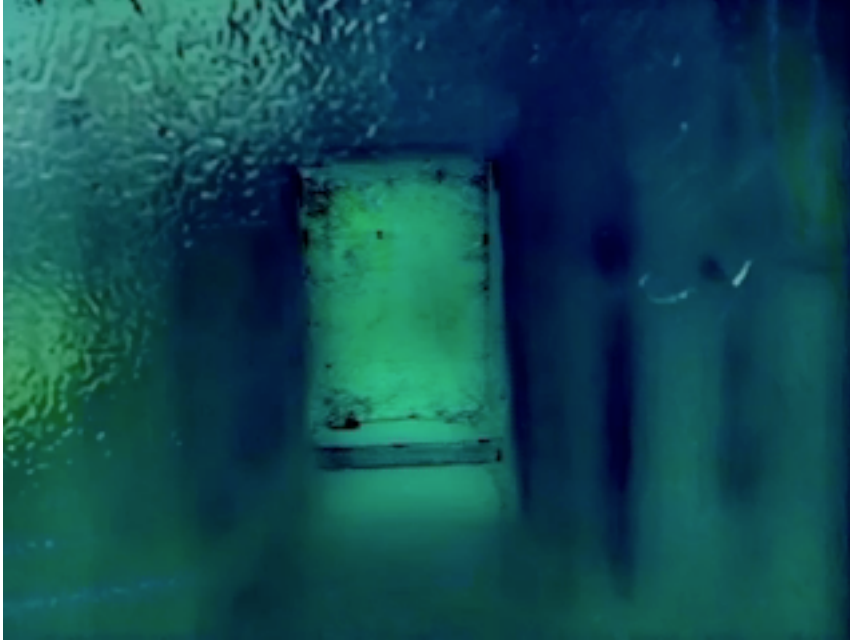
Excerpt 2 – Excerpt demonstrating spatial construction.

Title: Edges
Year: 1998
Visuals: Maura McDonnell
Music: Extract from Barry Truax 'Digital Soundscapes' CD (Truax, 1987).
Duration: 4' 48" ; Format: Quicktime, 320 by 240

Appendix IV: Maura McDonnell – 'Towards One' (1998)

TITLE OF WORK – 'TOWARDS ONE'

The fixed media video work '*Towards One*' (McDonnell, 1998b) is a seven minutes audiovisual composition created in 1998. Both the music composition and the visual composition were composed by the author and they were composed in tandem, exploring similar concepts and ideas in both domains.

ARTISTIC IDEAS – HARMONY, RATIOS AND TETRACTYS

The narrative arc in this work followed some philosophical ideas in relation to the division of the music octave and the colour scale into proportional steps. The most stable steps in the music scale — the octave, the fifth and the fourth — were deemed to represent the high point of the piece, where harmony was presented in its fullest symbolic manifestation, when these intervals were used (see Figure 10). A symbolic reference to ancient colour systems was explored in the colours chosen in the work, with the start of the work comprising the absence of colour in black and the end of the work consisted of white, thus all the colours in-between were moving from black towards white. This was a metaphorical reference to the containment of all colour between black and white. Such a continuum represented the 'whole' of colour. This was also in analogy with the musical octave representing the 'whole' of tonal music. Black and white being the starting and end point for a proportionate colour scale and the most pleasing colours considered to be those that correspond to the division of colours between black and white. Colours chosen for the palette in this work were influenced by these ideas and research into ancient colour schemes. The simple intervals in music could also be mathematically represented as geometric ratios. Another proportionate system that corresponded to the proportions and ratios underpinning the overtone series in a pitched tone and the intervals of a tonal scale, therefore, underpinned the principles for creating patterns and geometric shapes in visual art and decoration. Such patterns utilised proportionate balances of space, line, dot and used devices, such as axial symmetry, parallel lines, central symmetry to build harmonious shapes. Geometric ratios, too, could be represented as geometric shapes or forms. One such geometric shape that symbolised the intervals of the music scale in geometric form was the 'Tetractys'. A tetractys shape was created in the content of this section of the work. At the symbolic level of harmony, the most fusion occurred in this 'tetractys' scene (see Figure 8). Another philosophical idea was to create an abstract world in which there were many symbolic references to the power of number and its role in the universe as an ordering principle, this became the basis for the title for the piece 'Towards One'. All is in one and the universe breaths in and out in this one. This can also be

seen in the tetractys scene, where the tetractys shape has been superimposed onto another background layer that animates into and out of a circular shape as if to create a symbolic representation of an in and outward breath from which all order and harmony arises.

The organ pipe scene, uses images of organ pipes as source material in order to make a symbolic reference to a 'visible music' form. The proportions of the relationships between the organ pipes was another visible form of music harmony. The music in this scene was created first and the sounds were all created synthetically, the timbre sought was one that was metallic. A melody was composed using these timbres to suggest simple intervals of the octave, the fourth and the fifth, in a similar manner, however, to how the author manipulated source video footage. The simple melody constructed was manipulated using sound processing effects and thus the intervallic source is hidden and, in some places, disappears. At all times, the author was seeking something to work with. When the metallic sound emerged in the experimenting stage, this suggested a highly reflective metal surface. The author experimented with recording metallic and reflective surfaces and, quite by accident, came upon the organ in Carlow Cathedral, Co. Carlow and discovered not only did the pipes have the metallic surface desired it also represented symbolically the geometric ratios of the music scale and thus fitted with the whole concept of harmony that was underpinning this work. Thus imagery was chosen as source footage that was inspired by the author's own synaesthetic response and association of metal to the sounds created.

MUSIC COMPOSITION

All sounds in the composition were derived from synthetic sounds, designed by the author in the object-oriented and sound computation hardware and software programming environment system, the Capybara-320 hardware and Kyma software. This system consisted of sound computation engines, an object oriented interface and synthesis and processing algorithms. Sounds were designed as simple short duration sounds, akin to a tone in a scale. Other sounds were more slowly evolving timbres, with long evolving timbres creating new sounds in an electroacoustic approach. Sounds were subsequently remixed in sound editors into longer duration units and processed with filters and pitch shifting. Sounds were also sampled and then played with a midi keyboard and crafted into simple melodies and harmonic material and then recorded as audio files. The approach to music composition was similar to the layering and manipulation of many layers of video and image footage as had been done in the two earlier works above just mentioned ('Dazzling and Blinding' and 'Edges'). In this way, the music composition techniques were influenced by the author's emerging image editing and video editing techniques. Sounds suggested recognisable timbres, such as woodwind sounds and vocal sounds. Other sounds resulted in various forms of noise and granular sounds, some of these sounds suggested natural phenomenon, such as wind, or train track motion and rhythmic sounds. Sounds were

sound designed and then used in sound design software to create tones that utilised Pythagorean cent values. A simple melody of arpeggios of the primary root triad, the fourth triad and the fifth triad were generated with a sampler. This was the symbolic material for the visible music section.

IMAGES

LIGHT AND MOTION QUALITIES

The work consists of five movements or scenes: Scene 1. Darkness; Scene 2. Journey through Darkness; Scene 3. Tetractys; Scene 4. Music of the Spheres; Scene 5. Journey to Whiteness. The peak time in the piece is the Tetractys section, as explained above, as it epitomised the ultimate harmony and unity of music and image in the work in symbolic form. The source material for all the scenes, consisted of recorded footage of items that had qualities of darkness or light reflections in them. For example, source footage consisted of video recording of images of light reflections on metallic material, light reflections on water surfaces. Some of the footage consisted of photographs and thus were still images, for example, photographs of organ pipes and brass sculpture objects. Some footage was also chosen for its motion qualities, such as video recordings of zooming into fast moving clouds, video recordings of a train journey from the vantage point of a central symmetry. All this footage, however, was manipulated extensively to create new image material. Images, therefore, comprising traces of the original light and motion qualities remained but these were now part of new images created through applying myriads of images effects, layering of duplicated layers in space and time. Techniques that had been developed in earlier works were then used here again.

SYMBOLIC FORMS AS SOURCE MATERIAL (ORGAN PIPES)

The organ pipes were used to build and construct a highly complex animation that was suggested by the sound designs for this section of the work (Scene 2 – Journey through Darkness). The sounds were metallic in texture but not recognisable as any specific timbre and yet, they were also pitched sounds. The timbre had within it qualities of rhythm, texture and melody, and these qualities morphed over time. They were designed using granular synthesis and audio-editing techniques. Here, the sounds intended for the music composition part of this section led the way in terms of structuring the motion and animation of the organ pipes and other motion imagery. Motions were also synthesised by keyframing position and rotation and scale of the layers of the source images in the digital video editor. There were attempts to apply effects and colour effects to the imagery to create a deliberate re-creation of a type of synaesthetic response by the author to the sounds, in which a very strong visual sensation of sharp object visual textures was associated with the sounds (see Figure 79 no. 3 and also Play Towards One – Excerpt 1 below). Here, the tiny minute textural gold cloud like formation were all sharp-edged in an attempt to

recreate this association and sensation with the sound designed sounds from the author's experience of the sounds.
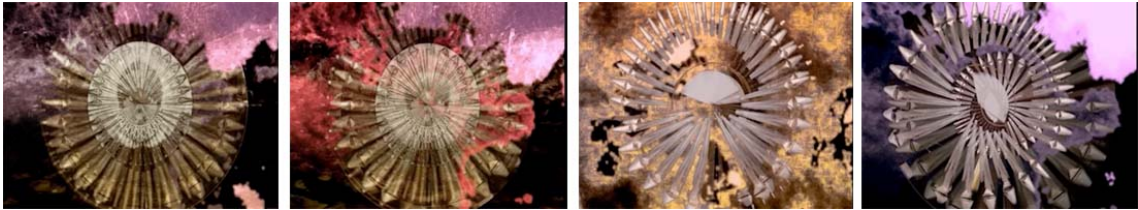

Figure 79 'Towards One' - Organ pipes as source visual material. L-R: 1, 2, 3, 4 frames from work

MUSIC AND IMAGE COUNTERPOINT

In this same scene — the Journey through Darkness scene — the composition and crafting of the images in time in the digital video editor timeline and the composing of the music composition were created together. This was a very interesting exercise and it lent itself to the author to decide to treat the visual and music material as if they were one type of material, that is, an art material that was going to be woven together. An event happened in the music did not consist of an event matching at the same time in the image. Indeed, deliberate off set of events were crafted between the visual and music. For example, the events in images were aligned to a very short delay after a music event, creating a type of call and echo effect. It was a form of counterpoint of the polyphonic elements in sound and image. Being able to cut clips to specific durations meant a lot of control could be had over the placement of an image event in the timeline and its duration. Counterpoint, then, was the dominant artistic form used in this section and a compositional technique applied to both the images and the music composition (see Play Towards One excerpt 1 demonstrating the counterpoint technique used).

TETRACTYS – SYMBOLIC REPRESENTATION OF THE SIMPLE GEOMETRIC RATIOS OF MUSICAL HARMONY

A complex technique that evolved in this piece is one that built on earlier forms of creating complex motion compositions. This scene — the *Tetractys* scene — consisted of two pieces of footage that were then further manipulated in After Effects. One consisted of a still photograph of the Carlow Cathedral organ pipes and the other comprised a video recording of footage taken from the centre of a train as it was travelling through the Co. Carlow countryside. What was looked for was colour, speed of forms, direction, light, and speed of light changes. This footage created interesting light effects and the sense of moving forward through a variety of landscapes, as the landscape moved passed the centre point of the camera recording position. Spatial and parallax effects were created. On its own, this footage was not that exciting. It was captured, however, not for what it represented to the visible eye but for its quality of dynamic light, frame and speed. With these two footage items, colour and video effects were also applied.

The organ pipe footage was animated using corner pin, polar co-ordinates, skewing transform animations. These two compositions then became the source compositions for the crafting of a motion and changing light *tetractys* symbol. The organ pipe animation was placed in the background. However, the very same animation was placed in the footage of the movements of the train and colour blending and keying was applied. This created a complex motion of spatial movement forward into the scene as well as a geometric animation of the organ pipes. This layer was animated in terms of skew, corner pin, till at one point the layer was transformed through geometric transformations into a triangle. This layer was then scaled down to make a small object that was to act as one point of the *tetractys* shape to be created later. This composite layer was then copied and pasted ten times and positioned in the frame into the *tetractys* geometric shape.

When the whole of the scene played, one obtained an intense motion effect. The background pipe scene animations mirrored the subtle internal motion animations within the space of each point (complex composite layered animation) within the shape. The music in this scene consisted of midi-controlled arpeggios using the melodic sounds designed in the Capybara sound computation system and were crafted into a short composition of simple harmony triads, the octave, the fourth and the fifth. At times, the seventh was used to add a little tension and interest. This scene represented a form of visible music in symbolic form applied to music and images at the same time and worked with and moulded through digital mixing and processing of image and sound material using digital computer audio and video effects (see Figure 80 and Play Towards One – Excerpt 2 below).
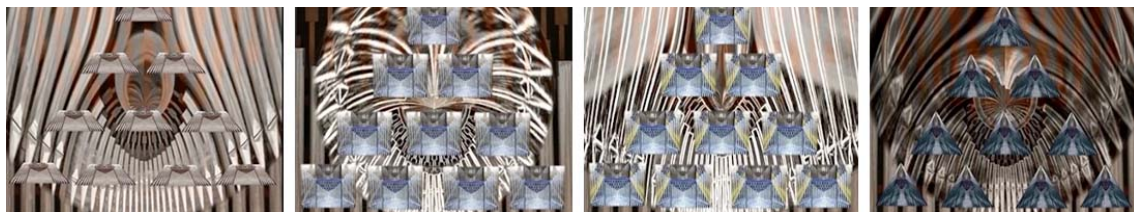

Figure 80 – 'Towards One' - *Tetractys* scene created in visual and simple intervals created in music

ANALYSIS

SYMBOLIC REFERENCES – HARMONY

The reason why harmony was chosen as the concept explored in this work was to investigate the foundation of the unity that can be found when an author deliberately chooses to fuse the two arts of music composition and visual composition. The question that the piece sought to address was, can a concept of an external harmony that has been applied to both domains assist in the fusion and unity of music and images? The assumption was that there are harmony laws that can be excavated and applied into such 'fused' art works. It was found, however, that the author actually

composed the music and images separately, but applied similar creative thinking and conceptual ideas to both domains. Thus, the function of the concepts of harmony did not necessarily bring about a fusion of music and images. Indeed, it took a lot of craft to weave the images and music together, just as it had in earlier works. Using external laws of harmony, therefore, did not necessarily connect the worlds of music and images.

FORM WITHIN MOTION AND INTERACTING TIMELINES

To create a dynamic imagery that could explore similar properties to music, such as direction, trajectory, speed, and contour, the focus in the visual composition is to create motion compositions. Any effect can be keyframed in Adobe After Effects, so an animation of colour, layers, shapes, particles, and speed can be made. Effectively, this is a form of composing motion. Each layer in a composite image has a timeline. A layer can be copied and that layer's timeline is independent to the original one. Subtle changes, therefore, can be made to the copied layer, and so on. Thus, one can build up layers of similar material that has subtle changes to the animation of its effects applied. Each timeline then interacts with each other at every frame, yielding new results. Forms emerge from the motion effects in the animating of a layer's properties but also forms emerge from the interacting timelines. A period of experimentation is conducted to get the balance between the final motion that takes place in the final frame and the animation and interaction of all the composite layers timelines.

SHARED COMPOSITION

The compositional process in this piece consisted of a mix of creating either a visual section first then creating the music and sounds for that section or composing a music section first and creating the visual section in response to the music.

VISUAL MUSIC RELATIONSHIPS - COUNTERPOINT

Counterpoint was deliberately used between the visual material and the musical material. A motif motion and melodic or rhythmic contour would happen in the music and the music would quieten and a similar speed rhythmic motion effect in the visual part would happen. It was as if the rhythmic and melodic and motion contour of the music was extended into rhythmic and effects changes in the visual part. The visual part had its own set of instruments as it were that were operated on a contrapuntal relationship with the music. The visual part became part of the music score and its temporal unfolding of its orchestral parts.

### VISUAL MUSIC RELATIONSHIPS - VISIBLE MUSIC

Another type of visual music relationship was based on the concept of harmony. A geometric figure was crafted to resemble a *tetractys* figure. This represented a visible form of music. The music made visible in the visible shape consisted of a harmonic proportionate relationship of geometric ratios to the whole. The ratios were the same ratios that underpinned the ratios of the

simple intervals of the octave, the fourth and the fifth of the music scale. The visible music of the geometric form created a symbol of music's harmony laws. A similar geometric law underpinned the photograph of the organ pipes that are cut to different lengths in order to enable the sounding of the tonal music scale.

Right click image to play in word document. Click image to play in pdf document

Excerpt 1 – Organ pipe scene used as a symbolic visible form of music.
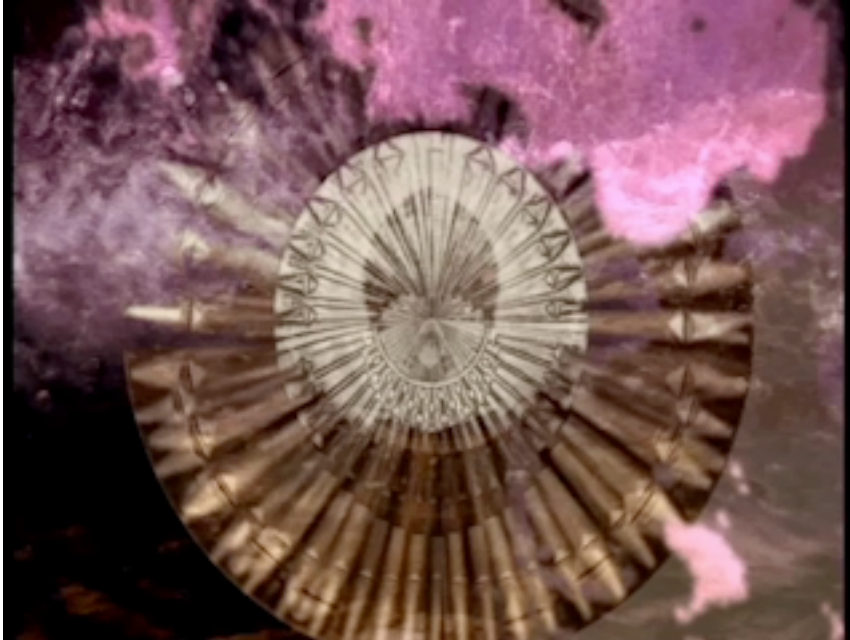
Except 2 – Tetractys scene crafted to create a visible geometric form of music intervals

Title: Towards One
Year: 1998
Visuals: Maura McDonnell
Music: Maura McDonnell

Duration: 6' 20"; Format: QuickTime, 768 by 576, square pixel, 4:3.