SYNAESTHESIA

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CONTENTS

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SYNAESTHESIA

INTRODUCTION Context of the dissertation /why the subject fascinates me

The overarching aims and objectives of this dissertation are to examine the subject of synaesthesia through the perception of a visual artist. Synaesthesia is the simultaneous blending of two or more sensory inputs, for example, when hearing music, seeing colour. Not everyone experiences it, in fact, it is apparently quite a rare phenomenon, with only one in 25,000 supposedly sensitive to it.

I have chosen to look at this subject because I personally see colour when I hear music - (I thought everyone did!) I was quite shocked to discover that few knew what I was talking about as a youngster when I mentioned that lovely glowing red or blue patch of colour that appeared in what I thought was my 'inner' eye, when I heard music. I saw, and still 'see', blocks of colour, abstract shapes, not figurative elements.

Being synaesthetic is one thing, and essentially it is a passive yet interactive perceptual state. When listening to music one is generally relaxed, attentive and open. I wanted to know more, but researching what todays neuroscientists are discovering, when applying formal, clinical systematic methods of research into how the brain operates and consequently into how perception works, is quite another and, in the dissertation I am attempting to pull together an amalgam of firstly, this research, secondly, my artwork which is based on synaesthesia, and thirdly to draw in other factors which I feel are related, for example, significant developments in music (12 tone serialism) and other current theories which equally transcend the neat boundaries with which it is convenient for us to classify our understanding of our existence in this environment.

I need to stress that I am a visual artist not a neuroscientist. Selecting what to include and omit has been a difficult task, as the elements are so disparate. The dissertation, by its nature, has distinct parameters - for example it is not an easily identifiable academic subject, which could be measured against cultural studies paradigms: nor do my research methods address it as a strictly scientific paper, nor a musical or fine art one.

But what it does do is identify and form linkages between this multiplicity of elements in a focussed way, examines theories and draws conclusions. I came to two key conclusions.

The more I researched, the more convinced I became that everyone is potentially a synaesthete, but because elements of our culture systematically de-sensitise our perceptual mechanisms, in only a few does the apparently extraordinary phenomenon of synaesthesia reach consciousness: and secondly, because synaesthesia does not cause psychological or physiological damage of any kind, it was not systematically researched until relatively recently (1970s), and thus one of the principal mechanisms which could offer incisive insight into how the neural and chemical links of the brain operate, and consequently how perception actually works, was bypassed because the scientific establishment did not take it seriously enough.

So we start with neuroscience, and synaesthetic theories, progress through music and artwork, and end up with personal theoretical conclusions.

My initial research and planning for this project indicated that the full field of research into synaesthesia was very great and crossed the frontiers of science, neurology and psychology. As I am not a specialist in any of these areas I began to look for a way into the subject which might be appropriate to my training as a visual artist. I realised that by taking one aspect of it, colour experienced when hearing sound, I could have scope for an extended visual research project.

The dissertation opens up a broader arena to identify, analyse and examine the implications of some of the exciting writings, research and discoveries currently being undertaken by neuroscientists into the workings of the brain, in a rollercoaster of competitive analysis which spans the globe, and at some related key developments in music, and at my artwork and its progression.

On further investigation, it became clear that synaesthesia is a colossal subject, is evolving almost daily as studied by a range if eminent neuroscientists, and is absolutely fascinating in that, although theories abound, no-one has managed to clarify why some experience it and others not, and what it is. Elusive.

"Synaesthesia, meaning 'joined sensation' denotes the rare capacity to hear colours, taste shapes or experience other equally startling sensory blendings, whose quality seems difficult for most of us to imagine." (1.0 Cytowic)

Although only one in 25,000 supposedly experiences it, it may well be that, like the phenomena of precognition, telepathy, clairvoyance, it is indigenous to humans and our perceptual sensitivity to such things is eroded as we move through increasingly desensitising lives, from childhood to old age. Perhaps its potential effects are masked .

Its key features are:

- It is pleasurable and enriching in the majority of cases, adding to life quality
- It is involuntary, intense, simple, immediate and often repeated identically over a lifetime to the same stimulus
- The experience is vivid and irrepressable, beyond the control of will
- It is perceived externally in personal space immediately surrounding the body
- Synaesthetic perceptions are durable, memorable but never pictorial - usually abstract shapes and colours.

As my research evolved it became clear that it is mysterious, outside what we deem to be normal perception, and completely elusive, even to eminent scientists and neurologists.

I feel that my research work (both written and visual) has started me on a long journey which may not have an end. The more I research, the more elusive it becomes and the greater its scale and scope.

In this dissertation I want to look at three main areas:

Part One - looks at definitions, research into and a brief history of synaesthesia: how the brain works in this context and two key theories from current research

Part Two - looks at the elements of music, some composers at the forefront of change, my work, the key problem of auditory space, colour from sound and personal painting research developments

Part Three - looks at present conclusions and secondary objectives.

PART ONE

1 SYNAESTHESIA: WHAT IS IT AND WHAT IS ITS HISTORY ?

DEFINITIONS FROM A VARIETY OF SOURCES:

"1a. A sensation in one part of the body produced by a stimulus to another part.

1b. Agreement of feelings or emotions of different individuals, as a stage in the development of sympathy.

1c. Production, from a sense-impression of one kind, of an associated mental image of a sense-impression of another kind: see quote 1903

1903 FWH Myers 'Human Personality'

'1.p xi: Vestiges of the primitive undifferentiated sensitivity persist in the form of synaesthesia eg when the hearing of an external sound carries with it, by some arbitrary association of ideas, the seeing of some form of colour' (1.1)

2 "Synaesthesia: a confusion between the senses, for example, some musicians experience colours for particular notes" (1.2)

3 "Synaesthesia - it is not a disease or a psychological problem, but a difference in perception, where the senses most people consider separate are mixed. Sight and sound intermingle, touch and taste run together" (1.2a)

4 "We..define synaesthesia as occuring when stimulation of one sensory modality automatically triggers a perception in a second modality, in the absence of any direct stimulation to this second modality. So, for example, a sound might automatically and instantly trigger the perception of vivid colour: or vice versa.... Our experience suggests that coloured-hearing synaesthesia is by far the most common form and that certain combinations of synaesthesia almost never occur (for example, touch to hearing)," (1.2b)

What are these source definitions telling us ? In many ways, and like the state of the art research being conducted into it, they are inconclusive

In their attempts to identify what is clearly an intuitive sensory response outside the realm of accurate linguistic analysis. The fact that synaesthesia is a spontaneous sensual perception occuring in the brain when one sense input generates sensation in another means that often language fails us in attempting to describe it. Synaesthetes report that their reaction was 'like' something, not that it 'was' the thing itself.

A BRIEF HISTORY

1704 Sir Isaac Newton worked on mathematical formulas to link vibration of soundwaves with the wavelengths of light (1.3)

1725 Clavecin Oculaire invented, an instrument that played light and sound simultaneously (1.4)

1790 Erasmus Darwin - harpsichord and coloured lanterns invented (1.5)

1810 Goethe - expounded links between colour and the senses in 'Theory of Colour' (1.6)

1810 Galton - 'Inquiries into Human Faculty and its Development' (1.61)

1890 'Coloured Hearing' (L'Audition Colore) book published in French(1.7)

1895 AW Rimmington creates the 'Colour Organ'

1910 Scriabin (1872-1915) composed 'Prometheus, the Poem of Fire' to express his own synaesthesia

1910 Kandinsky (1866-1944) wrote 'Concerning the Spiritual in Art' (1.9) He was a synaesthetic artist who used this to move into abstract work, expressing his vision of direct experience

1922 Arthur Bliss composed 'Colour Symphony' based on synaesthesia

1927 'Coloured Hearing and the Synaesthetic Factor of Experience' (Das Farbenhren und der Synsthetische Faktor der Wahrnehmung) published in Germany (1.8)

1968 AR Luria 'The Mind of a Mnemonist' published (1.91)

By 1930, synaesthesia was considered a freak psychological incongruism which no-one could explain. However, the medical professions accepted synaesthesia as a real phenomenon as it had been reported independently in notes and investiga tions over a two hundred year period.

Significantly, as it caused no major psychological or physiological disturbance, it was not seen as being worthy of research and was not systematically investigated. Scientists found more pressing subjects to study.

The key question now is, where does the synaesthetic joining of two or more senses take place in the brain ? How does it occur ?

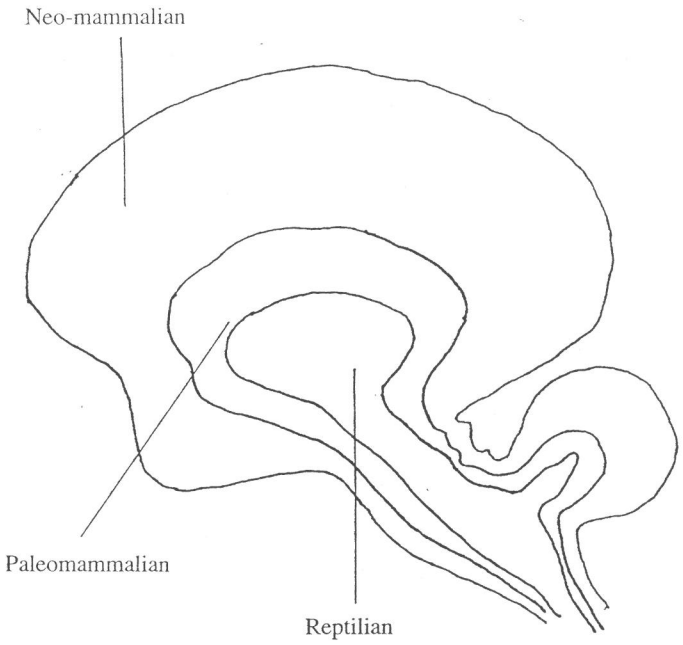
2 HOW THE OPERATION OF THE BRAIN WORKS IN THIS CONTEXT; CURRENT RESEARCH:

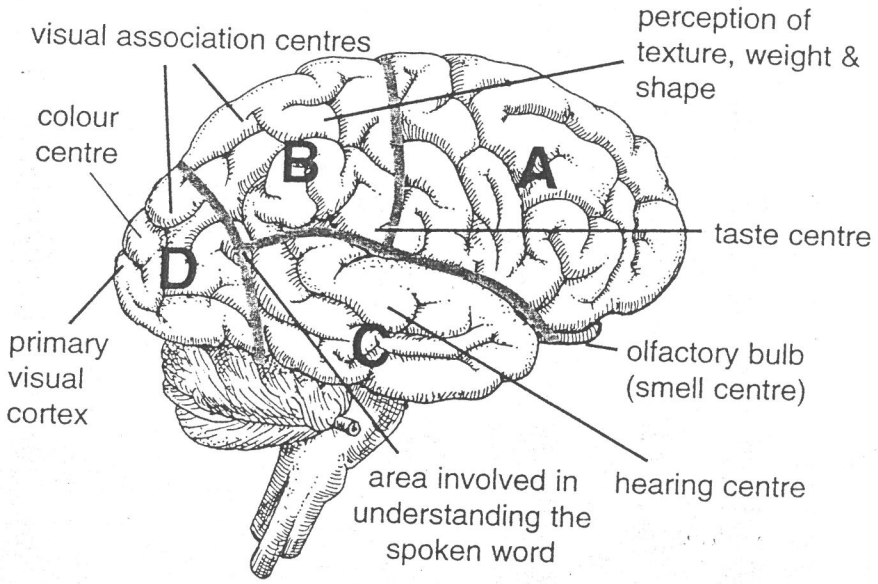
The standard view of how the brain operates, from the thinking of the 1950s, was that the flow of information was linear, that the cortex was subdivided into specialist operations -(eg the auditory cortex dealt exclusively with sound input) and that the cortex itself was the dominant or ruling area. (These views are still widely perceived as true by the general public)

American neurologist Dr Richard Cytowic states

> "The first step is for the sense organs to transform either electromagnetic energy (vision), mechanical energy (hearing and touch), or chemical energy (taste and smell) into nerve impulses. These impulses then travel to different relays in the brainstem and thalmus, and from there to progressively more complex stations of the cortex where different aspects of the external stimulus are sequentially extracted from the stream of nervous impulses. These aspects are somehow assembled at the end of the line into a conscious experience so that we understand what it is in the external world that has triggered our sense organs" (1.10)

The 1950s view indicated that as the human brain evolved, three distinct systems of different evolutionary age, each controlling a different behavioural category, became apparent, (see Figure 1)


Neo-mammalian
Paleomammalian
Reptilian


visual association centres
perception of texture, weight & shape
colour centre
B
A
taste centre
D
primary visual cortex
C
olfactory bulb (smell centre)
area involved in understanding the spoken word
hearing centre

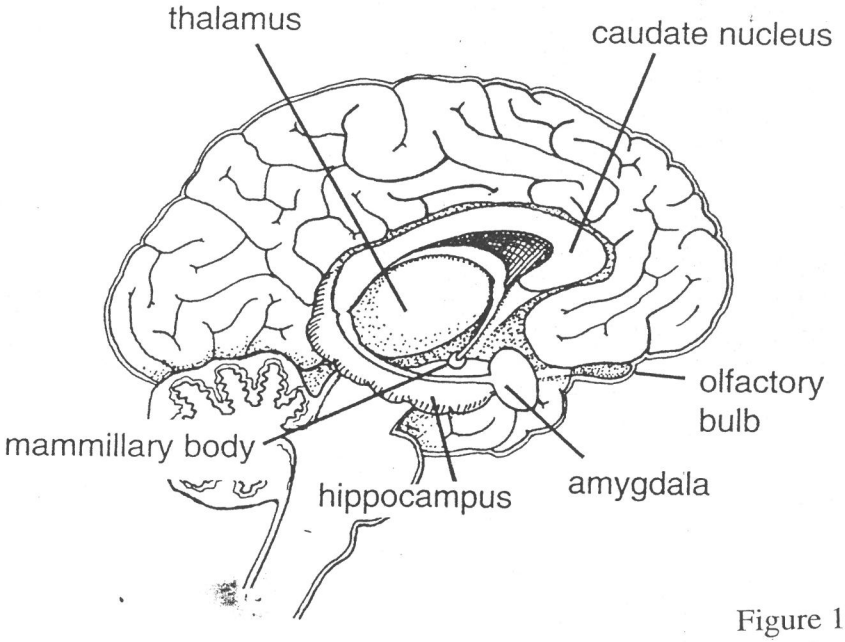

thalamus
caudate nucleus
olfactory bulb
mammillary body
hippocampus
amygdala

Figure 1

1 The earliest reptilian brain controlled self-preservation

2 The paleomamalian brain controlled socialisation, caring for offspring, and, significantly, responding to emotions. This is also known as the LIMBIC system

3 The latest neo-mamalian brain included the massive cortex and was perceived as the ruling entity overall (biggest therefore most controlling). The cortex was therefore assumed to be the control location of the mind.

However, neuroscientific research is revealing more about how the brain operates almost daily. The CURRENT view of how it works indicates significant development and change from these earlier ideas. Information messengers are now known not just to be nerves, but to include hormones, endorphins, peptides, molecular messengers, axon fluids, neorons, chemical messages between nerve cells, even extracellular fluids. (More than fifty have now been identified.) The resultant MULTIPLE MAPPING of communication channels enables many locations to process compound information AT THE SAME TIME. (Linear, heirarchical channels and comparing the brain to a computer are thus outmoded concepts.

Cytowic summarises:

"The new view has five main points:

1 Non-Linear information flow and 'inner knowledge'

The flow of neural impulses is NOT linear, but parallel and multiplex, including transfer of information that does not even travel along nerves. Thus, it makes no sense to speak of heirarchy.

2 Function is not strictly localised

We no longer speak of localisation as a one-to-one mapping, but of the distributed system: a many-to-one mapping in which a given chunk of

brain tissue subserves many functions and also, conversely by which a given function is not strictly localised but is distributed over more than one spot.

3 The primacy of emotion

While the cortex contains our model of reality and analyses what exists outside ourselves, it is the limbic brain that determines the salience of that information

4 Emotional calculation

Because of this, it is an emotional evaluation, not a reasoned one, that ultimately informs our behaviour

5 Emotion makes us human

Likewise, all analogies of the mind to a machine are inadequate because IT IS EMOTION, MUCH MORE THAN REASON, THAT MAKES US HUMAN" (his emphases) (1.11)

For centuries, emotion has been looked down on as primitive, 'feminine', while reason was held as the superior development ('masculine') - emotion was ignored: but without emotion, our behaviour would be predictable and unimaginative, robot-ically rational and insensitive.

Neuroscientific research into how the mind perceives music has become an inter-national agenda raising more questions than it answers, particularly because of the inter-active nature of emotion, which cannot be separated out. As a species we are not designed to close our ears. The human ability to make cross-modal associations is the foundation of language - we absorb and learn from auditory stimuli from a very early age, inside the womb. We take listening, and thus music, for granted but to appreciate music takes very complex organisation within the brain.

- Neurologist Peter Fox working at the University of Texas at San Antinio looks into the brains of performing musicians using PET (Positron Emission Tomography scans) a sophisticated nuclear medicine technique which produces an image of radioactive distribution in the body, identifying the relationship of local nerve-cell activity to brain blood-flow, or brain activity) Playing musical scales produced little reaction, whereas performing symphonies or concertos showed strong reactions in the right hemisphere indicating sustained emotional content and expression.(1.14)

- At Massechusetts Institute of Technology Media Lab, Michael Casey is developing a universal musical instrument, a musically intelligent computer, a virtual accompanist which can mimic any instrument, tempo and which tries to learn what an accompanist can do expressively. It takes a blank score, creates phrases, constructs the sound-fabric of an orchestra, and takes paradigms to read it. He believes there is a lot of crossover between artist and scientist, the first working intuitively, the second trying to rationalise and measure. (1.15)

- Musicians and scientists working together at the University of California tested spatial reasoning and discovered that Mozart can make you more intelligent because music actively primes our brains - on testing spatial reasoning there was a major improvement, a 47% increase after six months of music against a qualifying group who heard no music for the same period.(1.16)

- In Germany surgeon Ralph Spintge is studying the effect of music on pain, and is developing the use of music in place of sedative drugs during surgical operations. (1.17)

- Professor Joseph Ledoux, a world authority on the emotional nature of the brain , based at the Centre for Neural Science at New York University, recently reported that the seat of fear in the brain has now been identified as the amygdala - a centre for processing other primal emotions and thus that a vital survival reflex has a chemical origin, which could be modified eventually by drugs.(1.18))

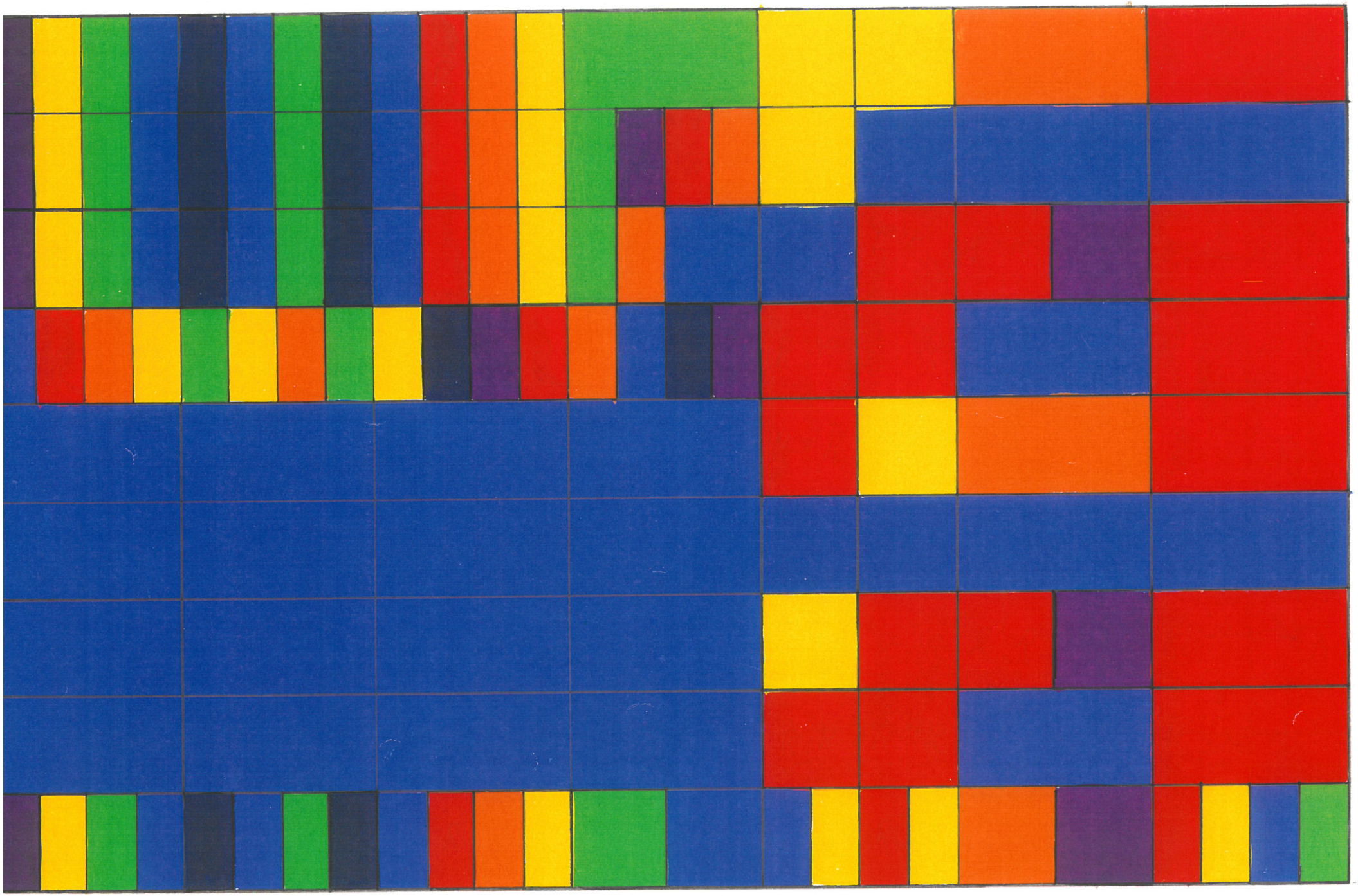


Illustration 3

But what is synaesthesia - how does it evolve ? A brief survey of research follows. As humans, we long to know everything about our surroundings. Our perceptual awareness has evolved so that we continuously address the interplay between our senses and form automatic reciprocal assimmilations. What we see, hear, touch, taste, smell and percieve, informs our logical, rational mind about our environment and its condition, and thereby our relationship to it.

That we make these cross-modal associations from an early age has been extensively reported (eg Born W, Spelke E, and Prather P 1982: Detection of auditory-visual relationships by newborn infants. Presented to International Conference on Infant Studies, Austin Texas: Piaget J, 1952 The Origins of Intelligence in Children, NY, International University Press: Rose SA & Ruff HA 1987, Cross-Modal Abilities in Human Infants - Handbook of Infant development NY John Wiley p 318-362: Rose SA Gottfried AW & Bridger WH 1981 Cross-Modal Transfer in Six Month Old Infants, Developmental Psychology 17, p661-669 et al)

Daphne Maurer hypothesises that as babies are born with transient connections between neural structures, and also that they seek out optimal levels of stimulation, all sensory modalities are active. However they look longer at a flashing light or colour and extend fingers towards a mid-intensity sound (like music). These, in addition to the gustatory feeding reflexes, are dominant perceptual activities. She further hypothesises that because an infant's senses are not well differentiated, they could at this stage blend in synaesthetic confusion. The number of infantile transient connections decreases with the development and maturation of the cortex, or outer layer of the brain. (1.25)

Bailey and Johnson analyse the possibility that synaesthesia is genetically inherited. They point out (and this is endorsed by Cytowic) that synaesthetes report experiencing the phenomenon from an early age, and that it is constant - having the same synaesthetic response years later to the same stimulus. About 25% of synaesthetes interviewed claimed that family members were also affected, and they further investigate different modes of inheritance through human genetics.
An interesting factor they discovered was that the sex ratio of synaesthetes was markedly biased towards females (research endorsed by Baron-Cohen, Cytowic, Segal et al). (1.26)

Harrison and Baron-Cohen examine the possibility of infantile transient connections being preserved in some who then are synaesthetic adults, and also the possibility of leakage between pathways such as visual and auditory ones. They look into whether synaesthesia can be learned and conclude that as an involuntary response, and as synaesthetes have no recollection of learning it either purposefully or incidentally, it cannot. (1.27)

Frith and Paulesu investigate the physiological basis of synaesthesia, believing it to be a special form of conscious experience, which cannot be observed by another. Brain imaging techniques (PET, MRI) formed the basis of much of their research work and led them to believe that the mechanism of synaesthesia will eventually be revealed by the sophisticated development of such techniques by examining cerebral blood flow, or brain activity. They interestingly pose that synaesthetic activity in the brain may indicate a feedforward convergence mechanism, suggesting unusual anatomical connectivity. (1.28)

Grossenbacher examines perception and sensory information in synaesthetic experience and argues that, as we face the world with an already full mind, (an amalgam of expectations, concepts, biases etc) percieved reality is an idiosyncratic dynamic mental modelling. He holds that there is far more to perception than stimulus, although attention becomes fatigued if overutilised. He notes the consistency of synaesthetic experience and significantly of its triggering enjoyable positive feelings, sensual pleasure, which he feels may be an indigenous result of multimodal agreement, pointing out that, even in non-synaesthetes, rich sensory experience frequently elicits enjoyment and appreciation. He believes both hit an emotional tone which is pleasurable.

He also believes that colour is the only dimension of vision which is not available to any other sense modality, and this explains why the most common concurrent is colour. It is not normally attached to other senses. He states that colour, although a common synaesthetic concurrent, is not typically an inducer - music is far more likely to fulfill this role, although why is not clearly understood.

He mentions that crosstalk (one stimulus connecting with and activating another) and feedback mechanisms could provide a basis for further research into synaesthesia. (1.29)

Finally, Critchley also examines the possible mechanisms of the phenomenon, hypothesising that, as synaesthetic experience seems to be generated at a mental level between the primary sensory cortex and the limbic system, at a higher mental level than the original sensation, it could be an indigenous part of the higher functions of the psyche at the interface of memory, thought and emotional responses. (1.30)

To sum up, key ideas do run through current research.

Firstly, the concept of transient connections sustained into adulthood (Maurer, Bailey & Johnson, Harrison & Baron-Cohen et al) was a popular but largely unsubstantiated hypothesis which would clearly require a more sophisticated pattern of research to become firmly established.

Secondly, the inheritance theory, evidenced by synaesthetes reporting familial synaesthesia, was substantiated but present in a very small proportion of such sampled synaesthetes. It is unlikely therefore, to provide a clear key.

Thirdly, the crosstalk/feedforward hypothesis was similarly evidenced by Frith & Paulesu's PET and MRI research and endorsed by Grossenbacher. This looks to be one of the most fertile bases for further research into synaesthesia.

However, there are two additional and key theories which follow, which seem to me to represent opposite ends of the neuroscientific research spectrum.

3 TWO KEY THEORIES

This current international interest in synaesthesia, with scientists trying to discover how and where it takes place in the brain, means that research into how normal perception works is consequently expanding. But for the purpose of focus we will concentrate on two key theories. The first is generated by a London-based team of neuroscientists led by Dr Simon Baron-Cohen (lecturer in Psychopathology in the Department of Experimental Psychology and Psychiatry at the University of Cambridge,) and his colleague Dr John Harrison (Research Fellow in the Department of Developmental Psychiatry also at Cambridge) The second is generated by Dr Richard Cytowic, a neuroscientist working at Capital Neurology in Washington DC.

THEORY ONE

Baron-Cohen's team research focuses on the cortex (or outer layer) of the brain, where information is processed. It is based on the core concept that sound, vision and the senses are processed in entirely different areas of the brain which they call SENSORY MODULES, and that each module works only to its specific input trigger - eg visual input hits the visual cortex only, sound the auditory one and so forth. They believe synaesthesia involves modules connecting in an unpredictable way, outside the perception of human minds in general. The London team's focus on the area of the brain where information is processed - the cortex- led them to believe that in evolutionary terms it was advantageous having the senses separated. Synaesthesia is caused, they believe, by genetic abnormality linking sensory modules.

THEORY TWO

Richard Cytowic's view is much more contraversial . He has studied the phenomenon for twenty years and his conclusions are still evolving. He maintains it is not the cortex (the analytical brain) but the LIMBIC SYSTEM, especially the hippocampus and amygdala, (much older sections in evolutionary terms and which are concerned with emotion and memory) where synaesthesia takes place. (Anatomical and neuroscientific research now show us how every major division of the nervous system has some physical structure related to emotion. The nervous system clearly has a central emotional core.) He bases his conclusions on the key factors which characterise synaesthetic experience, already mentioned on page 3, underpinned by his research.

His systematic research using synaesthetes, including experiments analysing which part of the brain was active to differing stimuli, used radioactive xenon gas to trace cerebral blood-flow (brain activity) and yielded astonishing results - to the auditory stimulus of music, it was not the auditory cortex which was activated but the VISUAL cortex, and the involuntary emotional limbic system.

His current conclusions and continuing research enhance these discoveries which fundamentally call into question widely held views of perception, cognition and brain processes.

> "I have come to the opinion that synaesthesia is a very fundamental mammalian attribute...that it is actually a normal brain function in every one of us, but that its workings reach conscious awareness in only a handful...it is that most brain processes operate at a level below consc-iousness. In synaesthesia, a brain process that is normally unconscious becomes bared to consciousness so that synaesthetes know they are synaes-thetic while the rest of us do not" (1.12)

(Peter Fenwick, consultant neurologist at London's Maudsley Hospital, also argues that the limbic system, or area of the brain related to emotion, is also a key area for music. He believes that music plugs more directly into feelings than words - it goes straight in and becomes direct experience.)

The implications of synaesthesia stretch many frontiers. We know much more than we think we know and are surprised to discover we know it. We have multisensory knowledge, deeper inner knowledge, and the catalyst at the interface is emotion - yet we are trained to trust objective facts not emotion. The hippocampus is a point where everything converges - all sensory inputs pass through the emotional limbic brain before being redistributed to the cortex for analysis. It has been argued therefore that the emotional brain is physiologically geared to overwhelm the rationality of the cortex as it acts instantaneously. The limbic system decides what is important and what to do. Both systems operate however the limbic brain processes immediately, the rational cortex half a second later (500/1000ths) as it is analytical in nature.

Do we make emotional or rational choices?

Both systems operate, but, has our neglect of and conditioning to devalue the emotional response caused us to imbue the rational brain with more power in the decision-making process ? Cytowic's research certainly endorses this paradigm.

When I 'see' colour when listening to music there is an instantaneous 'this is it' inner knowledge certitude which accompanies the experience - the shock of recognition: yet it is also a kind of instantaneous familiarity which does not change. It reciprocally enhances and heightens the awareness of listening - a clearly enriching sensuous experience.

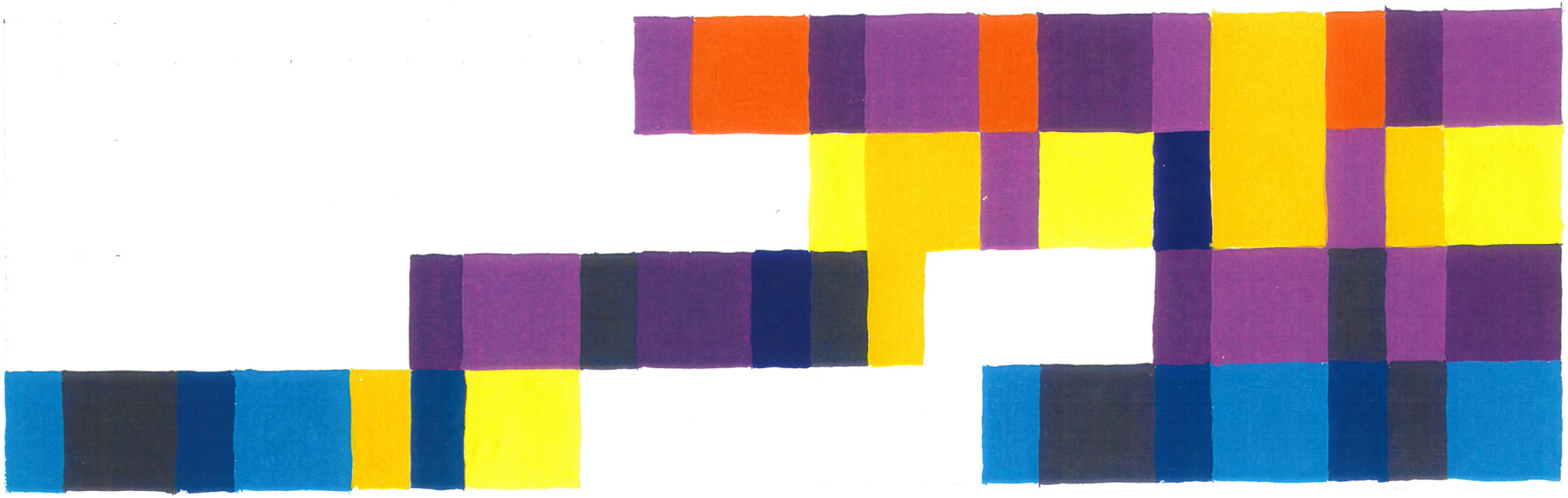


Illustration 4

PART TWO

RESEARCH

4 Elements of music/ some key musicians

Both music and colour form major parts of human experience. They can generate both a physiological and an emotional response.

Differences between African, Byzantine, Arabian, Chinese, Greek, Indian, Indonesian, Japanese, South American and Western music are extremely marked, as are the eccles-iastical and secular modes, historical and current computer-generated modes. The hypnotic effect of much current popular music finds an echo in repetitive chants and intonations of say Gregorian chants or Russian Orthodoxy. Rich spontaneous creativity eg certain jazz, John Cage et al transcends structural barriers and forms its own dialogue and paradigm.

The span and construction of musical modes is enormous. With regard to music we must somehow link the huge gap between psychoacoustics and ethnomusicology - comparisons between Western twelve tone scales and the extremely subtle, almost indistinguishable tonal differences in for example, Indian classical music (microtonality) must be taken into account.

We take music for granted, yet to appreciate it as we have seen, takes very complex organisation and linkage within the brain. Perceptual systems, mechanisms of memory, abstract cognitive activity - music involves a highly elaborate processing system that is still not understood. How do we account for the whole response to music, not only the sensory and cognitive but also the emotional and aesthetic ?

Clearly there is a symbiotic and interdependent relationship meshing these elements.

The most outstanding factor in music is its immediacy - it gets straight through to us. It is a happening and as such demands spontaneous attention - its attraction is immediate and compelling. It triggers off the long and delicate chain of processes involved in normal auditory perception and a more tenuous and intricate series of sensations concerned with other phenomena, like imagery, and colour-hearing .

Movement, fundamental to the human grasp of the stable spatial world, is the essence of music, and in its immediacy music is a living thing - is itself a process of becoming.

As far as we know, music has existed in all human cultures. It has four main attributes:

Loudness	-	strongly audible
Rhythm	-	motor factor, relation of long, short, accented/unaccented movement determined by duration and emphasis
Pitch	-	set at a particular level
Timbre	-	characteristic quality of sound produced by each particular voice or instrument

These four main attributes are clearly not independent - loudness also depends on frequency for example.

It is important to look at composers at the forefront of change in our era, who have altered forever how we perceive musical structure. Postmodernist serialism (a method of composition based on the serial ordering of pitches - dodecaphony or twelve-tone composition) created by Arnold Schoenberg (1874-1951) and followed by his pupils Alban Berg (1885-1935) and Anton von Webern (1883-1945) amongst others, was a catalyst which opened up composition to a new generation and paved the way for others quick to seize on its potential. (Each note had equal value)

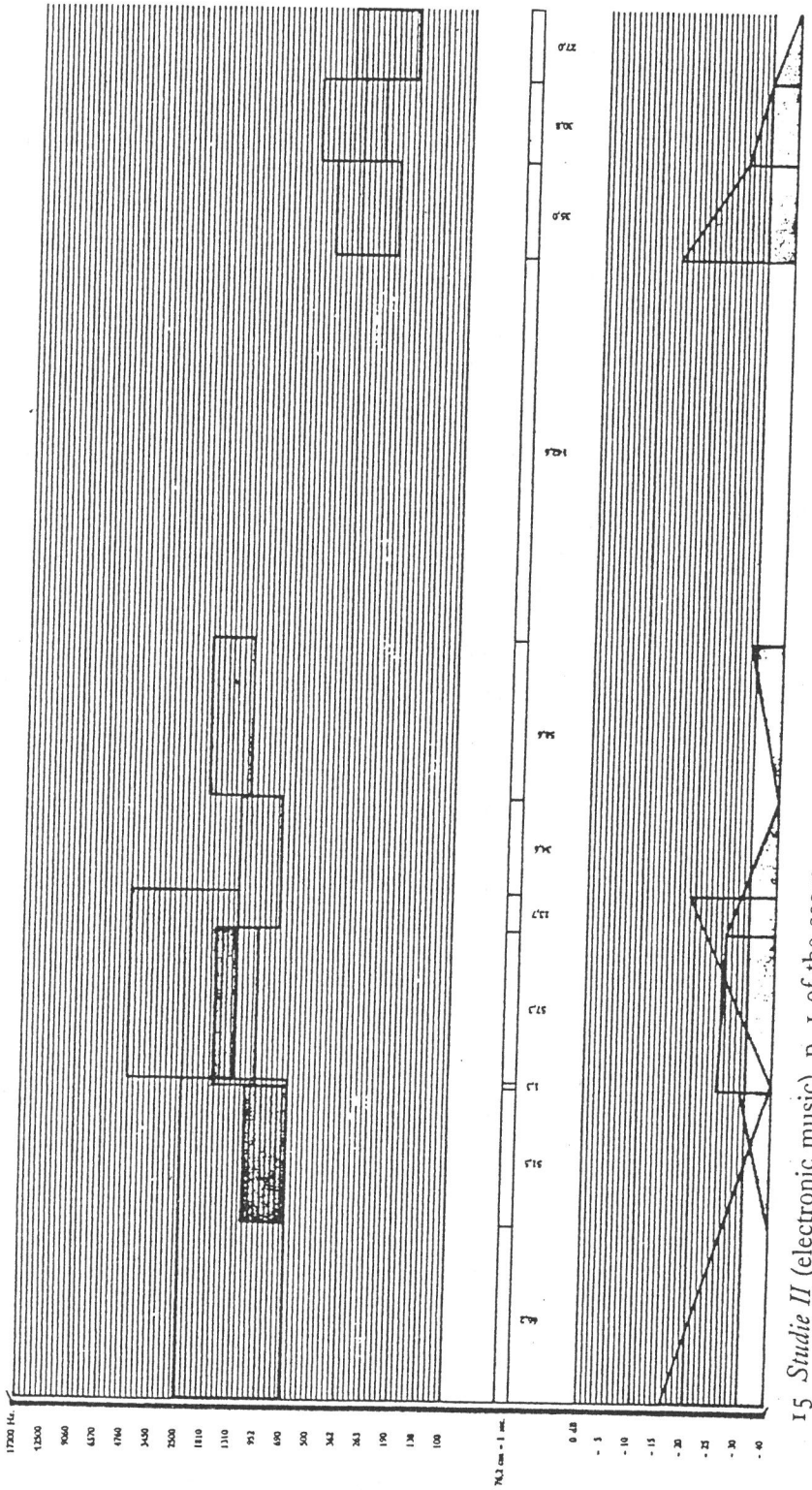
Hungarian Bela Bartok 's (1881-1945) research into Eastern European, Magyar and Arab folk music triggered intriguing dissonant harmonies, chromatism and tremendous contrapuntal and rhythmic vitality at about the same time: his discords have a powerful emotive effect. (Although using figurative visual subject matter, some of Pierre Bonnard's (1867-1947) colour in, for example, "La Fenetre Ouverte" (1921) and "Salle a Manger a la Campagne" (1934/5) begin to me to visually parallel Bartok's auditory contrapuntal dissonance, although perhaps Brigid Riley's abstract developments, particularly the most recent work, better echo Bartok's utter precision and juxtaposition of harmonic dissonance.)

Karlheinz Stockhausen (b1928) a pupil of Messiaen amongst others, concentrated on composing using electronic means at Cologne and contributed to the development of serialism using electronic modulation and transformation. His scores are visually unlike anything that had gone before. He devised highly personal methods of notation. (See illustrations 9 to 11)

ILLUSTRATION 9

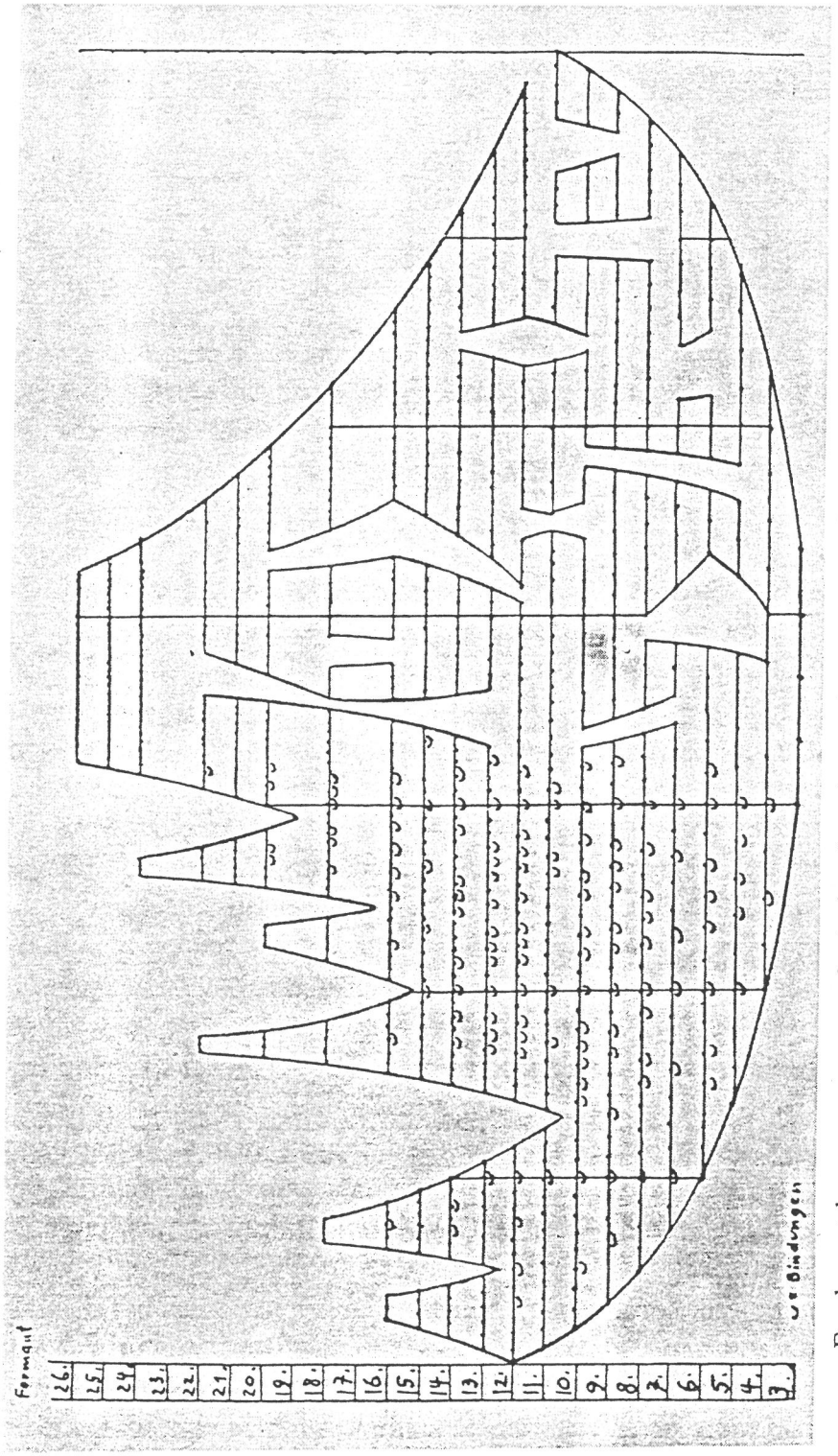
STOCKHAUSEN

ELECTRONIC MUSIC: A MUSICAL HOMUNCULUS 1953–5



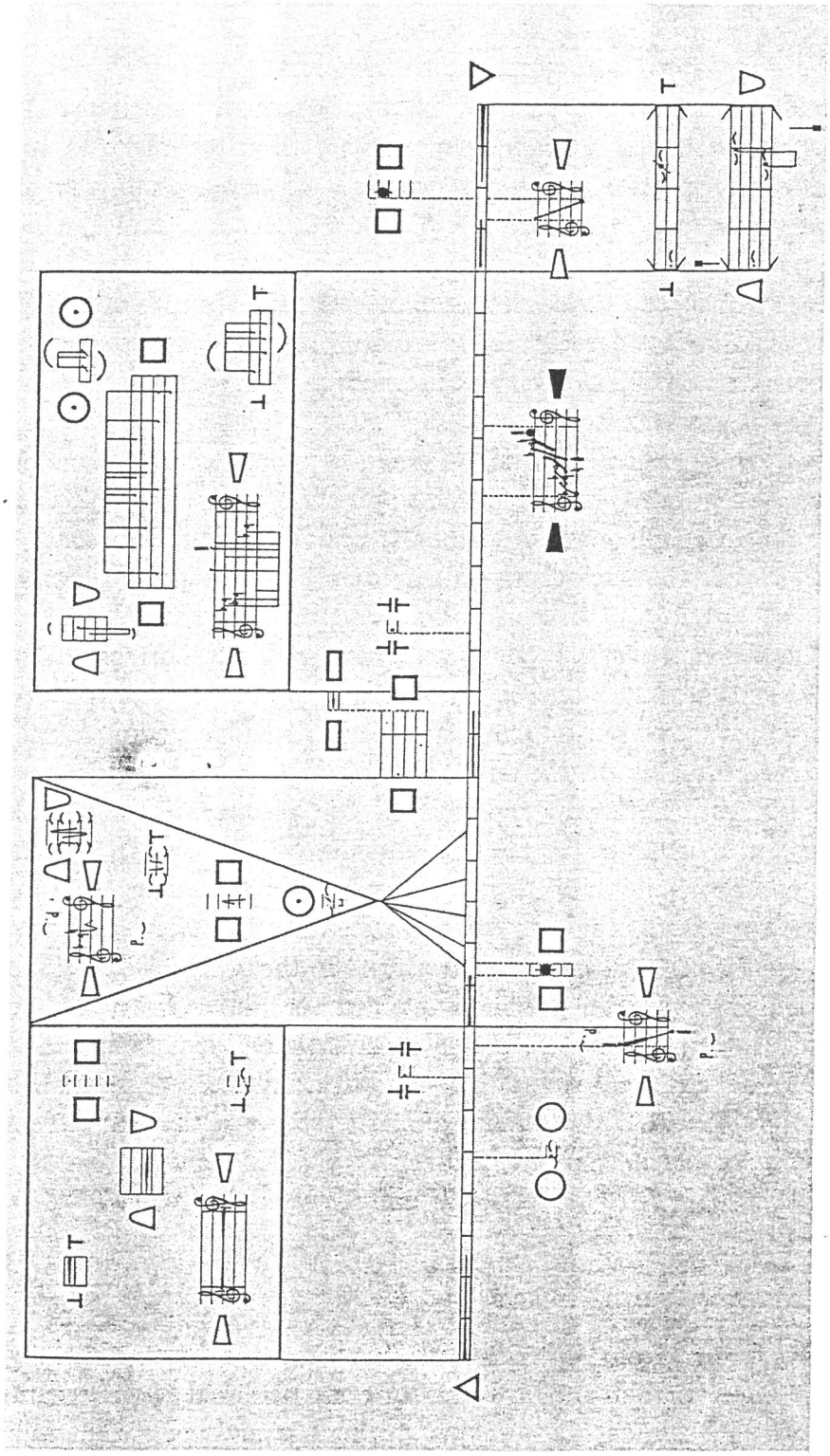
15 *Studie II* (electronic music), p. 1 of the score

ILLUSTRATION 10



20 Fundamental spectra over seven basic durations (mountain panorama at Paspels)

ILLUSTRATION 11



24 *Zyklus* for a percussionist

John Cage, (1912- ?) was a pupil of Schoenberg and influenced by Dadaism (particularly Duchamp) in the '50s.

A 'user-friendly' and seminal catalyst in his application of the principles of indeterminacy and chance, born from his search for new horizons in musical composition, a highly creative driving force whose writings (notably "Silence" and "A Year From Monday") also reflected a completely new, liberating amalgam of Eastern and Western philosophy and mysticism. Rather than eliciting a feeling of formal necessity, Cage's compositions and writings celebrate the spontaneous, the incomplete, the chance non-heirarchical indeterminacy of 'whatever happens happens'.

His view was that chance operations were not mysterious sources of the 'right' answers, but a means of locating a single one among a multiplicity of answers. (In this he was a practitioner of the science of non-linear behaviour of systems, or Chaos Theory)

For him, sound did not exist as one of a series of discrete steps, but as transmission in all directions from the centre. (As we have seen in Part One, this is a similar paradigm to the role of the limbic system and intercellular connections which are not linear but multiplex and simultaneous.)

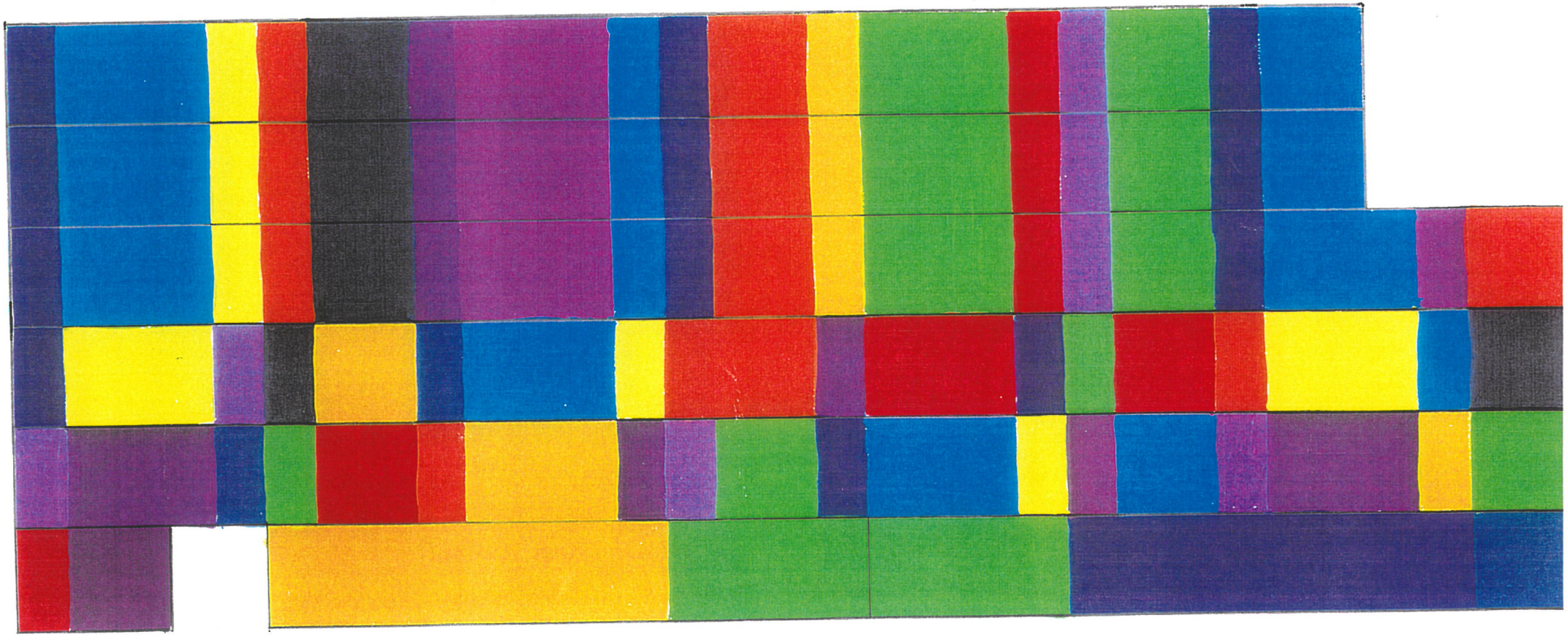


Illustration 5

Theorists working in the new non-linear sciences tell us that complex systems of human thought , creativity and nature are systems characterised by infinitely complex unpredictability - the relation between order and disorder. Chaos theory continues to be a revolutionary indeterminist paradigm cutting across the sciences .
The impact of Cage's philosophies and work, at their deepest level, introduce fresh aesthetic paradigms which parallel scientific modelling of complex chance systems. In the context of modern thought, he expands the potential interconnections with tremendous courage and a level of acceptance enviable in the aesthetic development of any era, but particularly appropriate for ours in a time when globalisation of information replicates phenomenal chance linkages which he adored.
Cage felt that Duchamp's work remained unacceptable as art and hence perceptually new and challenging. (Which is the light switch, which the art object?)

He tried to escape the boundaries of Western music by applying the principle of indeterminism - the equality of all sound phenomena ensuring randomness in his music, and described his journey as "going from something towards nothing, and there is no way of saying success or failure since all things have equally their Buddha nature". (1.13) He taught us to be ready for any new experience, to be empty (as in open) and to simply listen and accept - a sneeze is as valid as a middle C.

The intuitive spontaneity of musical forms such as jazz and its developments and truly innovative musicians like Miles Davis (1926- ?) present us with an incredibly fresh, new and liberating 'non-structure' which encourages extension of Cage's philosophy which was to just listen. His improvisation was highly creative. He was ever a man of few, but significant, words:

"There will be fewer chords but infinite possibilities as to what to do with them - you go this way, you can go on forever" (1.13b)

He essentially rejected the European approach to improvisation and developed his work using West Africal ritual dances with a multi-woven rhythmic line (drum-choir) as a basis for a soundstream - producing essentially collective music with multiple rhythms and textures (African drums, Eastern sections, melodies, polyrhythms) plus subtelty and lyricism. The later work became minimalist with solitary, unexpected dischords. He initiated the element of surprise - causing the audience to really listen with their intelligence, whole being, as well as their ears. Davis' unique contribution had a major impact on the realm of jazz. A milestone in its history.

American Harry Partch (1901-1974) rejected everything which had gone before and tried to re-make music, designing and building all his own instruments. He wanted to develop music that would transcend the conventions of musical composition and rejected ordinary scales, instruments and sounds. His basis was the multi-tones he created (usually forty three tones) in the space of one octave.

His instruments included the

1 Chromelodeon - on which the multi-tone scale is painted in colour and also numbered for identification in producing exactly desired musical combinations (reed pump organs tuned to the forty three tone octave with total ranges of more than five acoustic octaves)

2 Cloud-Chamber bowls - (pyrex chemical carbuoys cut in half and suspended on a rack) Each bowl has at least one or more inharmonic overtones

3 Mazda Marimba - made up of tuned light bulbs severed at the socket (See Appendix 1a, b, c)

His music is extremely subtle and strange to listen to, using almost indivisible micro-tonality reminiscent of Indian Classical music. His was essentially a 'low tech' genre, unlike current experimental processes like electrodes picking up brain energy and producing a digital score from them (Tomorrow's World February 1998)

The music of Phillip Glass (b 1937, a pupil of Ravi Shankar amongst others) makes much use of the repetition of minimal elements to construct his sound-fabric. Morton Feldman (b1926) and Arvo Part (b ?) use musical modes that are characteristically slow, quiet and delicate. Both use chance to allow freedom of choice in performance.

The hypnotic effects of current 'House', 'Techno' and 'Indie' music have an immediate appeal through simple repetitive phrases delivered at fast tempo. As digital musical instruments are used to generate much of it, tracks may go on for half an hour or more. It appeals firstly through the energising tempo (motor factor) then through the comfort band of 'melodic' repetition. Played very loud in large cubic spaces, the air vibration of speakers hits the body physically and generates interaction.

There are scores of other musicians and developments which have had a significant impact too numerous to enter into in detail here.

Synaesthetic composers such as Russian Alexander Scriabin (1877-1915), Oliver Messaien (1908) and Karlheinz Stockhausen (1928) and synaesthetic artists such as Wassily Kandinsky, and David Hockney are well documented. All experience colour when hearing music - each channeling their faculty into creative output.

I interviewed James Hugonin, whom I believe is a synaesthetic painter, at his exhibition in Kettles Yard Cambridge, the full transcript is Appendix 2. He requires music to be played to complement the veils of colour in his work. This original research was extremely revealing. (See also Modern Painters Spring 1996 (1.22))

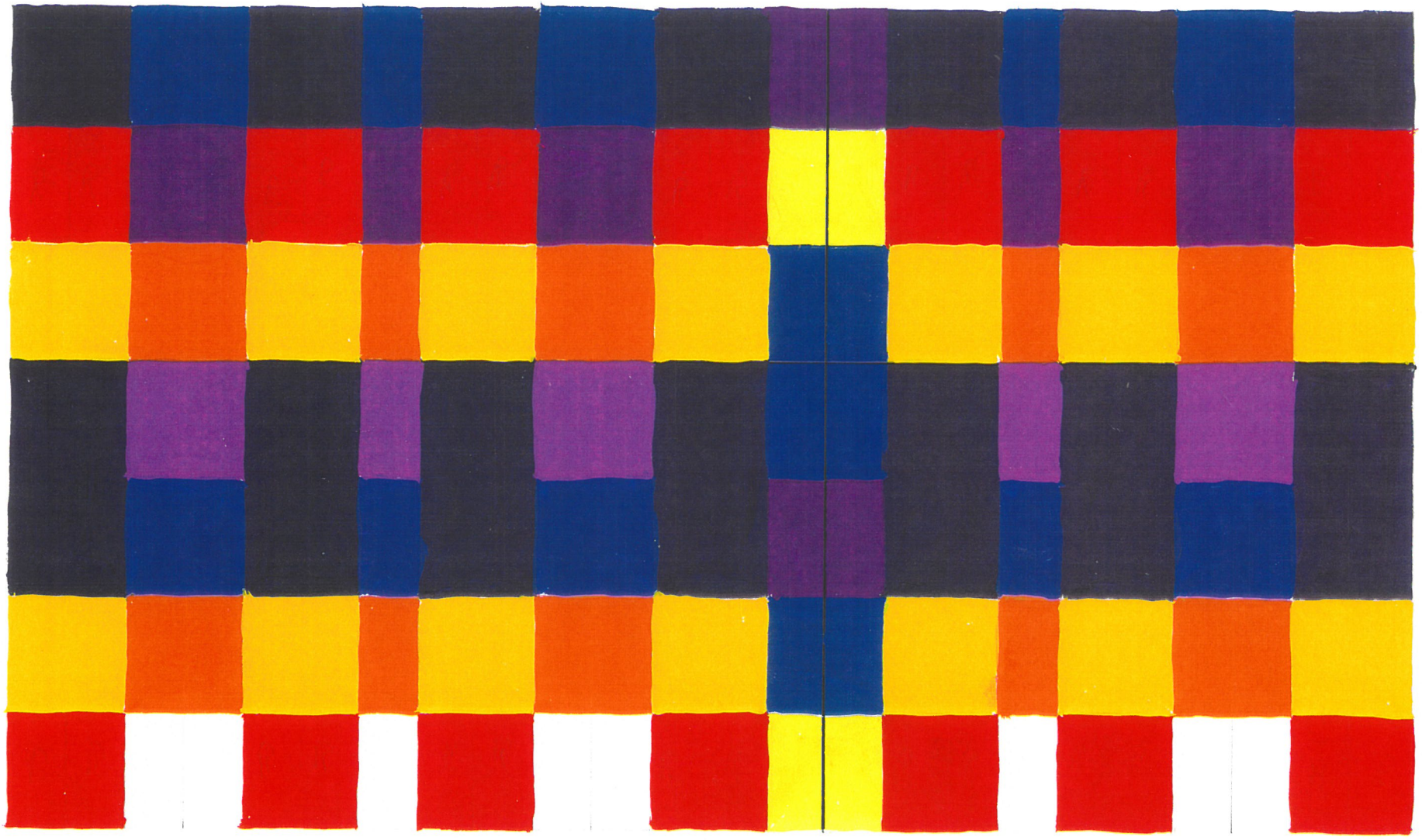


Illustration 6

I want to clarify, at the outset of the personal research section, that my aim is not to replicate synaesthetic response in seeing colour to hearing music. (I doubt that this would even be possible). My overarching objective is to explore creative ideas about how certain elements engendered by it could be made visible.

5 PERSONAL RESEARCH: COLOUR FROM SOUND/AUDITORY SPACE

During my visual art research, major questions began to present themselves:

* Could there be a colour equivalent to sound generated for those who are not synaesthetic?
* What applications might this have (eg learning to read musical scores by means of colour, healing light projections, colour healing etc)
* How could such a system be established, what paradigms would be necessary for such a vast auditory spectrum ?
* If this could be achieved, what would different composers work look like ?
* How could key elements such as rhythmic structure, velocity, echo sequence etc be made visible ?
* How would duration in time be expressed ?
* What variation in proportions were needed for composers individual and distinctly characteristic 'shape' ?
* How and where does music exist when we hear it ?
* Where does the synaesthetic experience connect in the brain ? Where does the 'this is it !' feeling come from ?

These are only some and not all are yet answered.

In making sense of music, certain attributes are inherent as we have already seen:

Loudness

Pitch

Rhythm

Timbre

Other attributes such as

Contour	Symmetry/asymmetry
Interval/duration in time	Repetition
Tonality	Inversion
Modulation	Bridging
Flow	Pace

cannot be separated. However, some of these individual characteristics to me became exciting arenas for visual research.

The first and major problem was to try to generate the visual equivalent of an auditory space-field which had to be :

- adaptable and fluent
- capable of multiple layering
- divorced from other types of spatial perception

Secondly, the decision to research individual classical musical scores in colour using my own twelve-tone colour scale generated dynamic and structured results. Composers analysed included Bach, Mozart, Britten and Bartok. (See illustrations 2-8.) Each note's duration had a mathematically accurate ratio according to what I felt was the fundamental 'shape' of a composers output - Bach was steep, deep and sonorous, whilst Bartok was thin, astringent and attenuated, Mozart chunky and solid. Each note was individual, clear and distinct - like marbles in a bag - all touching yet each separate. This was a euphoric period when I felt I could go on indefinitely.

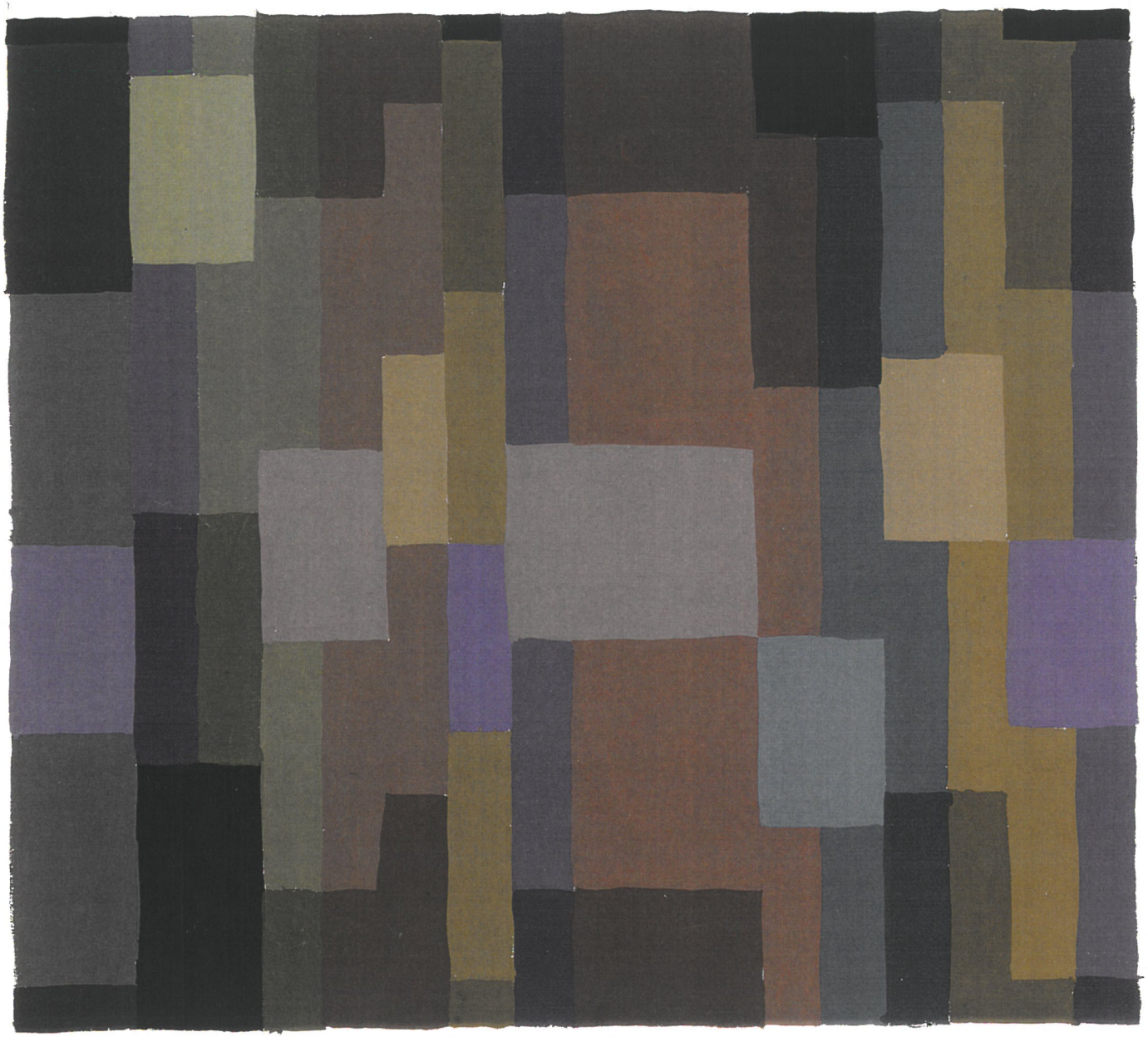


Illustration 7

But the whole was becoming more than the sum of the parts, and, over time, it became apparent that this was a limiting paradigm as one was bound by the strictures of another's creativity and form. (I do feel however, that the working potential and range of possible applications for such a system is infinite, and would like to consider, over a longer period, developing a programme of further study linking up with researchers, neuroscientists and other artists.)

Certain indigenous and abstract qualities of music/sound began to assume major significance for me:

Duration in time

Vibration - perceived, auditory, optical

Structural organisation - including bridging, suspension, tension

Dynamics - drive, pace, velocity

and the innate ability of one section or aspect of music to influence and ALTER the structure as a whole in auditory perception. This challenging reciprocal reaction had the ability to transcend time, bridging sections which could be minutes or even entire movements (rather than seconds) apart. Perceptual memory (an individual phenomenon) could also not be ignored.

When the music ends, the flow and influence into auditory space does not, and indeed, the mind, responding through the immediacy of the limbic system, may reconstruct its own linkages forming a new, and highly personal, structure. We all recognise sections of music we love - and with almost palpable anticipation, mentally hurry through to those pleasurable resolutions which we greet with the shock of recognition. We need the expected to recognise the unexpected.

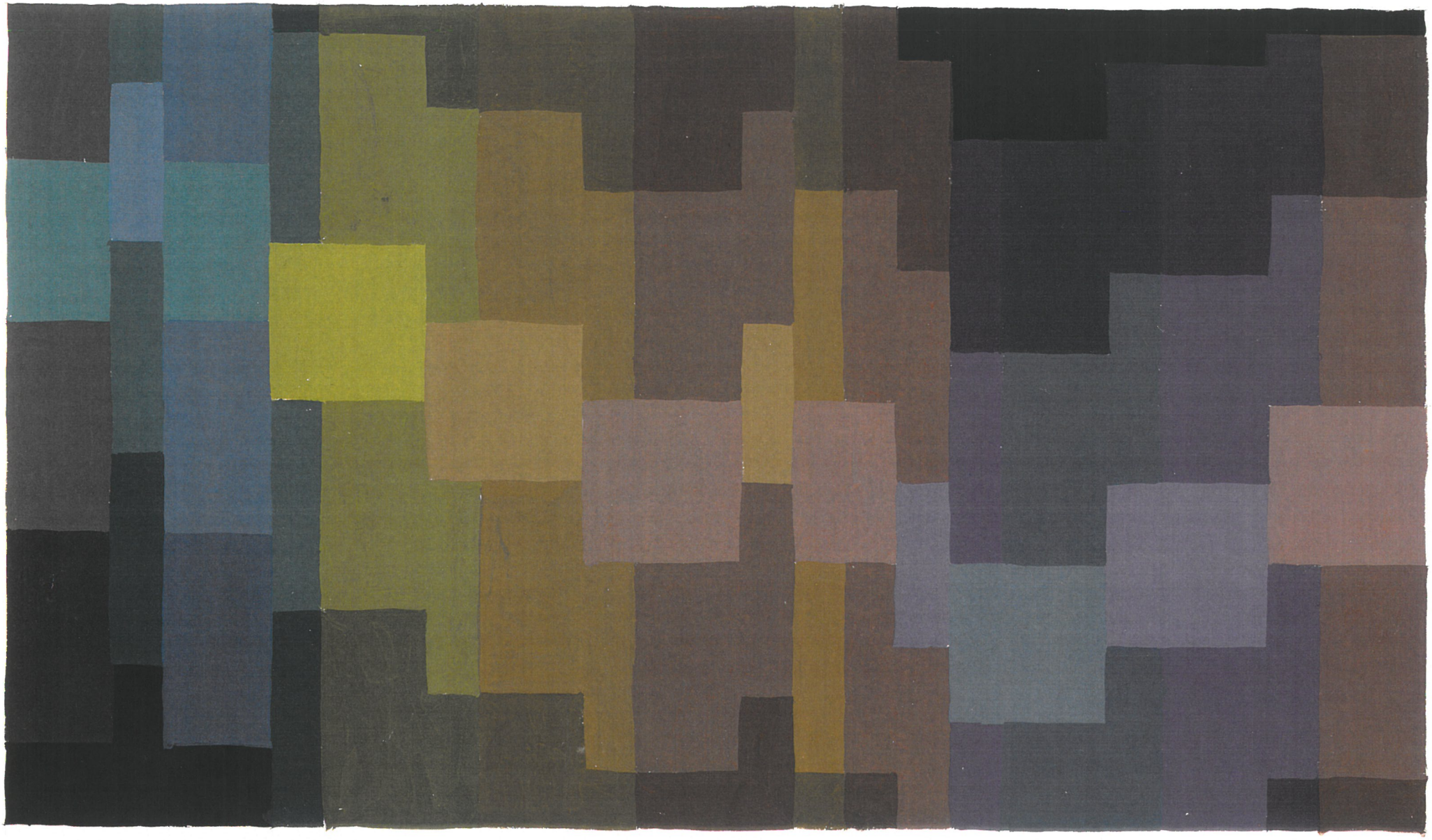


Illustration 8

The very basic question I started with was 'What does a sound look like ?'
This led into what type of sound and how to represent it - studies in ink using a large brush produced results resembling Franz Kline work, which were unstructured and loose. I needed a higher level of definition and control. Single gestural marks followed which started to make sense. Speed of mark and density of ink loading affected the image and the ratio of white surrounding it was ultra-significant creating tension values within the image and in the interrelationship with the edges.
Second question was 'How can I translate musical scores into colour ?'
Clearly, if a colour scale could be evolved for the twelve auditory tones, it would then remain to devise specific ratios for each note value - semiquaver would use fifty percent of the space of a quaver and so forth. After extensive experimentation, I eventually devised this system (which remains confidential).
Listening to hundreds of compositions of all kinds implied other types of problems to solve - what about octaves? what about loudness? what about tempo ? what about a multiplicity of instruments or voices sounding simultaneously ? what about the overall 'shape' of a composer's work ? (There is enough to continue researching for years !)

Starting with a few bars from different composers generated interesting comparisons, and there followed a blissful period of translations. But other elements were starting to demand more attention - duration in time - the length of time a piece might occupy, bridging - the way a passage of music hovers above nothing until the sound-fabric rejoins, vibration - optical and auditory, dynamics - the drive, counterpoint and pace of a work.
Inspired by the complexity of Brazilian rhythms, a series evolved using black gouache on white paper, with five or six bands of simultaneous rhythms proceeding diagonally across to optically simulate the energy and contrapuntal vitality of the

sound. Similarly, using a very tranquil stimulus - Gregorian chants, a more static, horizontal series emerged where the auditory space demanded large, void areas of suspended animation, over which the sounds hovered and shimmered.

Certain musical compositions seemed to fold in on themselves in a reciprocal FOUR dimensional action. A series of large gouaches exploring this phenomenon yielded the clue as to how an auditory space-field might be initiated. But four dimensions on a flat two-dimensional surface ?

I had no idea how these elements might be brought together visually. The field of exploration was, and continues to be truly daunting given its scale and complexity.

And how about resolving things ?

Generating a visual equivalent of the sound-field of auditory space seemed to me to be, in itself, a colossal problem. I listened and listened to music - WHERE was it existing ?

- in the Renaissance space of cubic metres of a man-made interior ?
- in the personal space immediately surrounding the body ?
- in the auditory canals in the ears ?
- in the 'head' ?
- in perceptual awareness (and where is that) ?
- in the chemical triggering of the limbic system ?
- in the 'inner' or spiritual, higher self (outside physical referencing) ?

It seemed to exist in some form in ALL of these areas simultaneously. Cytowic's 'multiple mapping' came to mind, and I tried layering, graphs, working on transparent surfaces but in the end I needed total simplification. A dark yet active field, where rhythmic brushwork both created, disturbed and activated the surface. This active field was crucial to the work which followed - there had to be a sense of 'something' rather than smooth flatness - a kind of three dimensional 'presence' - an active 'void'. This was the space-field I needed.

It was possible now to start to put sound into the auditory space-field, and gradually the colour system built up in this 'inner' space. Painting after painting followed. Things which gradually started to work were duration in time, implicated in the physical length of the works - they had to be experienced in the fourth dimension by means of a two-dimensional activated surface and this could occur by walking beside them, viewing them close-to, and also occur by viewing them in their totality from a distance. The paintings got longer according to the tension I wished to generate in the auditory space-field.

Vibration was also working through the juxtaposition of the colour and the optical reactions formed a parallel interface with the sound. Structural organisation and pace also came together, and suddenly, the amalgam became its own language, more that the sum of its parts.

But the containment somehow was not working - the 'innerness' and depth of space was beginning to take over core ingredients. Having created what I felt was an 'active void', it was apparent that it was becoming a metaphysical gateway into which sound/ colour seemed to disappear (an auditory 'black hole'). The affirmative presence of the colour could not survive in this territory.

I needed a condition of emptiness which could be both an active void and co-exist with luminosity- an apparently limitless space yet one which suggested fresh openness. How could I generate a void to create a charged space-field which would not absorb colour luminosity?

In the process of thinking I would have to turn the conceptual ideas inside-out, the breakthrough came - INVERT THE AUDITORY SPACE-FIELD.

It was truly a 'Eurika !' moment. But how could this be achieved ?

I had to find a way of using the active-void space field in conjunction with inverted space.

Studies helped little. Working on white paper however gave the clue - put the auditory space-field in the inner area, and move the sound/colour to the outer edges.

The discovery of three major phenomena occured:

a) sound/colour flowed OUTWARD into the white surround- it became a SECONDARY SPACE-FIELD where colour could fluctuate freely

b) the centre IMPLODED giving a deep-space infinity and creating a VORTEX

c) the EDGES became hyper-active with the optical liberation engendered by the ENERGY OF WHITE.

Working with the interrelationships of two space-fields, radically differentiated yet visually integrated, was daunting and thrilling simultaneously.

The paintings now became eleven feet long as duration in time was stretched, and concurrently they reduced in depth from about eighteen inches to six inches. Six inches by eleven feet was so exciting visually as it generated startling tension. I took the colour round the edge of the frame and this increased the 'objectness' of it, introducing another dimension, a kind of time/space/auditory/object continuum in constant flux. Linkage between edges of one painting and the next added to this reciprocal action.

This is where the work stands today, and quite clearly, there is far to go. But the insight and complexity of the process, the journey is, in many ways, more significant that the finished work.

PART THREE

6 PRESENT CONCLUSIONS AND SECONDARY OBJECTIVES

In this section I want to look at the implications of the current research into the workings of the brain, and consequently synaesthesia, and what my research means for me and the future objectives of it.

Our brains are the most complicated structures that are known to us in the universe. Is the brain a machine? - a physical machine of working components which are nerve cells or neurons - how can it experience pain or see colour, or know that a joke is funny? Does it have 'awareness' neurons which allow perception, thinking, memory and intelligence?

Current research applying psychological, medical and electronic clinical procedures, (PET, MRI) forces us to recognise that perception and the workings of the brain involve an extraordinarily complex interactive matrix, which we may never fully fathom. The more we find out, the less it seems we know. Each question generates further levels of enquiry in an exponential growth worthy of the attention of non-linear chaos theorists.

Cytowic's revolutionary research and theories (unpopular with the scientific establishment as they focus on emotion not rationality) are truly at the forefront of change in our perception of who we are as humans and what makes us tick. His eventual discovery of multiple mapping, as a result of intelligent alertness in experiments which activated the Visual, not auditory cortex in response to music, has far reaching implications. Multiple mapping implies that the brain 'networks' with both itself and with bodily systems, cells and fluids instantaneously, and that it is emotion at the interface which we must take much more seriously. We have all experienced 'fight or flight' reactions which cause major chemical changes in the body.

Daniel Goleman in 'Emotional Intelligence' states:

> "..repeated over our evolutionary history, the survival value of our emotional repertoire was attested to by its becoming imprinted in our nerves as innate, automatic tendencies.....a view of human nature that ignores the power of the emotions is sadly shortsighted. The very name, 'homo-sapiens', the thinking species, is misleading in light of the new appreciation and vision of the place of emotions in our lives that science now offers. As we all know from experience, when it comes to shaping our decisions and our actions, feeling counts every bit as much - and often more - than thought. We have gone too far in emphasising the value and import of the purely rational -of what IQ measures - in human life. Intelligence can come to nothing when the emotions hold sway." (1.13c)

Cytowic is equally clear on the primacy of emotion:

> 'Our brains are not passive recievers of energy flux, but dynamic explorers that actively seek out the stimuli that interest them and determine their own contexts for perception...it is an emotional evaluation, not a reasoned one, that ultimately informs our behaviour.' (1.23)

It would seem that the hippocampus and amygdala, among the more ancient parts of the brain in evolutionary terms, are worthy of intensive scrutiny. The fact that synaesthesia remained unresearched for so long means that we overlooked one of the most significant keys to our existence for over two hundred years and allowed ourselves to be convinced that the superiority of rationality was indisputable. The value and importance of emotion was belittled as a 'feminine' trait, and perceived as weak and therefore unworthy of study.

Perhaps significantly, the majority of scientists at this time were male.
Current advances in medical thinking are ennabling this situation to be reversed, but it will still take a fundamental shift of common belief before emotion and the limbic system - the instantaneous movers and shakers of our survival mechanisms and which tell us what is salient and what is not - are accepted as being the catalyst for our actions and feelings, and hence, our perceptual core.
Emotional and rational responses co-exist, but the emotional response is literally spontaneous, while rationality requires deduction and is half a second slower.
(In evolutionary terms, half a second slower can mean the difference between eating or being eaten.)
Researching our perceptual core can reveal more of the workings of synaesthesia and in time, it will perhaps be fully exposed and understood.
Clearly there is a need for scientists and artists to stop seeing themselves as separate - I believe the fundamental signal of synaesthesia is one of INTEGRATION not just of how we sense the world but of who we are in it

Integration and the breakdown of barriers is at the heart of much current innovative hypothesis.

Victor Papanek talks of the artificial markets generated by large corporations for economic gain which unnecessarily exploit planetary resources when often a smaller, or more localised and integrated solution is appropriate.

The Gaia theory initiated by James Lovelock, proposes that, similar to the human body, the planet is one integrated self-regulating macrosystem or superorganism. He believes everything is integrated and has intrinsic value.

We have also looked at the non-linear, indeterminate science of Chaos Theory and indeed, even religions such as Buddhism base their belief on the value of all things as having equal value - a stone is as valid as a cloud is as valid as a human, and that self-knowledge, deep personal inner scrutiny and loss of ego, is the way to enlightenment. This may take many lifetimes.

In the business world, management systems, to be flexible enough to respond to fast-changing demands, need to become non-linear, non-heirarchical, enabling a more rapid, decisive and appropriate solution to be reached and implemented, with 'cells' grouping and regrouping as necessary.

Implications of the digital revolution (Marshall McLuhan's 'Global Village, Gates et al) will be exploited by the next generation perhaps more successfully than by ours. Globalisation, the macro element, and independent working, the micro, will co-exist with homeworking and networking. A result of this will be a growing demand for a more appropriate, holistic lifestyle and increase the demand for related therapies.

Conformism is an intrinsic attribute in our evolutionary conditioning and survival depended on it in previous eras. But it is INTEGRATED DIVERSITY which will become significant now, with individuality at the core.

"As our outer worlds grow more similar, we will increasingly treasure the traditions that spring from within." (John Naisbitt & Patricia Aburdene, Future Worlds p161)
These deeper values (including the arts) give a clearer sense of 'self': we trust our 'gut' reactions and feelings without fully knowing why - an 'inner knowledge' often transcends a rational thought.

Reductionist analysis is also failing us in its insular and micro journeys - learning more about less and the cult of the fragment without linkage. There is a process now of CONVERGENCE as divisions between science, philosophy, art, the humanities are eroded and in the resultant holistic view - that we are integrated organisms- human values will assume far greater significance. Knowledge is one thing, but how do we reach wisdom?
Like music, we need to look at the whole - it is always more than the sum of the parts. Active listening - listening with all our senses - and without the mass distractions and interference we encounter in daily life, might perhaps trigger synaesthesia in a greater range of people. If multiple mapping, integration and emotion are at the forefront of our existence, as both science and the arts indicate, then what we currently perceive as our definitive 'humanness' is only the tip of the iceberg. Parts of us are inaccesible to self-awareness. What 'touches' us may give insight into our instinctive sense of 'rightness' - the 'this is it' phenomenon. Enhanced awareness is the key and to achieve this we need more stillness in our existence, living fully in the 'now'.

I believe we will turn inward and outward in new ways. We live in a unique time at a hiatus in human evolution. Mass culture represses the richest and deepest stages of our growth as individuals - mental, intellectual, emotional and spiritual (at the same time as keeping us informed about the world we live in, ironically.)

We allow this insidious and pervasive de-sensitisation to occur as part of our culture which we tell ourselves we cannot do without. Only vigilant awareness and selectivism can balance it. Living now and being fully conscious on all levels as humans, allowing knowledge to inform wisdom, can equip us for the accelerating mutability we face.

The social implications of synaesthesia experienced by a greater spectrum of individuals could enhance and resonate with this process. Specifically, colour experienced when hearing music, the most prolific mode of the phenomenon, could increase pleasure and memorably enrich human existance; through it our intuitive capacity, creativity, inspiration, insights and inner knowledge could come to the fore significantly raising our awareness of the now, and give a deeper understanding of ourselves as individuals. Synaesthesia has, I believe, profound implications.

My work, beginning to explore the process of visualising music, could also have far-reaching implications. I am certainly not the first to attempt this, and furthermore, reports by other synaesthetes do not indicate a common language of colour- to-musical note value. Indeed, it is the very differences which define the individuality of the phenomenon. In my work there is at the moment, a collision between the classical, rational urge for order and the emotional urge for expression. What is now needed is a disorder characterised by clarity. A more indeterminate mode.

However, the discovered multiple mapping of sensory and perceptual experience must surely imply that we can infinitely enrich our cognition and thereby our existence, synaesthetic or not. I do subscribe to Cytowic's view that we all have synaesthesia, but that it only comes to the surface in one in a 25,000. Imagine if all experienced it !

Five billion people would be living richer and more enhanced lives with a greater understanding of their 'inner' selves, connected to the moment.

I feel that after deep and intensive work I am only just getting to the inner layers of the subject, and as mentioned feel the working potential and range of applications of a colour code for music is infinite in all directions. Working with neuroscientists, researchers, other synaesthetes and artists would open up exciting integrated possibilities and is certainly worthy of extended future study. A code could be synthesised in ways which could be acceptable to a large part of the population.

Our society trains us to control our emotions (particularly in the West). It is a rational control mechanism over our emotionally reactive limbic system, and highlights an archaic and deeply-rooted conditioning. We need to work towards changing this on an individual basis, not so that we become OVER emotional, but so that we have the ability to use intuition more effectively. The brain is fantastically efficient. When we are faced with new problems, we generate creative solutions. We see things in a different light. Emotion influences everything.

Perhaps our higher mental functions come about because of our ability to both utilise and express emotion: Cytowic poses:

> "...the multiple facets of mind are the human equivalent of the duality principle in physics...light is simultaneously a wave and a particle...by analogy to the duality principle, our minds are simultaneously analytical and intuitive, appositional and propositional, holistic and sequential." (1.19) and "...how strange that we identify so strongly with the rational mind while we connect most deeply with life through our emotional psyche.." (1.20)

His statement implies that transcendence indicates an inner knowledge and this has an independent life in the emotionally reactive limbic system.

The artists role is perhaps to see through the surface to the inner, or transcendent reality. Art is the medium of the unconscious - it has symbolic meaning.

Awakening the SELF is the key, and perhaps solving abstract problems the route. Both music and colour are interprative paradigms at the axis of culture; both have meaning beyond the sum of their parts; perhaps they symbolise the fact that feelings have validity as emotional paradigms, outside physical referencing. And perhaps it is this plurality which is the key to the multiple feedback of systems - immanence and transcendence together.

Breaking down barriers between science and the arts, indeed, between all aspects of life which we perceive as measurable, albeit in an indeterminate way. The powerful swing to the idea of an holistic existence, to the interconnectedness of all things, (parallel with infotechnology, ultra-rapid computers, satelite networks etc) and the decentralisation of systems and networks, embodies our intellectual outreach at this time. In the future there will be multitudes of informed people.

Abstract problems may be the key. We need a higher level of understanding of abstraction. Some aspects of it we absorb by the osmosis of living - spatial perception for example, and music - the auditory gaze of an abstract spatial orientation.

The concept of abstract space was addressed by key American field painters from around 1945 onward, notably Mark Rothko, Barnett Newman, Frank Stella, Larry Poons, Ellsworth Kelly, Morris Louis, Helen Frankenthaler, and installation artists such as Dan Flavin and Donald Judd, Claes Oldenberg and others and visually created a completely new paradigm for what we perceive as Art & Space.

Suddenly, subject matter could be anything, and simultaneously. They seemed to fall broadly into two categories - the stark, formal classicism of Newman, Kelly, Judd and the more lyrical romanticism of Rothko, Poons, Louis, Frankenthaler and Flavin. Somewhere between the two, was Agnes Martin with her sonorous and meditative work.

My view is that we need a new blueprint of a higher visual fluency in order that the rational (order)

and the emotional (expression) can reach a balanced, instead of weighted, counterpoint. 'Seeing' music does not adequately describe the process either. There is a SPATIAL PRESENCE that incorporates more. What I am coming to recognise is that there is no boundary between the interaction of mind, brain, music, space and perception. Only ENERGY POTENTIALS.

Sound is a metaphor for life - we disappear into it, conscious of our 'selves' through our senses yet lost in its scale and interactive complexity. Music breaks down the barriers between materialism and spirituality, reason and emotion - it mediates between the inner and outer world. It has a subliminal, associative role. A work of art is a language in its own right and as such has an absolute value. It is contextual-ised not through an appropriate 'setting' but by means of multiple layering of perceptual experience, be it conscious or subconscious. It overlaps the accumulations of memory - cleansing and reconnecting in a purified form. The power of emotion similarly has the ability to connect interior realities with exterior stimulus - it is a mordant which transforms, and linkage can begin at any point and go in multiple directions. A spiritual paradigm. Agnes Martin puts it succinctly:

> "It is quite commonly thought that the intellect is responsible for everything that is made and done. It is commonly thought that everything that is can be put into words. But there is a wide range of emotional response that we make that cannot

be put into words..... we are so used to making these emotional responses that we are not consciously aware of them till they are represented in art work. Our emotional life is really dominant over our intellectual life but we do not realise it...abstract or non-objective feelings are a very important part of our lives" (1.21)

The synaesthetic urge to render in concrete form something which is inherently non-material and amorphous - music - is my search. In spite of the extensive neuroscientific research underway, no-one knows how the transference of synaesthesia happens. Abstract paradigms, in releasing us from identifiable connotations are, I believe, the key.

But our emotions, chemically triggered in the limbic system, signify we have a vested power in inner territories, personal intrinsic value. Emotions make us human. Their purity, primacy and immediacy reaffirm their place at the core of evolutionary and perceptual growth and thus are a paradigm for our individual identity.

It is up to us to use this vested power with wisdom.

In conclusion and to summarise:

Firstly, in spite of extensive, sophisticated international neuroscientific research, no successful or definitive conclusion about why synaesthesia exists has been reached. Nor why only a few supposedly experience it, or what indeed, it is or how it operates.

Secondly, we have examined key theories on the subject from opposite ends of the spectrum, one essentially based on the 1950s view of brain operation of individual, linear sensory modules with abnormal genetic linkages expounded by Baron-Cohen and Harrison, the second based on the clinical discovery of multiple mapping and transmodal transmission in the brain by Cytowic. Also we have examined a range of other experimental research and drawn conclusions from it.
Evaluating the evidence it is clear that Cytowic's current conclusions and emphasis on the powerful ancient brain core (amygdala and hippocampus) and its ability to chemically stimulate instantaneous emotive response through the limbic system may provide us with a more distinct direction for future research. For me, Baron-Cohen's theory is simplistic and provides no clear evidence as to how linkage occurs - he speculates only that it is a genetic abnormality.

Thirdly, as it is inappropriate to consider the abstract forms of colour and music synaesthesia, without looking at both, we have concentrated on some key innovators in the field of music who have expanded the boundaries of their artform from classical structures to what could be termed the layering of auditory abstraction, and similarly touched on field painters who paralelled this paradigm in the visual arts.

Fourthly, we explored my own visual art research examining processes and intuitive directions into how certain elements engendered in music could be made visible. As I emphasised, the aim is not to replicate synaesthetic experience but to explore intense creative ideas implicated by it. Twelve-tone colour scales, auditory space and its inversion were the catharsis. Abstract cognitive constructs are the key.

Secondary objectives:

In some way, the visual results of my research are starting, only just starting, to make inroads into the subject on a personal level, and it will clearly take further years of research and linkage with scientists and synaesthetes before definitive conclusions can be reached. My secondary objectives include finding other synaesthetic visual artistsand examine how it impacts on and interacts with their work: linking up with synaesthetic composers to explore the possibility of constructing a colour-to-note learning system, or coloured representation of their auditory work, depending on their working methods - flexible enough be the composing for conventional instruments, electronic digital output or other creative combinations.

It could also be possible, given sensitive enough technology, to construct a total sound/ colour environment, where the recipient at once hears sound and experiences dynamic coloured light on continuous curved surfaces which totally surround them.

As colour and sound are experienced by most, could a universal language be generated and what potentials could it have ?

The pivotal importance of emotion implies that these future goals could all potentially be achieved (and reciprocally contribute to raising awareness of the phenomenon.)

Cytowic states :

> "Emotion, which I use to include irrational, a-rational and non-verbal knowledge and cognition, is what actually directs our thoughts and actions... our inner knowledge..is largely inaccessible to introspective language, which means that what we feel about something is more valid than what we think or say about that something" (1.24)

It is only through a more accurate knowledge of the operation of the limbic system and subsequently emotion, that we can hope to reach a deeper understanding of what synaesthesia is and how it works, indeed, why evolution has preserved it. This I leave to the neuroscientists who have sophisticated aparatus with which to explore it.

Is synaesthesia a means of communication and if so, what has it evolved to communicate ? From my own perspective, there seems to be no logical, rational reason as to why I see colour when I hear music. It is an immediate, involuntary sensual perceptive response, and it definitely enriches my life in that it combines two abstract elements which I value highly - colour and sound are large parts of human perceptual experience.

It could be argued that telepathy, precognition, clairvoyance etc have survival value in that they might be deeply rooted and pre-linguistic warning systems. But what is the function of synaesthesia ?

Perhaps there are parallels in subliminal perception. This contraversial hypothesis poses that one might be affected by external stimulus that one is not aware of - a kind of perception without awareness, in which the brain receives and processes information and generates response actions, without any of these elements reaching consciousness.

The hypothesis clearly suggests that consciousness and the transmission of information can operate independently at a pre-conscious level of processing, which implies totally different cognitive systems are in existence and functional.

In other words, that there is a latent awareness threshold response system. I believe it could be posed that the older, evolutionary brain (amygdala,hippocampus) the limbic system, because it reacts instantaneously, could be the seat of this latent awareness response system. Indeed, perhaps synaesthesia is an element of this pre-conscious level of processing, since it amalgamates major perceptual factors like seeing and hearing.

In conclusion, there is so little known and understood about synaesthesia that it continues to form the elusive basis of aspects of intense neuroscientific research and offers fleeting insights into how the brain, and consequently perception, works.

I believe as stated earlier that all are potential synaesthetes and until we expose the subtelty of its mechanisms, we cannot fully comprehend how the limbic system, and subsequently emotion and perception, operate. It has to throw significant light onto our existence as human individuals.

Had emotion been taken more seriously at an earlier stage, scientific investigation might be further advanced. However, what we do know is that transient connections between neural structures, the integration of Cytowic's multiple mapping, (parallelled in

other key theories of our time, is the closest we currently are to gaining insight into its transcendent, and perhaps subliminal nature.

Daphne Cousins
May 1998

OTHER RESEARCH COMPLETED

I did think about basing this study on other sound/colour synaesthetes, but their scarcity and unavailability for extended study precluded this. Using myself seemed the most logical solution.

Acting on instinct I contacted James Hugonin, a painter, whose work I found of great interest.

I visited him at his exhibition in Kettles Yard, and he agreed to be interviewed.

Although he feels he is not synaesthetic, it is clear from the discourse that there is a distinct possibility that he is.

The transcript of the interview is attached as Appendix 2.

I particularly wanted to find PET or MRI scans of sound/colour synaesthetes. I hunted thoroughly through a range of medical, scientific, psychological and neuroscientific publishing, and on the Internet, but found the nearest were verbal sound/colour scans, and they were frustratingly not near enough.

Extensive efforts were made to contact Richard Cytowic - I rang and E mailed him on 24 separate occasions over a two year period, but did not recieve any response.

There is now an International Synaesthetes Association who can be contacted through Dr Simon-Baron Cohen at Cambridge University.

Note on the Illustrations: ILLUSTRATION 2

I have used my own 12 tone colour scale throughout. Rather than convert an entire piece of music in the dissertation, I have used a few bars of several works by different composers to invite comparison and contrast.

In Nos 3-6 the notes are represented in static form.

In Nos 7-8, I have taken a single melody and used a double echo sequence where the echo of one note affects the surrounding area of the next.

APPENDIX 2

JAMES HUGONIN INTERVIEWED BY DAPHNE COUSINS

10th May 1996 at Kettles Yard Gallery, Cambridge

DC - When did music and colour start to come together for you - was it always so, or a gradual process?

JH - I find it hard to separate the two things, both music and colour are important. I think the sensation of colour and the sensation of music too, of course they are different forms but they both operate for me on this level of sensation. I feel drawn to particular colours and to particular paintings very much in the same way as I feel drawn to particular music. I mean the paintings I feel drawn to are Seurat's and a lot of the French Impressionist painters and the music I feel drawn to is very much to do with Feldman, its also to do with, there are many composers, Debussy is important, there are links and crossovers, really working though the two forms.

DC - Did you study music or do you play an instrument or sing?

JH - I don't study music, I don't play, well I do play the guitar very badly! No, but I think my interest in music is much more to do with responding to particular works and very deeply feeling those works of composers. I mean some of works for me have been and Morton Feldman's Palais de Marie, I think is a wonderful work, I can't play it or sing it. In a way, I don't really want to, it's just that the work itself has to have a resonancewith me and its that resonance that is what's really interesting, not so much that I can actually play it. I don't have a burning ambition to play or create music in that way, most of the music I am drawn to is often of a very quiet nature. And again its much more to do with something which corresponds to the way in which I work as a painter. What I really want to do is to paint; this idea of singing, this performance is also quite interesting. I don't really want to be a performer, as such. I like the fact that by being a painter, one distances oneself from the actual performance activity.

DC - When you are looking at or working on your painting, does music drift into your head?

JH - This is a difficult question. I actually like working in silence often. I sometimes work with music, it's usually very specific music though and often the music becomes too much. I prefer working in silence or just, I almost want my mind to go into neutral when I'm working, but don't quote me on that! What I'm trying to say is sometimes if you really think about it the work of a composer, its their work, its their expression and sure, things come into my head when I'm working but I almost don't want too much to come in. I want a very strong dialogue to emerge between what I'm dealing with on the painting and what's going on in me and it should be a very straight exchange between the painting and me, and therefore, if there is too much emphasis on music it doesn't work.

DC - How did you get into painting?

JH - This is a long story. Its interesting, I talked to a teacher who taught me when I was about six or seven and she is quite old now, she must be eighty or ninetyish, and she was saying that even from the age of five or six, art was a real interest. I do remember, going back to that stage, of making a sculpture very badly in this art class and being very upset with myself for making this really bad sculpture and I have to have something which I could relate to. If I made something, I had to be able to stand by it. But I think this whole art thing for me comes from being able to literally stand by what you make, so its got in a way, moral connotations, its certainly got emotive connotations; its to do with what I actually am as a person, its an expression, you are baring your soul when you make art, or you should be! When I talked to this person, they said "No James, it was in you at that time". At about the age of seven to fourteen two things happened.

Aged six or seven I was left handed and somebody slapped me on the wrist and said "Look, James everyone's got to write right handed here". That completely threw me, it really did, I was dyslexic and I had a lot of problems with stammering and all sorts of things at that time. That in a way made me draw into myself more and this drawing into myself also brought out this art. I also had a kidney operation at fourteen, I had to have a kidney removed, I was getting very ill already between the ages of nought to fourteen. I was born with a dead kidney and this made me very ill, I practically died but anyway I had this operation and that was quite a turning point as well because when I went back to school, fourteen is quite a critical time to be ill for a long time, because all my peers moved on, went on to continue their education and my education was gradually getting less and less. I went back to school and one of the masters said to me "Look James, I think you better do something that isn't going to tax you very much, why don't you just go to the art room and mess around up there" and I looked at this chap and I said "right, if you think art is about that, I'm really going to prove it to you that it isn't" and that really turned the red lights on in me and I have never really looked back. At that time, I didn't really know a great deal about art but I read a lot of books about it, I totally, because this man said this to me, it was almost by default! I was so incensed that it started the whole thing and then I went to art school and from that has led to many other things. There has always been a very strong determination. Also being in hospital at that time was quite important, when you are at this point when literally you could die, I remember people looking at me and thinking "God, he's not going to last too long". I really can remember it, it's a very strong thing, it affects you at that age. So I knew I just really had to, if anyone was going to pull themselves together it had to be me, and I had to do it and art was my way of doing this, and it's remained that way.

This thing with art really continued when I went to Winchester School of Art and my art teacher at school was also very important to me. He really encouraged me to continue with painting. Its always been painting that I've been interested in. I did do sculpture but I was so bad at it, I don't really think in three dimensions, I really do have this obsession with the flat plane. The flatness of a painting has always been very strong to me. So I was at Winchester then I went to Farnham and then did a post graduate at Chelsea, that was when I was between the ages of about 19 and 25. The sort of work I was doing when I was at college began on a singular line; Rothko was very very interesting to me and has continued to be very interesting. Certain painters began to take on a real prominence in my thinking and in my activity as an artist, Cezanne, Rothko, Seurat, Mondrian, a real mixture of art, but in a way its very singular. I think all those artists were really trying to provide the framework for an expression, whether its Cezanne with his faceted areas, whether its Seurat with his dots and tiny areas of colour, whether its Mondrian with his grids, or Rothko with his particular form of expression with large rectangles of colour, they are all trying to find a vehicle of their own, to find something which really expresses them, both them as painters, but is also going for something much deeper, trying to uncover a much deeper side of them and so I always found I was drawn to that, right from quite an early age, twentyish, seeing the Rothko show at the Tate and seeing several Rothko shows was a very moving experience for me. I started off often painting landscape painting but the landscape paintings I was painting became very much abstracted, they developed into literally dots and dashes of colour. It was again the expressive power of colour that was coming through all the time. I found that also at college, I then tried to paint like Rothko type paintings but it was absolutely hopeless, you can't do that. It had to be something that actually came from **me**. And so gradually how my paintings developed and how its developed over the last ten years or so I had to find a form of expression that really was me, it was nobody else, it was to do with me and how I saw the world and related to the world. In a way I tried to find that by having this development of the grid it is crucial to this, but the grid to me is only a holding mechanism, it is not the subject of the painting particularly, its a form from which I can have tremendous freedom to work with colour in a particular way. I actually started these grid paintings in about 1980, but is was there in the work when I left college in 1975. It was beginning to come through in the work from 1975 - 1980 but I actually found a way of working with those very very small areas of colour right from the early '80's. That has really developed right through to '95/'96. Gradually the paintings have become stronger and stronger, I can't emphasise this enough, I think it takes a long time for a painter to develop, its a lifetime's activity, its not just what

you did in the last decade. Its to do with much more fundamental things really and I just feel this grid has given me something to work **with** but also to work **against** and its this working with something and working against something that's really important.

DC - The photographs of your studio show that light is of primary importance to you. Did this determine where you lived?

JH - I've lived in the north of Northumberland now for nearly ten years, it was a very deliberate decision to move up there. I actually come from the north of England and there is something about that light, the eastern and northern light in the northern part of Northumberland which has always drawn me back to it. Maybe it is because I was brought up there, but there is something that I **do** feel very drawn to. Its difficult to define exactly what that is, I think it is something to do with the light, its the sharpness of the light on the east side. I feel at home in that north east bit of England. Culturally, it is difficult, lets be honest about it, it is difficult for me because in many ways my education and everything was in the south. If you can get remote in this day and age it is remote in certain aspects but there are certain very strong aspects about the landscape and about the culture up there which, although I feel outside of in some ways, I also identify with to a terrific extent. I think that culture and that light has informed the paintings and its difficult to be more specific than that it has definitely informed the work that I do. I think if I worked in London or a big city, I don't know whether I would make the paintings that I've been making up there.

DC - You work with wax and oil paint which gives a water colour translucency. Did you devise this mixture in response to the demands of your ideas and work? How did that evolve?

JH - I think that if we really look closely at the paintings, the painting is really to do with the grid, some of the work actually allows the grid to come through, some of the brush strokes allow the grid to come through, other brush strokes are very opaque and they almost force the grid itself to work in a different way. I think when I work with wax and oil paint together it is actually allowing the brush stroke itself to come through. That is the only reason I use wax and oil together as an extending medium. I often use a printing extender to also allow the brush stroke itself to look as if it is like water-colour. But its really just part of a painting process to give a wide variety of mark and by giving a wide variety of mark it actually means the painting itself becomes that much more detailed and focused really.

DC - Its giving an extra dimension to the dialogue isn't it.

JH - Yes, everything is to extend that dialogue.

DC - How do you draw up your grids, what medium is it?

JH - Yes, the grid is actually drawn with a silverpoint wire, it isn't a pencil line. Its actually a silver wire which actually **scores** a grid into the surface, very slightly, into the surface of the gesso. There are about fifteen layers of gesso on the wood or the board to begin with but then I actually score this line into the surface of the gesso. I like the idea of actually **scoring** a line, however thin, its just to do with this thing that you haven't actually got this line just floated on the surface. It actually becomes part of that surface. Other painters to me that have been really interesting (and I'd really forgotten about this, but its actually incredibly important) the painter Ben Nicholson, and its also got a connection with Kettles Yard which is why I was incredibly pleased to be able to show my work here. Ben Nicholson has always been interesting to me simply because of this attention to the surface, and this grinding down. I don't use paint in any way like as physical a way as Ben Nicholson does but that scoring of the grid and that attention to the detail right from the start of the painting is absolutely fundamental to the work I do.

DC - As the painting progresses and builds up, do the decisions get harder?

JH - The individual decisions don't get harder no. The paintings take a long time. After drawing the grid I then paint the individual stripes, which you can't actually see in the finished painting. The individual stripes are painted vertically down the painting in literally strips of red and then green and red and green, so right at the beginning of the painting you are actually getting this sort of shimmer which is underlying everything. So you get the grid and you get this stripe, it could be orange and blue in some paintings and red and green in others. So right from the beginning you have actually got something which is like a flickering image. But then after that there are specific areas of the painting which are built up in implied curves so you've got a sequence of one, two, three , four marks which may be all done in the same colour, but that is in the shape of a curve, either a curve going downwards or a curve starting from the top and working down, and those are built up in wave forms which actually cross the painting. They might be quite widely spaced across an imaginary wave form and that wave form works both across the painting and I also make the wave form work down the painting as well. Now, as to whether the decisions get harder, they don't necessarily get harder but I've got to really **believe** in the painting that I'm making. The other thing is I work one painting at a time, I don't go from one painting to another, and then do a bit on another and then come back to the first one, its very much one painting and I'm totally single minded in this way, one painting takes all my attention and to say that the decisions get harder, the decisions just become different decisions, they're not necessarily harder ones. But I have to believe in the painting at each stage that I'm making it, that is absolutely crucial. If there is something just slightly wrong, for instance, when I talk about this imaginary wave, each sequence of colour that I put down in those tiny curve forms its also got to work within this imaginary wave that I set up. I can explain a bit more actually on the paintings themselves.

DC - What inspires your creativity?

JH - I'd like to say just that inspiration comes in many forms, I have this very strong drive within me to make, I don't know why it is, but I've always had this thing of making these curved forms! And as soon as I start a painting, its not just a case of filling it up , its a case of moulding that painting to try and create something believable to me. To try and create something I can totally stand by, that inspiration comes, it really just wells up inside me, this need to make those particular forms wells up inside me to such an extent that I have to just put them down, I don't know whether that makes sense to you.

DC - It certainly does.

JH - What I'm trying to say is painting comes out of a need, its not just other painters, it comes out of a strong physical and emotional need in me to actually make these paintings.

DC - You have exhibited widely, in which countries have you received most acknowledgement?

JH - This is a difficult question. I think that the most critical countries to me in terms of the response to the work have probably been Germany and Holland.

In Germany the paintings have gone down amazingly well, maybe its a cultural thing, but people seem to have an enormous fascination with the paintings in Germany, and one of the main collectors of my work is a Dutch pharmacist and he is absolutely fascinated with the paintings, he has bought 9 or 10 paintings now, I don't know whether its a cultural thing or what but he's totally involved in the language of them and the German collectors too, they seem to have a knowledge of this type of painting. I find often in Britain its a more reticent sort of response, I'm not saying reticence is bad, I think there are a lot of very strong supporters of my work in Britain, I really must say that. I think that I'm totally indebted to them for the way in which the work has been received over here. But I think it is Germany and Holland, and to a certain extent America where the work has been appreciated, I think the sort of work I am doing in a way although I work in Britain, it feels out of place here, whereas the work itself is maybe more appreciated in other countries.

59 60

DC - As your work develops in the future do you perceive that music and the arts will continue to be central to it?

JH - Yes, I think that's undoubtedly true. I think this involvement in music this involvement in painting, I don't see that fundamentally changing. I'm really excited about developments in music and I really want to continue just working. I mean people often say, "How is your work going to change?" or "What are you going to be doing" - I mean how can I answer that question? Maybe I'll make very similar work. At the moment I just feel this great welling inside me of just wanting to make more and more of this particualr work and I have done for ten years. I mean it hasn't got any less! I think what I'd like to try and say is that mainly work isn't just a kind of luxury, I just feel drawn towards making this particular sort of work and if it stays the same for twenty, twenty five years well it stays the same. What I'm trying to say is I haven't got a great deal of control over how it will develop, and I don't want to have really. Because I think the thing that is actually making the work, I just feel so grateful for that really. And also I really **trust** in it, and I have done all the time I have painted.

I'll just talk a little bit about this idea of believing in what you're creating and believing in a painting. Its no good doing something which you really feel instinctively is wrong, isn't quite working. You can't deceive yourself when making a painting, I'm not just making these paintings for myself, I'm not really making them for other people either, but is not just a selfish activity. People often think painting is very selfish, it could be construed as such, but you are not really making it for those reasons. You're making it to try and express something really deep within you, and if you're trying to do that, it has to be at a very sincere level. The painting is making you come to terms with yourself and that's what its always about and the painting can't move forward until you actually do address yourself and come to terms with that thing inside yourself which is making you make them. I'm not exactly sure what that thing inside myself is but that's why I'm continuing to make the work.

DC - We are now in front of the paintings in the gallery. The surface of the board is crucial to the effectiveness of the paintings, how are the boards prepared?

JH - They are actually prepared with about fifteen layers of acrylic gesso. Each one is actually sanded down, so it takes, just the preparation of the board, takes really quite a long time. But is very important to actually work with this luminous surface. I really want to work with a very, very strong white to begin with. Then after that the grid is put on and after the grid, those very thin veils or washes of colour and then the idividual marks start.

DC - The grids you draw allow for white to shown between the colours, is this to enhance the luminosity?

JH - Its not really to enhance the luminosity but its a very, very important part of the painting. I mean, if all of these marks didn't have that white space betwen them, the paintings would operate in a totally different way. That gap between the individual marks is absolutely crucial to the way in which the paintings work. In that sense it is very, very similar to what Seurat was doing and the Pointillists were doing, they were also interested in this idea of leaving those tiny dots of colour, leaving this gap so that in a way, by leaving that gap, it actually allows the colours, we can then re-create the colours in our eyes and at various viewing distances because of that gap. If they were all jammed together, it wouldn't work in the same way. I like the idea of those colour patches being separate from each other at this distance (about 2 feet from the surface of the painting) but then when you move away, **then** they merge and this gap allows the whole painting to work, its an absolutely crucial element in the painting.

DC - The surfaces of the painting shimmer with veils of colour, they need a lot of space to breathe.

JH - Yes, that's a very good question because when I think that the painting works, I feel that the colours do almost breathe. I really want to try and work with space in the painting in a very, very tenuous way, in a way which both allows a certain freedom to the colours so that they are almost coming out of the painting, you almost feel you could reach in and touch the colours, but at the same time they are constrained, its this freedom and constraint, that ambiguity in the paradox of the two things that is absolutely vital to the working of the paintings.

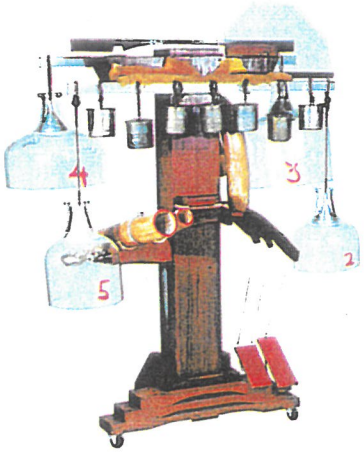
DC - The individual and multiple optical reactions across the surface seem to hang tenuously on the subtlety of changes in temperature and pitch. Is this an intuitive process?

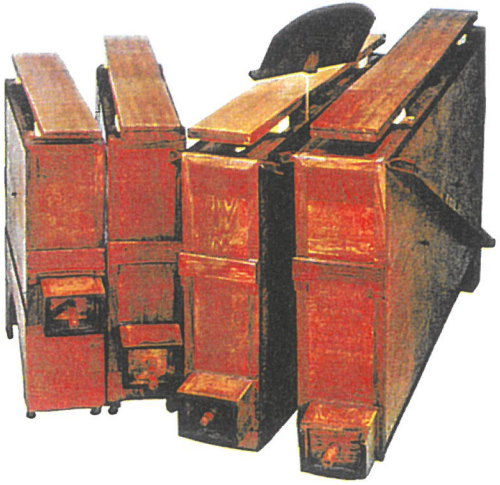
JH - Yes, its totally intuitive buts its something I really work towards almost. Its something I don't consciously aim to get in the paintings, but almost unconsciously it happens, Because of this element of time, maybe it takes between six months and a year to actually make one of these paintings, sometimes longer, sometimes its a shorter time, but the time element is a very important part of determining how all these very subtle nuances of colour work. The paintings aren't pre-meditated at the beginning, at the beginning I haven't a clue really how its going to end up and I don't want to have. I want the painting to develop over this very, very long time span and to be in control of the painting in one sense and yet also for the painting to be slightly out of control That's very important. There always must be this element of **risk**, this element of not quite knowing how the thing is going to end up . Its absolutely vital. It gives the **life**, if you like, to the paintings. And so a lot of those things like the way colour suddenly shifts and appears to almost billow in certain wave forms, when I'm half way through the painting I can't quite determine how those waves or flickering of light, or however you'd like to put it, how these things are going to end up. But I want that excitement, that tension, to be there, all the way through the painting, and although I haven't got total control of that, there are calculations being made all the way through the painting to try and control it to a certain extent, but not too much and that's maybe where the art comes in, as to how much one is in control and how much one doesn't quite know. I want the final painting to be a surprise, because, if it is a surprise to me, then maybe all these different things can work on many levels and the painting, when I've finished with it, it can go on working because that's the real test of the painting, that its got to go on working, not just for my lifetime but for a long time.

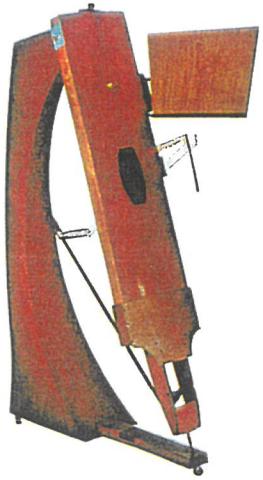
Band 9 (1:56)
Spoils of War (1950-1955)
Played by Danlee Mitchell

Band 10 (3:57)
Marimba Eroica (1951-1955)
Played by Danlee Mitchell

Band 11 (1:24)
Surrogate Kithara (1953)
Played by Danlee Mitchell







Band 4 (1:09)
Chromelodeon II (1953-1959)
Played by John McAllister

Band 5 (2:04)
Chromelodeons I & II
Played by Linda Schell

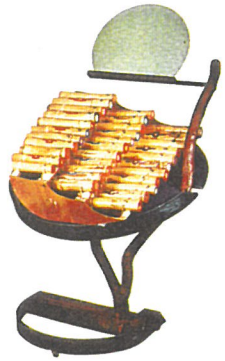
Band 6 (:55)
Crychord (1960-1961)
Played by Danlee Mitchell

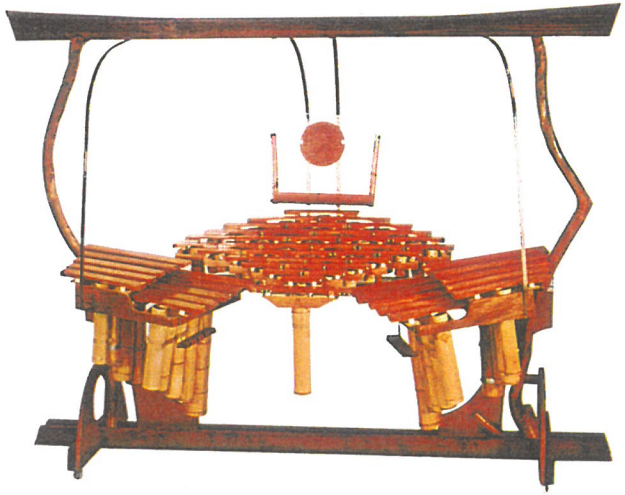
Band 7 (1:42)
Zymo-Xyl (1963)
Played by Danlee Mitchell

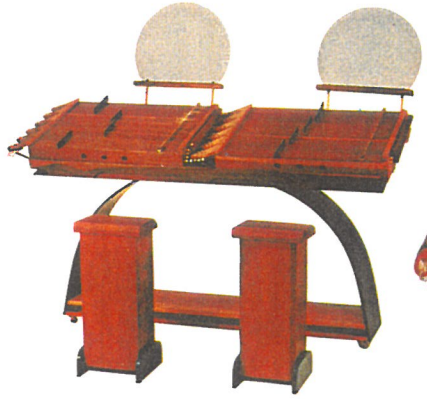
Band 8 (1:35)
Mazda Marimba (1963)
Played by Linda Schell

Band 9 (1:50)
Gourd Tree (1964) &
Cone Gong (1965)
Played by Linda Schell
and Danlee Mitchell

Band 10 (1:12)
Eucal Blossom (1964-1967)
Played by Danlee Mitchell







Band 11 (2:22)
Quadrangularis Reversum (1965)
Played by Linda Schell

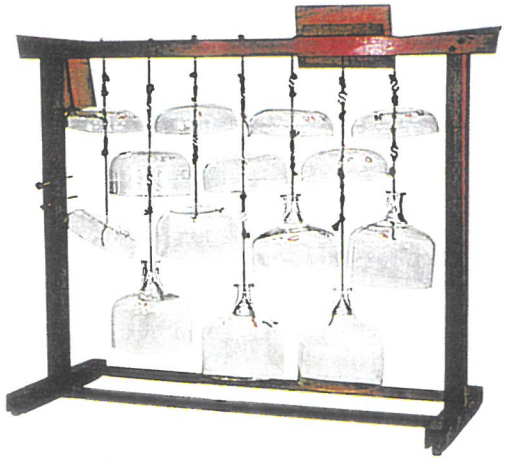
Band 12 (1:37)
Harmonic Canon III
(Blue Rainbow) (1965)
Played by Danlee Mitchell

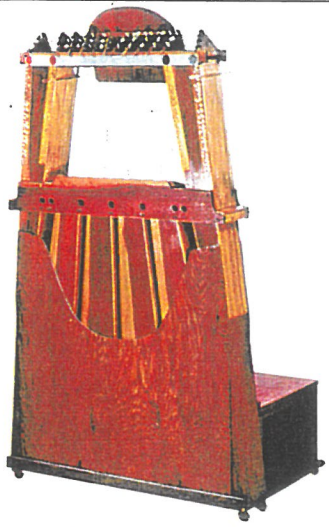
Band 13 (3:00)
Hand Instruments:
a. Bolivian double flute (1965)
b. Ugumbo (Zulu instrument) (1965)
c. Waving Drum (1965)

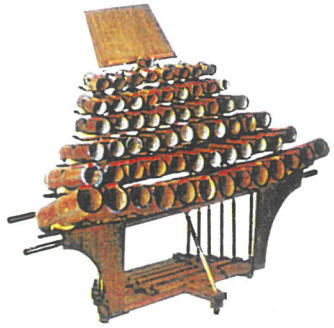
Band 6 (1:30)
Diamond Marimba (1946)
Played by Linda Schell

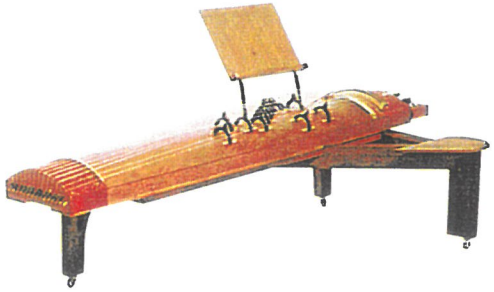
Band 7 (1:22)
Bass Marimba (1951)
Played by Linda Schell

Band 8 (1:52)
Cloud-Chamber Bowls (1950-1951)
Played by Danlee Mitchell









Band 12 (1:21)
Kithara II (1954)
Played by Linda Schell
and Danlee Mitchell

SIDE 2
Band 1 (1:55)
Boo (1955-1957)
Played by Danlee Mitchell

Band 2 (1:22)
Koto (1956; present Koto
a gift of Lou Harrison, 1966)
Played by Linda Schell

Band 3 (1:15)
Harmonic Canon I (1945;
reconceived 1959)
Played by Harry Partch

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