Printmaking and illustration with heat: identifying techniques and determining the suitability of print materials

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ABSTRACT

The practice-led research was concerned with the development of the combination of high relief prints and the creation of different shades of printmaking inks through heat. The research was in the proportion of 60% practice and 40% theory.

To locate this research within contemporary practice, the study began with the literature review and consideration was given to the work of artists, who use heat in their work. The literature review also investigated embossed patterns and relief techniques including the work of artists who produce imagery through pronounced relief. Existing colour systems were reviewed and these assisted a framework for correlating the colour samples that were modified through the application of heat to printing ink. This review demonstrated that there was no compelling evidence to suggest that artists had seriously taken into account the connection between heat, colour and relief pattern.

Studio research consisted of a series of studies that explored the potential of heat and its facility to change the effect of printmaking inks. In this research, temperature, variation and duration were all recorded. Research also examined the ability of heat to relax and release paper fibres under pressure thereby achieving extremes of positive and negative relief, as well as embossed and textured surfaces. This was done by exploring different methods of pressing paper under heat to form and print a variety of high relief, involving concave and convex forms. The research also examined punctured paper, tears, and embossed holes and examined how the fragmentation of paper fibres could be enhanced through heat. The research culminated in the making of a series of full scale prints that demonstrate the use of heat and its ability to enable high relief prints and subtle changes of colour. The research concluded with an examination exhibition and a written dissertation.

Author's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of the University of Gloucestershire and is original except where indicated by specific reference in the text. No part of the thesis has been submitted as part of any other academic award. The thesis has not been presented to any other education institution in the United Kingdom or overseas.

Any views expressed in the expressed in the thesis are those of the author and in no way represented those of the university.

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SECTION 1

WORK CREATED BY HEAT AND FLAME

Evidence for the purposeful use of fire by prehistoric man was difficult to document and substantiate. Most historians confirm that the prehistoric people greatly changed their way of life with the use of fire. These extend from prehistoric man, who tried to create images on the cave walls using ashes, which they applied with their hands, to later attempts by the Egyptians, Chinese and Persians who made lasting images on ceramics and building blocks. Historically heat was a radical medium to fix patterns in the work of these civilizations. In the classical world *Pliny* refers to the use of heat in relation to wax that was used as a medium for pigment and fixing colour on masonry.[1] With the advent of oil as a medium for coloured pigment in the Renaissance, *Leonardo da Vinci* continued some of Pliny's experiments by heating colour that had been applied to hard surfaces such as wood and masonry.[2] From this, Leonardo developed a subtle method for differentiating light and shade known as *sfumato.* In doing so he believed he had begun to revive some of the methods used in antiquity that involved heat. These he incorporated into "The Battle of Anghiari".[3] However, this experimentation that began in 1503 only lasted until 1505, because it failed miserably, and he never continued his examinations further[4]. In Persia the application of heat was used to design leather, prepare book covers and graphic work. In the mid twenties some contemporary artists also applied heat and fire in their work. Yet none of these artists have used the transformative properties of heat, in combination with inks or printmaking techniques.

It is beyond the scope of this dissertation to describe the use of heat in relation to art. Therefore what this section is concerned with is the work of artist who used fire and heat. Of particular interest has been the works of artists such as Susan Weil, Cia Gue-Qiang, Ana Mendieta and Willie Cole who examined the effect of heat on paper, canvas, and wood through naked flame, heating, burning and smoke colouration as well as light. Other selected contemporary artists such as Yves Klein, David Nash, Richard Wilson and Roger Ackling also worked with traditional and non-traditional materials to produce work with heat and flame. I am also interested in these artists because of the mystical dimension that heat and flame brings to their work.

The main purpose of the works discussed in this section was to study and identify existing techniques of obtaining an image through heat, and from this develop a strategy. In this section I have tried to categorize the work of artists into different methods, themes and techniques such as explosion, ignition, gunfire, flame and fire works. It was also necessary in addition to heat and flame, to recognize sources such as the effect of sunlight.

One of the first successful attempts to generate imagery by light was the work of American artists *Robert Rauschenber* and *Susan Weil* who used blueprint paper in1949. They produced dynamic effects by shining a sun lamp around a model, as the model lay on a large sheet of blueprint paper. When the paper was developed, the exposed areas turned blue, leaving a monotype impression of the model.[5]

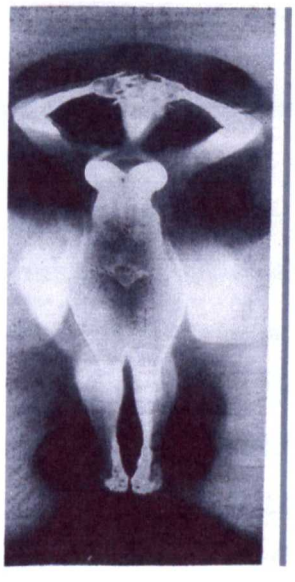


Fig. 1. 2.
Female Figure I
Rauschenberg,
1950,
266.8 x 91.5cm
(105 x 36 inch)

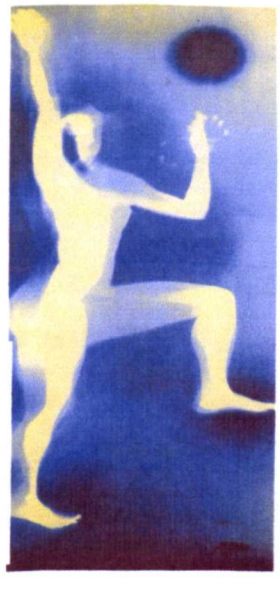


Fig.1.3.
Female
Figure II
Rauschenberg
1949 – 50

In 1953 Rauschenberg explored another unmediated, monoprint process where he inked a car tyre and drove it across a scroll of paper that was on fire. The result was the twenty- two-foot-long *Automobile Tyre Print,* the trace marking a path of movement.

Yves Klein and Ana Mendieta also created images of the female body using flame and heat in a similar process used by Rauschenberg (Fig.1.19, 1.20). This resulted in the negative and positive heated imprints that Yves Klein called *Anthropometrics* (Fig.1.5, 1.7). The colour in Klein's paper yielded dark shadow images, surrounded by deep brown. Following these experiments, Kline went on to produce a large number of fire paintings during 1961- 62 such as *Fire Imprint* and *Fire Painting* (figs 1.4- 1.8.).

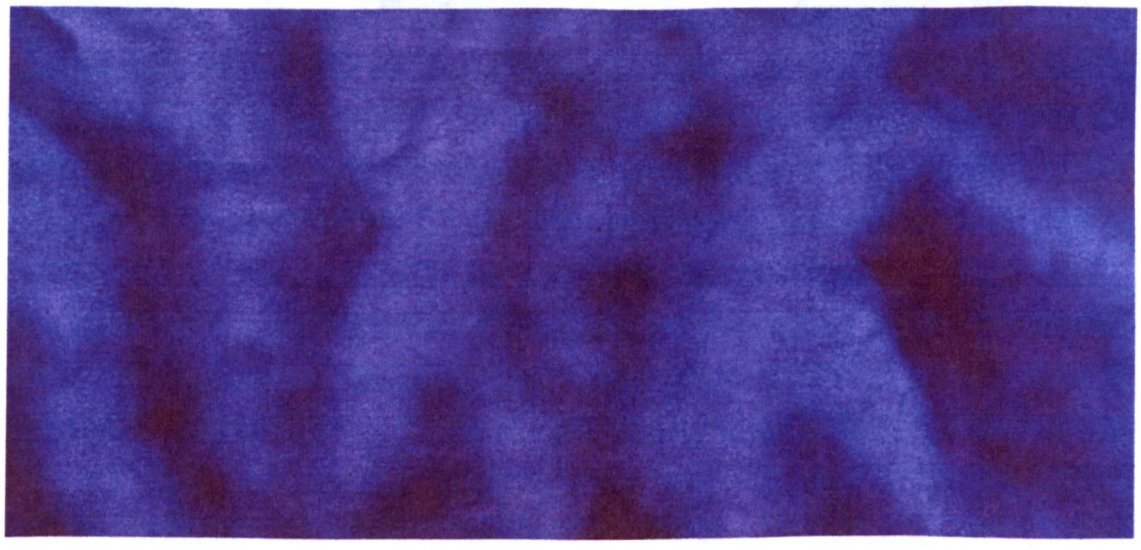


Fig.1.3. Hiroshima, *Yves Klein*, 1961, 139.5 x 280.5 cm

Kleins' fireworks also created imprints that recorded the trace of fire (fig.1.8), showing marks that have compelling immediacy. He also recorded the trace of fire in *Hiroshima 1961* by imprint (fig.1.3). The idea of this work came to him when he was visiting Japan in1953. In this visit Klein saw the amazing stone in Hiroshima on which the silhouette of a man had been burned into the rock surface by the atomic flash. Klein, deeply moved by what he had seen, was fascinated by the concept that an echo of life remained after death. It was this idea that was central to this work where several blurred shadowy figures are captured in active postures emerging from a hazy blue atmosphere[6].

In the early nineteen sixties, Klein made an initial group of fire paintings (fig.1.6-8) fire columns and firewall (Fig.1.9). His first exploration with flame was to create a fire imprint by holding a sheet of paper or compressed board to a flame for a few seconds. Depending on the intensity of the flame and the duration of combustion, the fire left a smoky ambience, a scorch figuration, a black density, a crackling veneer and even burnt hole. Klein's explorations for producing various marking on paper was also of interest to this project because he managed to produce rosette markings and also registered shadow of his Fire wall and Fire sculpture (Fig. 1. 9.).

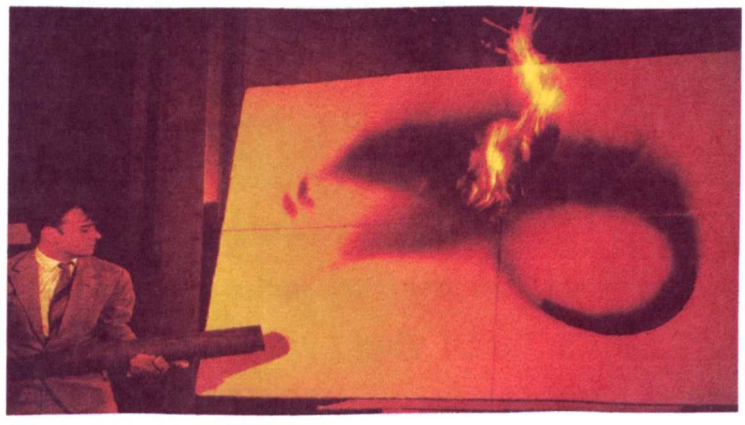


Fig 1.4. The use of giant fire torch in a combustion process.

through his use of fire, Klein managed to achieve collaboration between science and art. For instance, the use of fire torch and large Swedish compressed board treated with fire retardant, burning gave him a greater control of the combustion process.[7] In the fire imprint, *Body imprints,* Fig 1.6, Klein fused the two aspects he had previously explored: firstly, negative representation through splashing water around an object and secondly, positive reflection from side to side of the substance. He expanded his exploration in the fire paintings and applied three models as objects then doused their bodies with water(positive imprint, fig.1.5) or water sprayed around them(negative imprint, fig.1.3) as they pressed against the surface of the Board.

Fig 1.5. Untitled, 1961, fire imprint, positive object

For several of the imprints Klein also used water to create pictorial effects. Splashes of water took shape as compositional voids, and water spots and linear drippings became counterforce to the fire texture (fig.1.8). He produced a series of about thirty fire imprints, including some in colour, made with the flame-thrower on specially treated cardboard. His basic idea was closely related to that of the compositions of marks left by rain and stamping of water, using the human body as a stamp (painting by fire and imprints fig.1.5.). Some of the multicoloured imagery employed various supplementary techniques to evoke a synthesis of the four elements. That of water, for instance, was integrated with fire by moistening a model with water and having her make an imprint on the surface before applying the flame. Since the damp area resisted fire longer, the imprint remained like a ghostly shadow within the surrounding dark, scorched ground.

Fig 1.6 untitled fire painting
1961,
50 x 38 cm

Fig 1.7 untitled fire painting
with body imprints, 1961,
175 x 90 cm

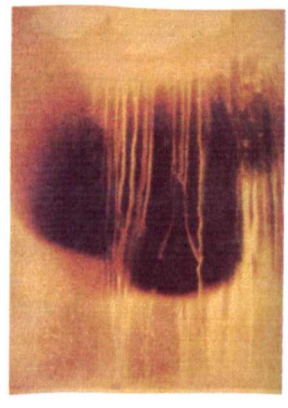


Fig 1.8. Untitled fire painting
1961,
130 x 97 cm

For fire, Klein further addressed the issue of fire in the following from Bachelard who was one of the most significant modern thinkers-dreamers of France[8]. A particular influence behind these works was the writing of Bachelard, particularly *The Psychoanalyses of Fire,* 1930, inspired this French artist as well as many other artists. Bachelard believed:

> "Fire and heat provide means of explanation in the most varied domains, because they have been for us the occasion for unforgettable memories, for simple and decisive personal experiences. Fire is thus a privileged phenomenon that can explain any thing. If all that changes slowly may be explained by life, all that changes quickly explained by fire. Fire is the ultra living element. It is intimate and universal. It lives in our heart. It lives in the sky... Among all phenomena; it is really the only one to which there can be so definitely attributed the opposing values the good and evil. It shines in paradise. It burns in hell. Thus it is one of the principles of universal explanation".[9]

Another artist working with flame, fire and explosion was *Cia Guo-Qiang,* the Chinese born artist who attracted international attention through his gunpowder explosions. The idea of fire painting came to him when he was a student, Cia set out to look for unusual tools and came up with the idea painting with "fire". At first, he used simple techniques but he soon felt that his paintings were too limited, so he tried painting with gunpowder. He has experimented with gunpowder as a means for making crude drawings, then by spreading the contents of firecrackers onto paper. In his first works *Cia Guo-Qiang* directed fire onto canvas and paper as Klein has done forty years before. He examined also the effect of oil paint before he made explosions on paper and applied oil paints in some of his works. Such example of these works are *Kuafu Running after the Sun* (1986), *A Drinking Vessel* (1985), *Chu Ba Wang* (Xiag Yu, The General, 232-202),1986, *Shadow* (Pray for Protection), 1986, *The Brand of the Archean Era,*1985, are prominent examples of experimenting with the combination of colour and explosives. In his more recent work he discovered how to create controlled explosions directly onto the surfaces of canvas or paper and created numerous gunpowder paintings in China. In this work he continued to use controlled explosion on paper to create drawings large and small. In marking the canvas with all sorts of unexpected effects, gunpowder explosions render painting active by launching a lively dialogue between the artist and his creation.[10]

While most of his fire performances were held out side of galleries and museums, there are some similarities between Cia and Klein's work. In *Fetus Movement II* Cia exploded columns of fire, comparable to Kleins *Fire wall and Fire sculpture*. While Cia exploded gunpowder similar to the L.C.Armstrong's technique(fig.1.22), Klein used gas flame for the creation of his work.

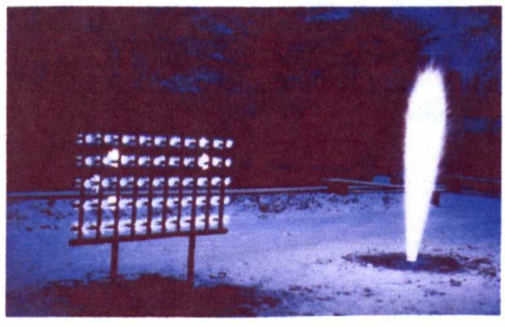


Fig 1.9. Yves Klein Fire wall and
Fire sculpture II,
Krefeld, France,
1961

Fig. 1.10. Cia Guo-Qiang Fetus Movement
Project for Extraterrestrials,
Hannover,
1992

Cia created some works that alluded to the spiritual, primal or emotional significance of the internal and external human body. He also managed to convey the serious message (traditional spheres of Chinese thought) behind his works. In Archean Era (Fig.1.12.) he pointed to the particular sign of rock painting through the ignition of his gunpowder technique.

Fig. 1.11. Chu Ba Wang
(Xiang Yu, The General 232-202 BC)
1985
Gunpowder and oil paint
On canvas
150 * 155 cm

Fig.1.12. Cia Guo-Qiang, 1985,
The Brand of the Archean
Era – Male (detailed),
Gunpowder and oil on canvas,
125 x 180 cm.

In Cia's work there is no sign of using objects as an imprint tool to make marks. Instead, most of his works involve the almost uncontrollable effects of explosion. Unlike Yves Klein, Richard Wilson, Johannes Schreiter and Alberto Butters who applied flame as a media in their work, Cia does not apply flame directly on his works.

Fireball was also one of Cia's most prominent works to which he applied extensive fire (fig. 1.10.). It was interesting that the idea behind this work had come to him on his flights from Beijing to Tokyo. Apparently he was aware that the physical disruption caused by jet lag stimulated the creative process.[11]

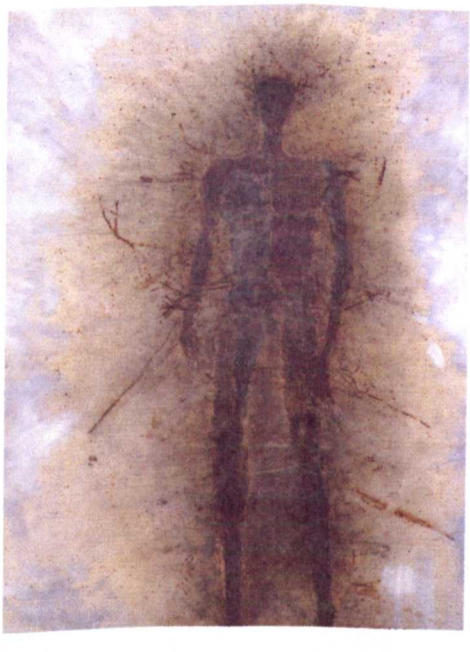


Fig.1.13. Self-Portrait,
1985-1986,
Gunpowder and oil paint on canvas,
167 x118 cm.

In *Self-Portrait, 1985,* Cia created shadows by igniting gunpowder on canvas to define a sensation of liberation and a distractive force.

Cia's contribution to the exhibition called *Chinae demain pour hier*, Hannover, 1992, entitled *Project for Extraterrestrial*, (fig.1.10) consisted of a gigantic explosion covering a surface area of more than ten thousand square metres. He believed these events were of interest not only to a human audience, but also unseen to an "alien" being who occupies a heavenly vantage point.[12] The huge scale of Cia's fire projects were in comparable with Klein's fire presentations which were made on a much smaller scale. An example of this work, *fire fountain*, *firewall* and *fire columns* were displayed in a one hundred meter square ground out side of the Museum Hausa Lang in Krefeld, Germany and Testing Centre of *Gaz de France* between 1957-1961. Later date in 1983 similar work was attempted by the English artist *Richard Wilson.* Although Wilson applied fire in his work, he never used flame on a grand scale or gigantic explosions, as had Cia Guo-Qiang. A significant example of his work with flame was exhibited at the Saatchi gallery and Matts Gallery in 1985, and a later work with galvanised steel grilling and gas flame that represents space and fire was exhibited in the Arnolfini Gallery. In 1987, he presented a work with fire at Plymouth Art Centre (fig.1.15) which had similarities with Ana Mendieta's Silueta (fig.1.16) and Cia Guo-Qiang's **Chu Ba Wang** (Fig. 1.11). Wilson's *Hot, Live,Still* (fig.1.14) was made from steel within the framework of an exhibition on the theme of self-portraiture. Inspired by the presence of a live gas tap within the space, the artist conceived two portraits, one the result of the heat from fire, and the other, the result of the light from fire.[13]

Fig.1.14. **Self-Portrait**, Richard Wilson
Hot, Live, Still I, 1987

Fig.1.15. **Self-Portrait**, Richard Wilson
Hot, Live, Still II, 1987

These two pieces of work which are like-size images of the artist's body can be compared to " Self Portrait of Cia Guo –Qiang" (fig.1.13) whose body was outlined in flame. *Irons in the Fire* was also another of Wilson's fire work, this was exhibited at the Mappin Art Gallery, Sheffield in 2003.[14]

The works of Cuban sculptor, photographer and painter *Ana Mendieta* were also of interest to this study. She created some of her work by gunpowder as well as flame. Many of her works are comparable with Yves Klein, Richard Wilson and Cia Guo-Qiang's. Like Klein's *Body Imprint* (fig.1.7) Cia's Chu Ba Wang (Fig. 1.11) and Wilson's *Hot, Live, Still 1987,* Mendieta focused on the space around the body. In her 'Silueta' (Silhouette) Series, she tried also to present her subject through smoke, fire and explosion.

Fig.1.16. Untitled, From the Silueta series, 1976, photograph, 9/15x7/15 1nches.

Fig.1.17. Untitled, From the Silueta series, 1978, photograph, 8/15x 9/15 inches.

In her work, Ana Mendieta featured social taboo and transgressions, which through flame, smoke and ash. In her *Silueta* series, (begun in 1974) and created on location in Iowa and Mexico, Mendieta carved and shaped her own figure into the earth to leave haunting traces of her body fashioned from tree branches, mud, gunpowder and fire (Fig.1.16.). A typology of *Siluetas* emerged, including figures with arms raised overhead and legs together to signify a wandering sole. Amazingly, this type of pose can be seen in the works of most of the artists who worked with fire.

The materials that she used were also highly symbolic. For instance in another work from the "*Silueta*" series (Fig 1.17.) she outlined her figure with gunpowder, creating a shape reminiscent of prehistoric cave paintings. By setting the *Silueta*

alight, she incorporates the ritualistic use of fire as a source of exorcism and purification, just as Cia utilized the same action in *Archean* and Wilson in *Self-Portrait* (Fig.1.14-15). In 1977 she imprinted her body using ink and made duplications of her hands and then heated the imprints with an iron and gas burner. She did this either on grass or earth, therefore only photographs remain. She also made a piece of work comparable with Cia Guo-Qiang's work (Crossing, bamboo, 1999). She called it "*Soul, silhouette of Fireworks*" where she created a bamboo outline of her body (Fig.1.16) and attached fireworks to its armature, the result was that the effigy burst riotously into flame. Although she used her body in the presentation of fireworks, as in the *Silueta* series, she was certainly not the only artist who applied own body to create an artwork with fire.[15]

As far as the use of heat and flame in the artists' works are concerned, the human body has provided some of the most remarkable images. This is as common to *Mendieta* as it is to *Rauschenberg, Richard Wilson, Yves Klein* and *Cia Guo-Qiang.* All have executed a singular outline for the imaginative way in which they explored ancient and contemporary ideas.

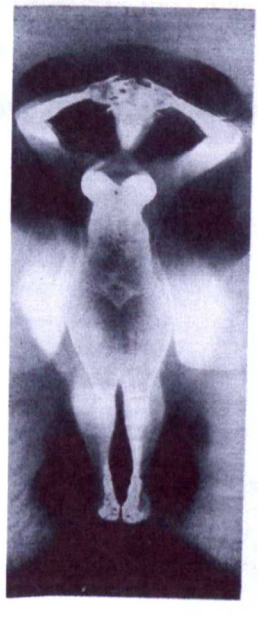


Fig. 1.18. *Rauschenberg's* Blue Print, 1950

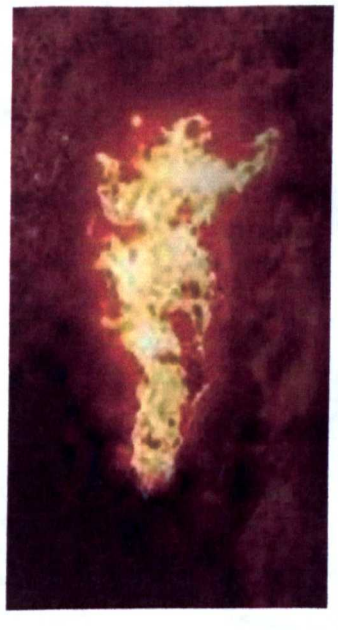


Fig .1.19. *Ana Mendieta's* Firework, 1981

Fig.1.20. *Yves Klein's* Fire Imprint, 1961

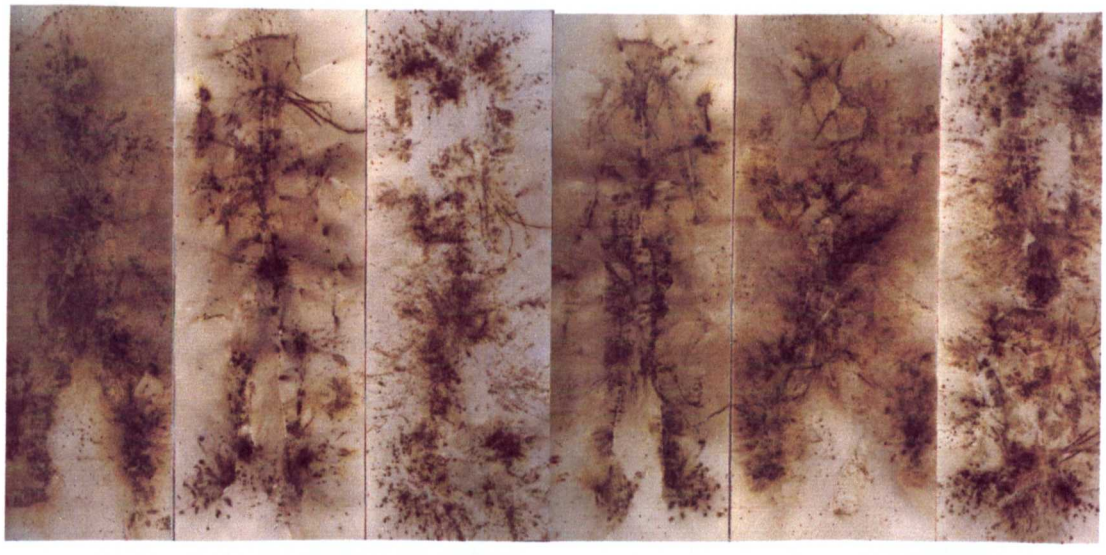


Fig. 1.21. *Cia Guo–Qiang,* The Vague Border at the Edge of Time, 1991, Japanese paper mounted on wood framed screen, (7 panels), Gunpowder. 595 * 200cm. In these works, Cia first placed Gunpowder along the outline of his shadow, as it happened to fall on the sheet of paper, then it was set on fire.

Another artist working with bomb fuse and also using the same materials as *Cia Guo-Qiang,* was the American artist, *L.C. Armstrong.* The crucial difference between these two artists was, although Armstrong used explosive materials to create her works, most of them seem commercial rather than abstract in that her patterns were more like photographic copies of flowers. Armstrong drew the stems of her flowers with a bomb fuse and burnt into the painted surface. The residue from the burning had to be protected, so the resin was first used to seal the smoky residue from the spent bomb-fuses.

Fig .1.22. Detail of Garden of Babel, L.C.Armstrong, 1998, Acrylic and bomb fuse, resin, on linen on wood, Original size 122 * 102 cm.

She described the development of her technique and the use of the bomb- fuse as follows: *" I developed this approach that has inherent contrasts, there is construction and destruction. I am scarring the surface with the bomb fuse, which is*

like healing. I attach the fuse to the surface to control the line, but I cannot control how the fuse burns, how it marks the surface. There is also a contrast between the sweet. Cloying, subtle colours and harshness of the burn".[16]

Fig 1.23. Detail of
Cia's Heaven and Earth,
1991

Fig 1.24. Detail of
Armstrong's Windsurfers,
2003

There is a close similarity between Armstrong's ignition fuse (fig.1.22, 1.24) and the effect of Cia's gunfire (fig.1.23). Armstrong only used the effect of ignition to burn her acrylic flowers, whilst Cia expanded this effect through all major works.

It is not only painters and printmakers who use heat to create their works, but heat is also central to the practice of sculpture as in bronze casting, for instance. A particularly appropriate example of a sculptor who uses heat is *David Nash* and his investigation with flame and smoke in his works.

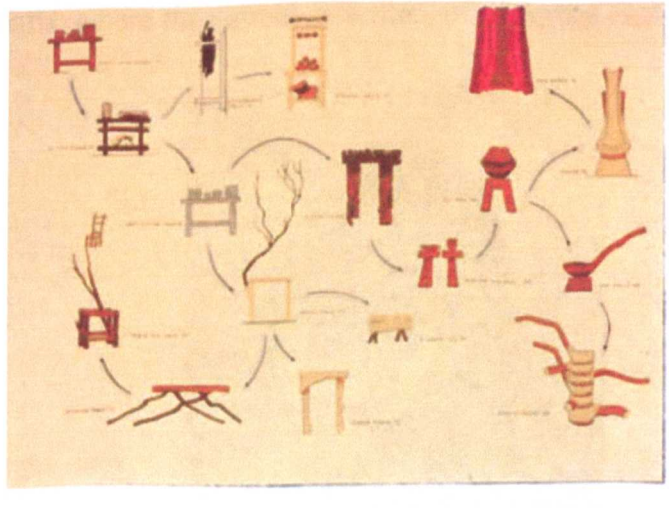


Fig .1.25.
David Nash,
From Table to Shrine.

He has also created some of his work by printmaking techniques (Fig.1.25). These prints relate to his sculptures depicting the work in a two-dimensional way.
In one of his print, *From Table to Shrine*, we see a history of his sculpture and how his work developed over the years. In his sculptures Nash used a variety of woods. Some of his works with fire are partly charred or lightly burned. As probably no other sculptor of our time, Nash investigated the relationship between wood, flame and smoke.

There is a close relationship between Nash's *Charred Panel* and the preceding attempts in the same area by Yves Klein (1962) and Roger Ackling (1996) but Nash's panels are burned much deeper, like a charred relief. In *Traces of Fire on wood*,(fig.1.29) Klein burnt his cardboard with a torch, because it was mounted on a piece of wood, Klein was not able to achieve a deep burn.

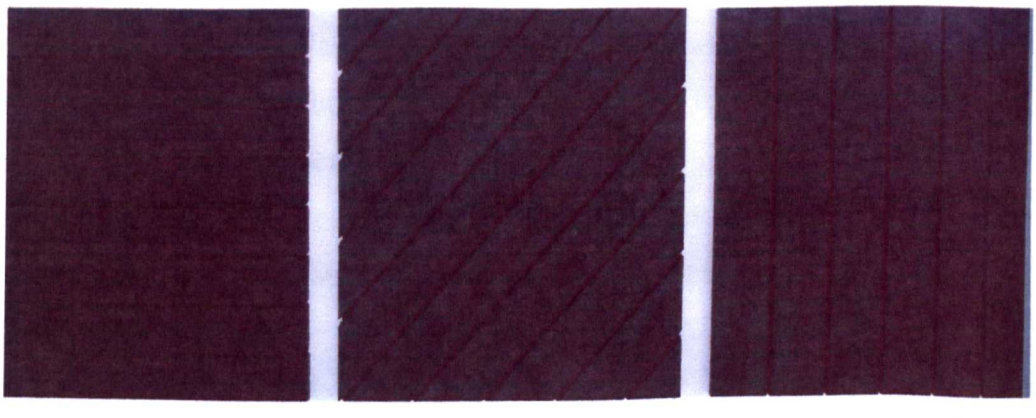


Fig.1.26. Three Charred Panels, 2004, Each 140 x 105x 5cm

Nash looks also for forms, which are generally comprehensible. Geometrical elements, like cubes, pyramids and balls, where the natural structures of wood are made apparent.

Fig.1.27. *Black Box*, 2003
Roche beech,
91 x 54 x 45 cm

Nash spent his time investigating the relationship between wood, flame and smoke. The idea of using fire in his work came to Nash while giving a talk at the Art college in Dublin where he began to think of making various domestic artefacts including a wooden hearth. The image had remained with him. Later when buying a wood-stove for his home, the potential absurdity of its name also struck him.[17]

Most people have experienced wood burning and seen the effect of fire and smoke that remains after a piece of wood has been partly burned. The view of the artist on these effects is certainly different; in that he looks for ways to apply these effects in the most subtle way. Nash has a very clear view on working with wood as a medium. As he had some knowledge of prehistoric man's stove, he made his own wooden stove in 1979 and began to produce work showing the effect of heat on wooden sculpture.

In his first investigation, Nash realized that the solid wood of the block itself, which was still full of moisture, did not burn away but simply formed a thick charred surface inside. The piece combined a practical function with an aesthetic one. In the way it linked interior with exterior space through the visible movement of the smoke, it echoed a very basic principle of sculpture(Black Box 2003, fig. 1.27). Like Cia and Armstrong, he has also experimented with the effect of fire on bamboo as well as other types of wood.[17]

On one of his journeys to Japan, Nash was visiting a monastery near his work-site, when he was surprised to hear loud explosions coming from a maintenance area. Investigating, he found that the gardeners were burning bamboo. The air within the hermetically sealed spaces of bamboo canes which expands with the heat, and explodes.[18] This experience gave him the idea of making a stove with bamboo, in which he wired all the pieces of bamboo together.

Fig .1.28. *David Nash,*
Charred Panel,
1999,
36cm x 60 cm

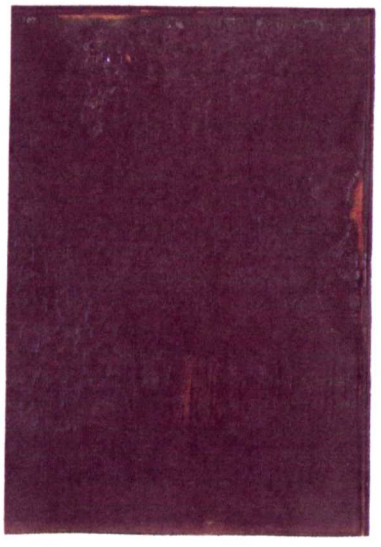


Fig .1.29. *Yves Klein,*
Traces of Fire on wood
and cardboard, 1962,
73cm x 54 cm

Fig .1.30. *Roger Ackling*
Weybourne
1996,
48.5 x 30.8 cm

Nash's recent works also shows that stove works and burned effects involved him in close observation of the functioning of fire as a force and its use as an agent informing and affecting sculptures of a vary different kind such as Pyramid, Sphere, Cube, 2005 (fig.1.30A.) and Charred Panel, 2001. He also examined the effect of burn on a flat surface, charred panels (Fig .1.28using a similiar process to Yves Klein applied nearly fifty years before (Fig.1.29). He has also found that fire itself, the formation and intensity of flames, varies considerably from piece to piece.

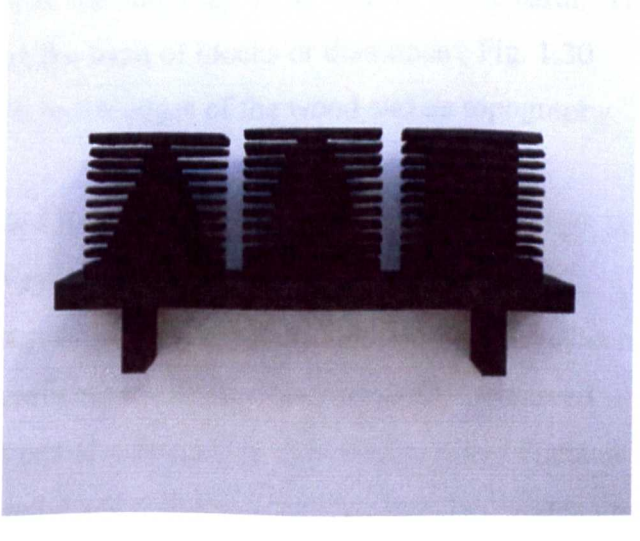


Fig.1.30A.
David Nash
Pyramid, Sphere, Cube,
Charred oak, 2005
3 parts on a shelf
overall size: 45 x 109 x 25 cm.

Roger Ackling is another British artist who uses wood and fire. Since 1975 there is an exiting progression in his work in which he projects sun light through a magnifying glass and burns parallel lines and dots on wood and card, which form geometric patterns. The wood that he used between 1975 and 1996 was remnants of previous objects that were obsolete, unidentifiable or broken weathered by time and the elements. These often included rusty nails, holes, stains or daubs of earlier paintwork.

Ackling makes his work out of doors. He works from left to right across the surface of the piece with the sun always at his shoulder.

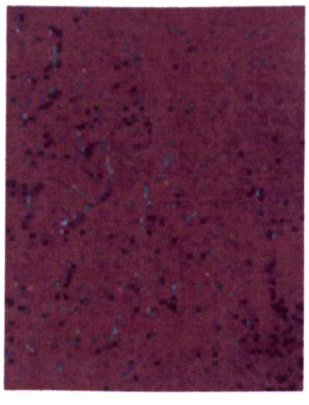


Fig.1.31.A.Detail of Klein's burnt surface

Fig.1.31.B. Detail of Nash's charred surface

Fig.1.31.C. Detail of Ackling's parallel lines

Acklings' lines are photographic in its truest sense. Each line is a repeat pattern burned by the sun, it might also be the sun's image, scaled down many million times. Each dot records the history of the sun's ray on its journey to the earth. The lines are drawn very close and take the form of blocks or diamonds (Fig. 1.30 and1.34) and pays careful attention to the edges of the wood and its topography.[19]

One of the most notable success that Ackling achieved with the use of the heat is *Weybourne*, 1997 (fig.1.32). In Weybourne attention must be drawn to the technically complicated vertical curved lines on which horizontal lines have been burnt. The focal points of the magnification vary as it moves along the curved lines. These types of curved lines can also be seen in the work of Lucio Fontana and Piero Manzoni who investigated diverse methods of illusion, space and matter

to increase the depth of their elements. The composition and continuation of burnt lines in *Weybourne, 1997* gives a deeper view to the work. The lines started from nowhere and diminish towards the end, emphasising the illusion of depth. When the lines are closer together, they form a wider black line, resembling a kind of secret writing.

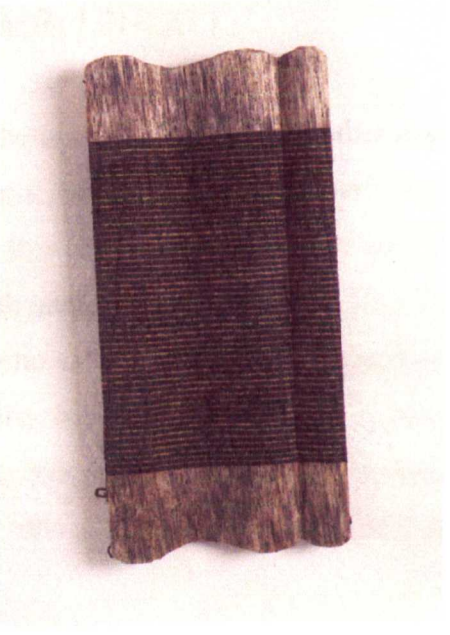


Fig.1.32. Weybourne, 1997,
26.8 x 10.5 x 1.5

In curved surface Ackling exploited a bulging surface to transcend physical geometry. Although, his works are not conceptual art, the curving vertical lines in Weybourne give the impression of decade and period of time, while a series of paralleled horizontal burnt lines suggest a text, which passes through surfaces. In the most literal sense, the marked areas in this work function as non-significant focal points, parallel lines compel the viewer to look repeatedly across the surface and probably from left to right as if reading. In this way the required 'norm' mobilizes one's eye enough to produce a language less zone of attention.

The effect of burn in the work of previous artists such as *Yves Klein* (Fig.1.6) and *Cia Guo-Qiang* (Fig.1.11) were mostly by chance and somewhat uncontrollable, effects being unplanned. Although, Ackling's lines have been burnt and formed without the direct contact of his hand, they are specific and meticulous. Their production is also remote but, their alteration by the artist gives them a specific and serene individuality, no danger of flame or explosion.

In contrast to the sharp edge of the burnt lines from focusing sunlight through a lens, are the edges of graduated lines which are produced by explosion. Detail of sharp edges can be seen in Ackling's parallel line (fig.1.31C) and graduated edge in details of Armstrong's Windsurfers (fig.1.24). Graduated edge could also be found in explosion works, such as Heaven and Earth (fig.1.21-1.22.).

Reviewing Ackling's work in this study, I believe that by applying other objects such as rubber, marbles and pins in his recent work, he has impaired the purity of the burn that was successful in his previous works. It is perhaps worthwhile to consider why he developed his works in combination with manufacturing products after 2002. In comparison with the work of David Nash who uses wood purely or discolouring and burn them for his expansion, Ackling's rubber band and drawing pins appear vulnerable and the presence of these objects distract the viewer from the burnt lines. Good examples of such works are *Norfolk 2002* and *2003* (Figs.1.33 and 1.34).

Fig.1.33
Norfolk 2002

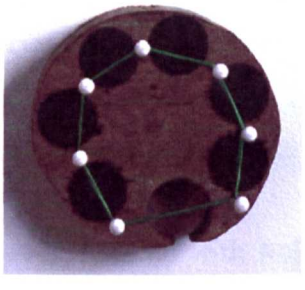
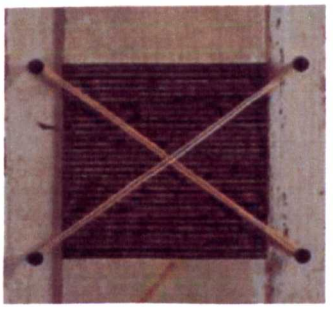


Fig.1.34
Norfolk 2003



Another artist using heat as a kind of ink is the African American sculptor and printmaker, Willie Cole. He discovered and manipulated printmaking in the course of his art making and has expanded the boundaries of the medium to accommodate his creative works. In the late 1980s he began imprinting hot irons in rows and figurative shapes onto surfaces ranging from paper and canvas to mattress padding and plaster. Using heat to record his images, and an iron as a stamping device, he creates elaborate compositions out of repeated printed forms. The scorches from the surfaces of the irons take on mask like appearances, while concurrently suggesting the African ritual of scarification.

In contrast to Armstrong and Ackling works, at first glance Cole's images are easily recognizable as made by steam irons. The scorched marks themselves call attention to how they were made when a hot iron was left on the paper too long, which caused it to burn and suggest branding.

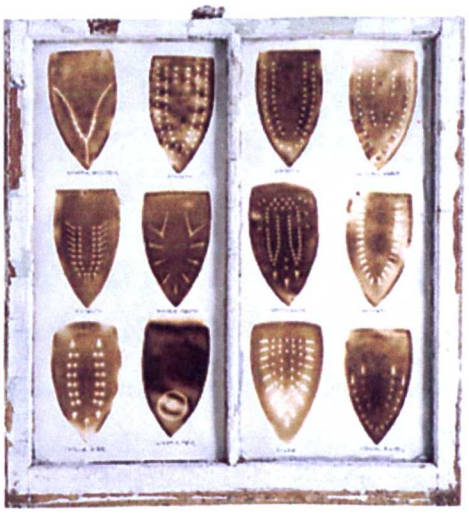


Fig. 1.35. Domestic I.D., IV
1992
Iron scorches and pencil on
paper mounted
in recycle painted wood
window frame.
88.9 x 81.x 3.5 cm

The mask like images patterned with slashes, arrowhead like markings and beadlike dotes. He often uses a variety of irons in a single work to allude to different tribal associations. in *Domestic I.D., IV* fig.3.32, he labels each "face" with its commercial brand name to encourage this interpretation, ironically suggesting the tribes of Silex and General Electric. This format is reminiscent of the Surrealist and Conceptualist device of mislabelling compositional element for ironic effect.

There is a close relationship with Ackling's boards and Cole's frames. Both use discarded wood or boards, which have had a previous use. For instance, Cole used a window frame in *Domestic I.D., IV, 1992* with its obvious sign of wear which reinforces both the domestic, intimate reading of the individual scorches and the sense of metaphorical history. The buckling paper also indicates the violence of the searing heat that Cole applied to imprint mythical faces, a process akin to branding, and adds an ominous and poignant overtone.

Cole focused on his primary concern: the imprints of an iron as a heated object to achieve his duplications. The depth of colour depends on the degree and duration of heat. He has used heat as a kind of ink and produced various patterns with the same iron. It would seem that Cole used geometrical patterns in most of his imprints. He was not limited to creating symmetrical designs through his works.

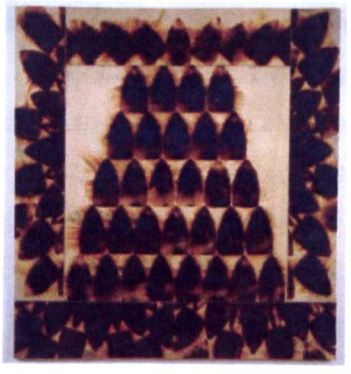


Fig.1.36, Carnival Game, 2004, Willie Cole, Iron scorches on play wood, 56 x 60 inches.

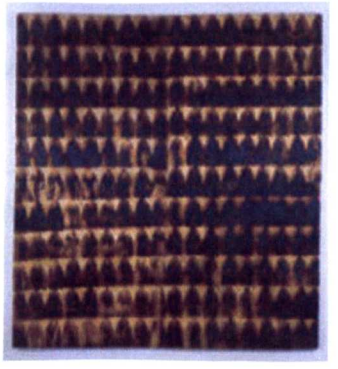


Fig.1.37, Fast Track Home, 1999, Willie Cole, Scorched wood, 72 x 73 inches.

In fact from a simple pattern he could create complex structure. In one of his works entitled Sunflower, Cole unites the decorative potential of his scorching with a powerful design. Imprinted on a canvas that is backed with mattress padding and wood, suggests a dynamic, all the more potent because of the method of its creation. It is obvious that he used hot stamp process for extensive repetition of an existing pattern and the creation of overlapping composition.

Most of Cole's geometrical designs are a duplication of only one pattern. However, his compositions are technically simple and uncomplicated. In fact, there are many contemporary artists who exploited geometrical patterns, but only a few applied heat as a medium. For instance, Roger Ackling exposed uncomplicated geometric patters in his burnt process. David Nash has presented his geometric patterns through burnt three-dimensional forms together with drawing of them, Fig. 1.40.*Nature to Nature.*

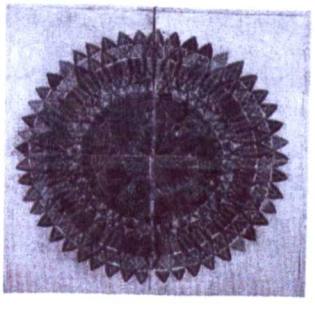


Fig. 1.38. Willie Cole, Sunflower, 1994, Iron scorches, 204 x 198cm

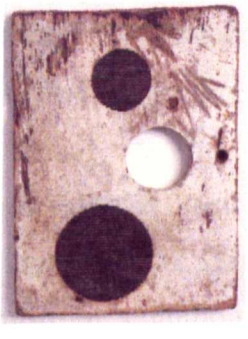


Fig. 1.39. Roger Ackling Weybourne, 1997, Sunlight on wood, 34 x 25 cm

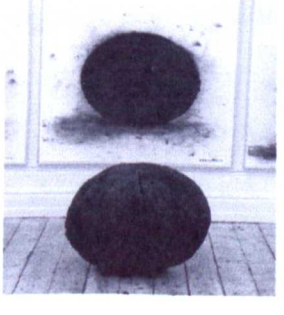


Fig. 1.40. David Nash Nature to Nature 4, 1990, Ash, charcoal, 120 x 90 cm

Nash, Ackling and Cole's work were linked to the concept that all natural forms have an underlying geometric structure, whether in their crystals, their cell-patterns or their atomic and molecular structure. Unlike Islamic compositions that have a complex geometric design, Nash and Acklings' works are simple and uncomplicated.

The basic component of their work is a simple square or circle derived from nature. Not only was the researcher inspired by the simplicity in the work of these contemporary artists but was also motivated by the geometric motif in Islamic design. The square is the most familiar and elementary structure in Islamic pattern therefore, the proportions of the practical work in the studio was based on the square (Dynamic rectangles described in section 2). A repeated or spinning motif is also a most recurring pattern in Islamic design. This coincidence of repeat pattern in the work of Ackling and Cole and the significance of geometry and repetition of Islamic art has been of major importance to this research.

Conclusion to Section 1

In summary, the review of the first section established a visual vocabulary that was essential to understanding what was meant by *creation by heat.* This led the researcher to understand the potential of heat and flame and also study the processes whereby image could be obtained through different application of heat.

Through this review it was noted that:

Yves Klein was the only artist who explored the brand of possibilities both negative (fig.1.4, Hiroshima, 1961) and positive (fig.1.5. Fire Imprint, 1961) processes to illustrate shades and texture by fire. In this research, the final work of the studio experiment was influenced by Klein's work, particularly his negative process. It was also significant that Klein fused these two aspects, negative representation and positive reflection from side to side of the substances and managed to accomplish the hidden quality considered to both heat and flame.

The practical work of this research was also noted the effect of gunpowder (fig.1. 11. Chu Ba Wing, 1985) and bomb fuse (fig.1. 22, Garden of Babel, 1998). There was a close similarity between L.C Armstrong's ignition fuse and the consequence of the gunpowder explosion by Cia Guo- Qiang. Armstrong only exploited the effect of ignition to create limited texture on her flower image, while Cia expanded the effect of explosion or fire through all of his major work. Unfortunately it was not possible for the researcher to examine the effect of gunpowder and bomb fuse during studio experiments due to health and safety requirements.

Despite, Roger Ackling who creates his work out of doors and projected sun light through a magnifying glass and burnt parallel lines on wood and card, his burnt lines only affected the surface of his work but David Nash burnt his surface very deeply (fig.1.26. Three Charred Panel, 2004) similar to a piece of charcoal.

The creation of image or texture by explosion and fire in the work of *Yves Klein* (Fig.1.6. Fire Painting, 1961), *Cia Guo-Qiang* (Fig.1.21.The Vague Border at the Edge of Time, 1991) and L.C Armstrong (fig.1.24. Windsurfers, 2003) were mostly uncontrollable. More textures generated by chance or in some cases a few of the achieved effects were unplanned. Although, Ackling's lines have been burnt and formed without the direct contact of his hand, they are specific and meticulous. Their production is also remote but their alteration by the artist gives them a specific and serene individuality with no danger of flame or explosion. Willie Cole's work in contrast to Armstrong and Acklings' works, are easily recognizable as made by steam irons. The scorched marks themselves call attention to how they were made, a format reminiscent of the Surrealist and Conceptualist device of mislabelling compositional element for ironic effect.

There was also a close relationship with Ackling's boards and Cole's frames. Both used discarded wood or boards. The buckling paper also indicates the violence of the searing heat that Cole applied to imprint these mythical faces, a process akin to branding, and adds an ominous and poignant overtone. Cole, Nash and Ackling's work were also linked to the concept that all natural forms have an underlying geometric structure, whether in their crystals, their cell-patterns or their atomic and molecular structure. The basic component of their work is a simple square or circle derived from nature. Not only was the researcher inspired by the simplicity in the work of these contemporary artists but, was also motivated by the processes of their creation.

[1] 'Leonardo da Vinci, *Ritchie Calder* (London: George Rain Bird Ltd, 1970) p78-79.
[2] 'Leonardo, *Richard Friedentha* (Germany: Thames and Hudson, 1959).
[3] 'Leonardo da Vinci, *Kenneth Clark* (London: Cambridge University, 1952).
[4] '*Art and Artist,* (London: Thames and Hudson, 1965)
[5] ' *Rauschenberg,* Joshua C. Taylor,(Washington: National Collection of Fine Art, , 1976) p63.
[6] '*Yves Klein,* Sidra Stich, (London: Hayward Gallery, 1995) p179.
[7] '*Yves Klein,* Hannah Weitemeier, Benedikt Taschen Verlag GmbH, 1995, p74.
[8] '*The Colombia Encyclopaedia*', sixth Edition, 2001.
[9] ' *The Psychoanalysis of Fire* ' Bachelard, Gaston, [USA: Beacon Press, 1964,]
[10] Dawei, Fei, 1989, p11.
[11] Project for Extraterrestrials No 10, *Dawei, Fei, 1989*
[12] *Hishhorn, Museum and Sculpture Garden,* Catalogue, 2003-2004
[13] *'Richard Wilson,* ed. by Michael Archer and Simon Morrissey (London: Merrel Publishers Limited, 2001), p. 52.
[14] [a-n] magazine, April 2002, edit, Susan Jones, p32.
[15] *New York Magazine,* Art Review, 95.2. Norton.org / archive
[16] The Washington Post, Saturday, March 22, 1977(Article).
[17] '*The Sculpture of David Nash,* Andrews, Julian, (London:

The Henry Moore Foundation, 1960).p190.

[17] *David Nash Making and Placing,*(Susan Daniel-McElroy. TATE St Ives, Leeds, 2004) p43.
[18] Andrews, P 110
[19] Extract from Annely Juda Fine Art, Catalogue, Set Aside, 1998, London.

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SECTION 2

WORK CREATED BY RELIEF AND BURLUP

Grammar of mathematical principles

Exploration of relief techniques

Anish Kapoor

Alberto Butter

Johannes Schreiter

Shozo Shimamoto

Lucio Fontana

Piero Manzoni

Enrico Castellani

Frank Stella

Kenneth Tyler

Barnett Newman

SECTION 2

WORK CREATED BY RELIEF AND BURLUP

This section explores relief techniques through the work of artists who have concentrated a relief that has a pronounced physical depth. Of particular interest in this section has been the work of Alberto Butter, Lucio Fontana and Piero Manzoni. Although I did not find any artist working with high relief (not in excess of 5 mm) through printmaking techniques, some other low relief techniques which identified in this review were, emboss print, sculptural image, relief print, deep etch, pulp image and inkless intaglio.

Emboss print

Raised and embossed image was used extensively in bookbinding prior to the advent of printing (fig.2.1.). Heat was used to make relief images on thin wooden board and also on sheepskin, deerskin and calf leather. For decoration, leather bindings were stamped in relief with heated panel stamps, and sometimes dyes were used in combination with blind images to accentuate patterns or titles. The main part of bookbinding's *finishing* was the lettering or relief images carried out by skilled craftsmen, using heated hand tools. Principally, relief patterns were made by heated wooden or brass letters.[20] Similarly, in some of the thirteenth century works on parchment and subsequently in early books, heat was used to create images.[21] In holy books such as the Koran and the Bible, this is particularly evident in the relief detail that is applied to the leather covers. Moslem experts believe that a Koran written in 1286 in Marrakesh may be the earliest known example of tooling with heated iron to produce relief images[21*]. In Egypt these boards were made of papyrus pulp.[22] In Islamic bookbinding, in the 10th century cut out patterns integrated with embossed text were used on the cover of a book to make a high relief. In this technique cut out patterns of papers were pasted as filigree on to the second pieces of different paper. Occasionally a Kufic inscription would be cut out and applied in this way.

Fig.2.1 the cover of a book,
Islamic patterns embossed on a thick paper.
14th century,
Victoria and Albert Museum.

The use of this type of tooling in Persia may date from the first half of the 14th century[23]*. In early examples it is not possible to determine whether or not the decorative points and lines were first tooled in embossed image without colour (blind) and then painted with liquid gold as had been done in *Copti* in Egypt.[23]

Most Persian covers in the14th century have geometrical ornamentation. A piece of perforated leather cut into an intricate pattern and superimposed on a board or geometrical design were used often in blind. To make a raised pattern, whole patterns were often stamped from a large heated metal block, while another technique was the embossing of designs with a heated matrix of toughened camel hide.[24]

Unlike Christianity, Islam rarely used pictorial representations of religious imagery.[25] The Muslim artist forbade the imitation of human and animal forms and was instructed to confine itself to plant and abstract motifs. It was for this reason that Islamic artists used the imagery of mathematics to discover the principal structures that are reflected in matter. Islamic art is essentially a way of ennobling matter by means of geometric patterns , there were contextualised through calligraphiy.[26]

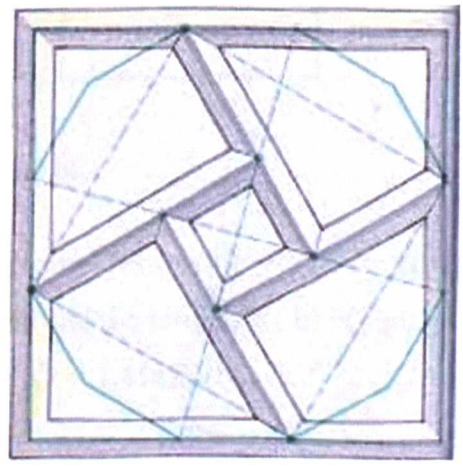

Fig.2.2. The basis of the square in square in Islamic design.

The key to the construction of the complex geometric design (fig.2.2.) is through a grammar of mathematical principles and the constraints of symmetry and laws of proportion. The basic component for Islamic design is a simple square or a triangle derived from the square. Most design known as the "*repeat*", rational system of growth generation.[27]

As the square plays central role in Islamic design, the square was selected for the practical work in the studio investigation of this research. In the final stage of the studio investigation a series of relief curved elements were also designed based on the proportion of Islamic ratio. The ratio of the elements within these works were based on the relationship between one element to the others and the surrounding space. For instance, a relationship between a positive element to negative space based on a specific ratio or comparing one element which is half of another double the former. In Islamic design the ratio is expressed as (a: b) or represented as a fraction (a / b), where a and b could be any number. Proportion is the equality of two or more ratios which can be either:

For continues: a / b = b / c = c / d etc., 2/4 = 4/8 = 8/16 etc.

For discontinues: a / b = c / d = f / g etc., 2/4 =3/6 = 5/10 etc.

Both have a constant characteristic ratio, in this case represented numerically as ½.

The rectangle is also commonly used in Islamic design. Its characteristic ratio is expressed by the measure of its short side (a) to its long side (b); a:b could be any ratio, 2:3, 3:5, 5:6, 5:8 :

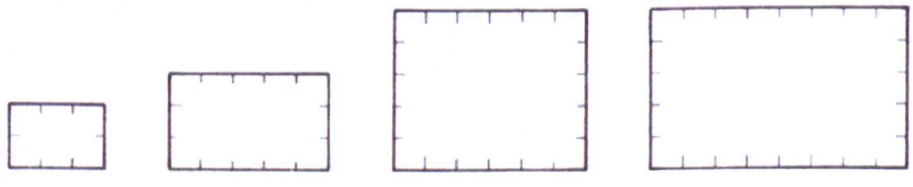

Fig.2.2A. Grammar of mathematical principles.

In a square, (a) and (b) are equal, and therefore the proportion is a/b = 1/1 = 1. When constructing a rectangle the short side (a) of a square and the long side (b) is equal to the diagonal of that square, the ratio a:b is equal to I: √2 = 1.4142.

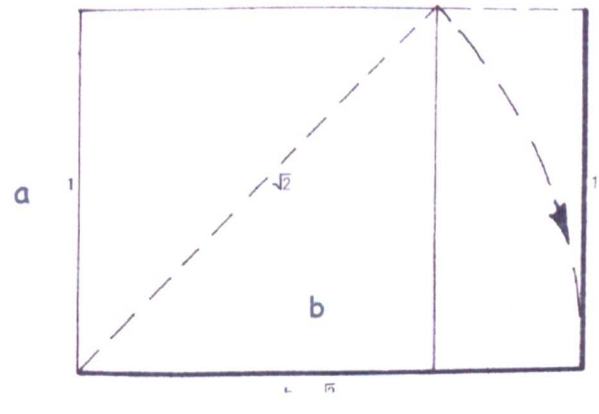

Fig.2.2B. Constricting a dynamic rectangle.

Rectangles with the ratio of their two sides a:b equal to 1 : √2, 1: √3, 1: √5, etc, called "irrational number" or the dynamic rectangles, the construction of which is illustrated in Fig .2.2C.

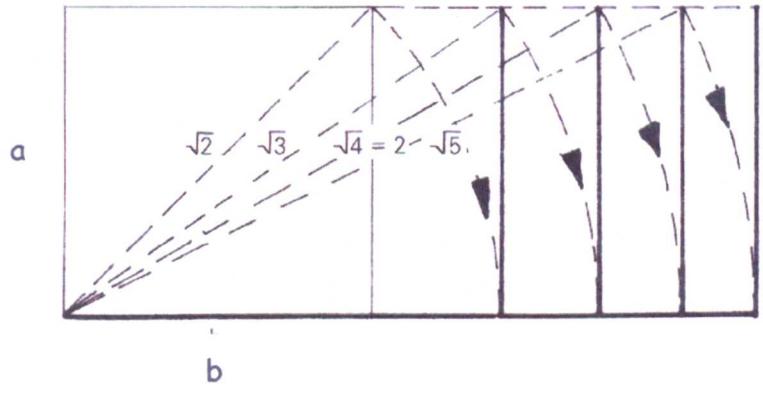

Fig 2.2C. Construction of dynamic rectangles, 1.414, 1.732, 2 and 2.236.

As the symmetric patterns are the most commonly used pattern in Islamic design, some practical work in the studio investigation was designed based on repetition of an element or symmetry. "Symmetria" in classical terminology meant the proportionality between the constituent elements of the whole. Since the concept of "Symmetria" are based on harmonic proportions, the linear numerical methods of analysis of geometrically constructed designs invariably result in approximations or inaccuracies because of the irrational numbers derived from the proportions of the geometric elements of the design[28].

Sculptural image

As far as high relief work in this study was concerned, Alberto Butters was almost certainly the only known artist who used heat to produce and form his paper or plastic relief and sculptural images. He also tried to transcend the confines of the two – dimensional surface through heat. It would seem that his work formed a bridge between the artists who used heat to discolour or change the appearance of their work and artists who worked with relief patterns. By the early 20's some artists such as Butters and Shimamoto started to use different materials, which had previously been considered non-traditional, for example polystyrene, fibreglass, polyester and plastic. By using artificial materials and with the development of modern plastics, such as

celluloid, Plexiglas and Perspex, new mediums were at hand for the artist to exploit. Although Butters started to exploit plastic bags in his works, other artists such as Lucio Fontana (1899), Enrico Castellani (1930), Pieter Engels (1938) had used variety of them in their works. It was only butters who extended the relief possibilities of plastic through heat.

Around 1949/50, Butters experimented with various unorthodox materials, in his tactile collages, these materials included pumice, tar and burlap that is a type of thick, rough and strong cloth. At this time he also commenced his "*Hunchback*" series, which were humped canvas that broke with the traditional two-dimensional plan. A few decades later his innovations were followed by other artists, such as Jos Manders (*Communicati,* series, 1968) and Anish Kapoor *(When I am pregnant* series, 1992).

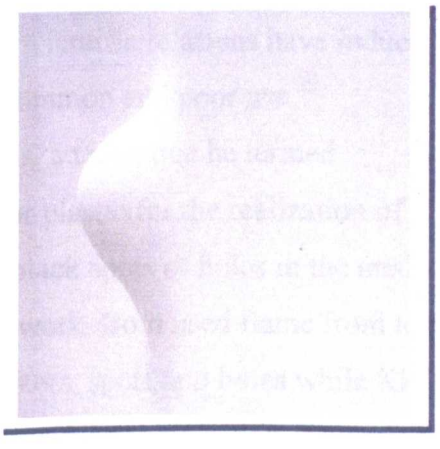

Fig.2.3. When I am Pregnant,
Anish Kapoor, 1992,
Fibreglass and pigment,
Dimension variable.

Butters' dialogue between the age old traditions of painting and the search for a new means of expression and representation led him to create various textures and surfaces with the topography of materials and the topology of abstraction.

Fig.2.4. Muffa
Alberto Butters
1959-61
58 x 46. 2 cm

For the creation of relief and topographic images, he first constructed some compositions and placed a central swathe of fabric that added both depth and dynamism to the compositions. One example of this series titled *muffa (mould)* fig.2.4. alludes to the rapid outgrowth that mould as an organism displays, evoked in the lively, effervescent surface of the composition. Discussing Butters use of fabric in the composition to create topographic image, Bruno Mantura says, "[Laying] aside almost completely all paintbrushes, the artist builds his work with an *outré* material, the old and consumed sackcloth, creating painting therefore with what is one of the oldest bases of painting[29].

Butters' compositions (fig.2.5- 2.6), form, themes, metamorphosis, accidental processes, natural processes, reactions (fig2.7.) and scientific relations have induced him to burn, to fuse and to carbonate, materials of common and poor use.[29]
In the mid 1950s Butters began burning his materials, a technique he termed *Combustion.* With the torch flame, he burnt wood or plastic for the realization of his pictures. In this case flame makes marks, crackers, black spots or holes in the medium. There is a relationship between Butters and Klein's work. Both used flame from torch to create their work. Butter used flame to make crackers, spots and holes while Klein used heat to create imagery on the flat surface or discolour his flat work. Butters' experimentations were in Italy, in the same period and parallel with Klein in France. In the mid Sixties Butters continued to work with plastic, elaborate form with fire and applied it on a support of cellotex (Fig 2.6). In these works, the vision was simplified; the colour was given to the background and the plastic, burnt or left transparent, had the function of creating shades of the same colour.

With *Rosso plastica,* another type of plastic, Butters also demonstrated his primary concerns with texture and bold, autonomous colour and the key work from Rosso plastica series. These series also present an apotheosis of Butters' technique of sculpting and layering his plastic surface using a heat source, a technique which he had developed in his Combustion series from the mid- and late 1950s. Butters in this series created a dynamically tectonic ground, with richly variegated and textured contours.

The strident boldness of the pigments and their powerful contrast with the blackness of the burnt areas have given clear voice to the artist's aims of creating a monolithic, monumental canvas that draws the viewer into their seductive depth[29*]. Rosso Plastica also in their magnificence and boldness of vision, forms a seminal work in Butters artistic development. The impacts of these series lie in their great richness and depth of colour and the movement of their surface. He also extended his burnt surfaces with translucent plastic that were either completely transparent or coloured and accented with burn marks and tears. Like Cia and Klein's combustion process, a large part of his practice was\ delegated to processes that he could not completely control.

Fig.2.5. Red Plastic,
Alberto Butters, 1964,
Combustion on burlap,
100 x 90cm

Fig. 2.6. Bianco Plastic BB4,
Alberto Butters, 1967,
Combustion on cellotex,
75 x 50cm

In 1973, after experimenting for several years on the alteration and on the combustion of plastic materials, he extended his experiments to discover other unusual materials, the Mildews (materials such as powder, pumice stone and chemical products). He used these materials in his works to make a higher relief. Butters presented these works(the series entitled '*Cretti* ')for the first time in Bologna and then in 1976 in the Galleria d'Arte Moderna in Rome. The appearances of Cretti were similar to the works of Yves Klein, *Traces of Fire on wood and cardboard*, 1962, (Fig. 1.29) and David Nash, *Charred Panel*, 1999, (Fig. 1.28).

By *Nero Cretti* (Fig.2.7) Butters might have wanted to produce an imitation of wooden burnt board. This work consists of a mixture of white zinc oxide and vinyl glue, and pigments.[30] When the texture of the surface dry, gives rise to a previously conceived structure: a burnt board with flame.[31]

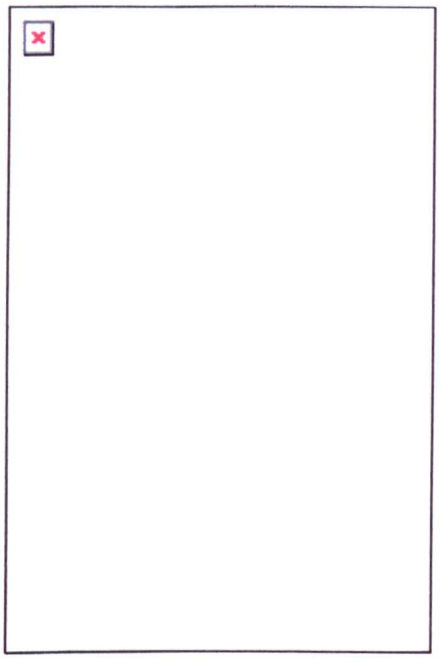

Fig. 2.7. Nero Cretti,
Alberto Butters, 1975,
Pigment on Cellotex,
96 x 73.4cm.

At about the same time as Butters utilized direct flame on his fabrics and papers, the German artist Johannes Schreiter created his prints using smoke and fire in the same period as Butters' investigations on combustion.

Fig. 2.8. Introversion 17,
1963,
Johannes Schreiter,
Fire and candle on paper,

Schreiter also modified his prints by setting them alight and then dousing them to develop new imagery. In addition he used smoke from candles to draw on and to heat and blister the paper in to sculptural relief.[32] His burnt works are unique, because it is very difficult to control the effect of flame on the surface; all the same, the effects of fire have a geometrical outline in his work.

The Japanese artist *Shozo Shimamoto was* another artist, who with Alberto Butters, Lucio Fontana and John Cage used heat and fire as well as tearing and piercing in their work. He has executed a number of experiments during his burlap and pierce investigations. To do this, *Shimamoto,* painted paper and then pierced it with holes to reveal the different layers underneath and also to extend the limitation of two-dimensional surface.[33]

When Shimamoto realised his works were similar to the Fontana's, he decided to move to another style of work. He stopped producing his "hole" works after seeing similar works produced by Lucio Fontana in the mid –1950s, fearing that he would be perceived as an imitator of the more established Italian artist.[34]

Fig, 2.9. Holes, Ana,
Shozo Shimamoto, 1954,
Oil on paper, unique,
892 x 699 mm

Shimamoto recognized, even admired the holes and pierced works by *Lucio Fontana* who cut his painted canvas to add the dimension of the hight and described that his hole had been done before Fontana's pierced work.

> "My works with holes ripped in the canvas happen to have been made before Fontana's, an Italian artists' works with holes in them. For a long time, I had been trying to bring this to the attention of the Japanese art world, but no one cared. This made me think that Yashihora had been right".iv

Fontana attempted also to transcend the confines of the two-dimensional surfaces such as paper and canvas, as well as his experimentations with stone, metal, ceramic and neon[35].

In a series of *manifestos* originating with the *Manifesto blanco* (white manifesto) of 1946, Fontana announced his goals for a "*spatialist*" art, one that could engage technology to achieve an expression of the fourth dimension. He wanted to meld the categories of architecture, sculpture, and painting to create a groundbreaking new aesthetic idiom.[36]

From 1947 Fontana's experiments were often entitled *Concetti spaziali* (Spatial Concepts), among which a progression of categories unfolds. The artists polychrome sculpture brought colour, considered to be under the dominion of painting, into the realm of the three- dimensional. His exploration of the way of producing holes, which he called *Buchy*, was the most important part of his investigation for this research. In this series, he punctured the surface of his canvases, breaking the membrane of two dimensionality in order to highlight the space behind the picture. From 1958, Fontana purified his paintings by creating matt, monochrome surfaces, thus focusing the viewer's attention on the slices that render the skin of the canvas. A painting such as *Spatial Concept, expectations* (Fig .2.10) is among these cuts, whose violent jags enforce the idea that the painting is an object not solely a surface.[37]

Like Alberto Butters, Fontana tried to bring a third dimension to his works and by piercing and slashing[v] the surface of his works. He managed to force the viewer to contend with the work of art as an object in real space, rather than a representation of illusionistic space.

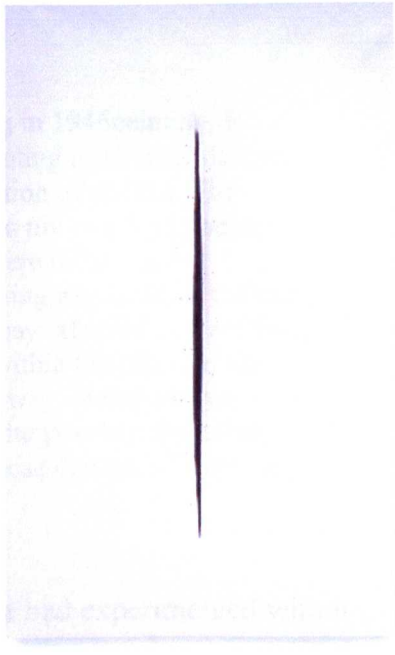

Fig .2.10 Spatial,
Concept-Expectation,
Lucio Fontana, 1965,
Oil on canvas,
97 x 56 cm

He investigated diverse methods of illusion, space and matter to increase the deepness of his slashes. In *Spatial Concept- Expectation* (fig .2.10) he affixed black cheesecloth behind the canvas which shimmers through a narrow vertical aperture, suggesting a dark , unfathomable realm. The work's title generically used by Fontana for many similarly subversive pieces- gives no clue as to what might be contained or concealed there. Fontana thus pointed toward the contingency of human perception.

He continued working on punctured canvases, followed by cut monochrome works, until his death in 1968. Sequins or glass fragments on the top of a canvas were sometimes used to contrast the solidity of the materials with the cut and the expansion of the dimension was particularly noticeable. By physically breaking the canvas, he sought a new means of expression in contemporary art by making invisible space visible and exploring the relationship between space and matter.[38]
As far as the expansion of relief and convex forms the surface was concerned in this section, Fontana's idea for the creation of three dimensional elements such as slashes and his burlaps was greatly significant. He also presented another theme theoretically, a

fourth dimension, and created a new idea of dynamic art based on the unity of time and space. He described more about his dynamic works in an interview.

> " From the outset I never called the work I was doing in 1946painting, I called it 'spatial concept'. This is because for me painting is a matter of ideas. The canvas served and still serves for the documentation of an idea. The things I am doing at the moment are just variations on my two fundamental ideas: the hole and the cut. At a time when people were talking about " planes "- the surface plane, the depth plane etc – making a hole was a radical gesture which broke the space on the canvas as if to say: after this we are free to do what we like. The surface cannot be confined within the edges of the canvas, it extends into the surrounding space. In this way, in these ways, – well, I don't know because I could not survive until the year two thousand; the important thing is that we have born witness to these demands." Interview by Daniele Palazzoli, Bit, no.5. Milan, Oct – Nov 1967. [39]

Fontana did not expand the use of fire in his works but he had experimented with it already in his ceramic and sculptural activities in the year 1937. His investigations opened to the elements of the great fire and the manufactures of *Sevres*, that it exposed in its first personal slow combustion stove the same year.[40] He made some reliefs with these techniques in *terra – cotta*, tablets recorded in coloured sculptures' ceramics (Dead Nature).[41] He was also driven by the sprit of exploration, constantly questioning and extending the boundaries of his own practice, redefined the possibilities for art and used a rich vocabulary of material to expand his space. Fontana superimposed several materials in order to add tohis dimensions such as chalk, *pezzetty* of glass, sand and *Payettes.*[42]

Fontana's final experiment was also interesting for this study. Not only he shred, ripped and made slash on canvass and paper, he continued his investigations in the last years of his life with shredding and ripping metals such as brass, steel and copper. In these continuous experiments, which he already practiced on burlaps and papers, Fontana conceived the creation action like sign of the intelligence of the artist, the element in the space in all its dimensions.

Fig.2.11. Concetto spaziale,
Lucio Fontana, 1962,
Ripped Copper,
94.5 x 57 cm

A good example of this series is *Concetto spaziale* (Fig .2.11) with holes, slashes and rips. The most famous series of the End of *God appears,* great burlaps vertical ovals monochrome also created in 1963, had some similar elements with this work.

Another artist who investigated the surface in relief was Piero Manzoni. His idea for planning a composition was similar to Butters, Shimamoto and Fontana, he believed that painting should represent nothing but itself. He began his series of *Achrom*[vii] in 1957. His techniques and activities were interestingly parallel and nearly in the same period as Alberto Butters, Shozo Shimamoto, Yves Klein, Lucio Fontana and Johannes Schreiter. He exhibited some of his works in a group show with Klein, Fontana and Butters in 1957. Like many of renowned mid twenty minimalists who applied reliefed elements and raised the surface of their works with white materials; Manzoni utilized chalk, cotton, bread or polystyrene in his works. He applied only white materials in order to create an aria of liberty; a surface, which is, and nothing else.

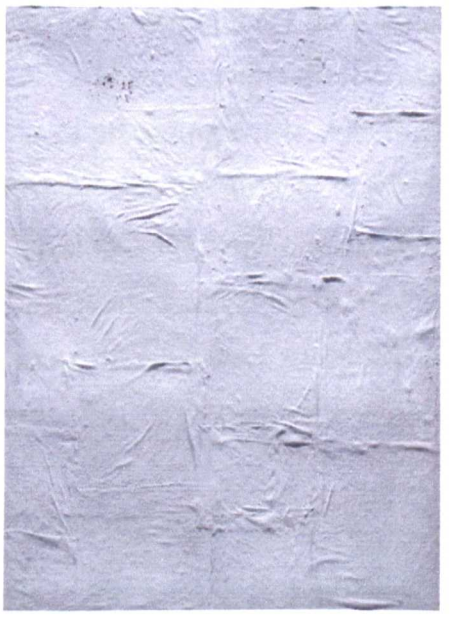

Fig .2.12. Achrome, 1958,
Piero Manzoni,
China-clay on canvas,

103 x 103 cm.

The Achromes were intended to be devoid of all symbolic or expressive content. While Kline's monochrome paintings were defined by colour, Manzoni responded by removing even this element and executed his works only in white on white. [43] Ben Nicholson, British artist also created a notable series of white reliefs in the mid 1930s".[44]

As pointed out in the preceding section, Fontana employed various colours in his spatial concept monochrome(*Concetto spatial*,1961 and *Attese*,1964), but he also applied white manifesto in his *Manifesto Blanco* series. Alberto Butters rarely used monochrome white in his works, however, in his *white man* 1952 series he used only white and just in one case, employed transparent plastic (*great Plastic I,* 1962). Manzoni however, investigated various materials and solutions to create his white reliefs. The first Achromes were built up of rough gesso that was scratch marked. He used kaolin in 1958, felt and cotton in 1960, wool and rabbit fur in 1961and gravel, and bread roll in 1962. These works constitute a conceptual investigation into the limitations and possibilities of the surface.

Fig.2.13. Achrome, 1959,
Piero Manzoni,
Gesso on canvas,
60 x 50 cm,

Another artist who had artistic experimentation to the overcoming of the traditional limits of the painted picture was Enrico Casellani[45]. He works with reliefed image built up from nails. His works, together with the works of preceding artists, Alberto Butters' combustions, Fontana's slashes and Manzoni's Achromes, the surfaces in relief constitute one of the most outstanding stylistic developments – and one of those most charged with meaning of the end 20s. In 1959 Castellani executed his first *Superficie near in rillievo* (Black Surface in Relief). This was a decisive work for the development of his art, opening up new opportunities for expression using canvases with two-dimensional surfaces.

Although he was working within the influence of the two-dimensional surface, as other mentioned artists, he tried to shift the focus of attention to the surface structure. Therefore he created a concave and convex space, positive and negative to draw attention to light and shade. The technique that he applied then became a characteristic of all his works and consisted of fastening the canvas or paper onto reliefs built up from nails; in this way, some part of the canvas projected outward, in contrast to other areas which form introflexions.

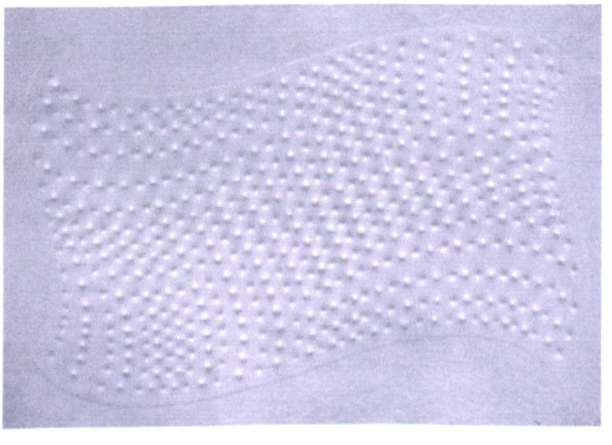

Fig.2.14. euro 1200,
Enrico Castellani, 1995,
Relief on paper,
41.5 x 69 cm.

Castellani uses monochrome surfaces in his process and shapes it to form double curves with repeated elements. He utilises a series of points in relief and points forming depressions, negative and positive poles, and a series of minimal operative interventions. They are constituted by a flat membrane, the physical characteristic of which – elasticity and spatial continuity – are not altered by process of formation. The structures resulting from this operation are matched by others that are both equal and opposite and thus cancel each other out in the organization of spatial totality".[46]

In 1963 Castellani also began to take an interest in the expressive possibilities of the diverse articulation of the monochrome surface in space: thus he made shaped corner canvases, projecting three - dimensionality.

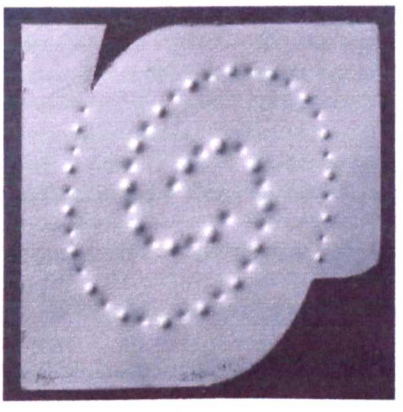

Fig 2.15. euro 600,
Enrico Castellani, 1996,
Relief on paper,
30 x 30 cm

Relief print

Several printmakers were also interested in expanding the boundaries of the two–dimensional surfaces in order to meet new artistic and technological demands. Among most attempts to create three–dimensional images through printmaking techniques, the sculptural print was remarkable. It was a challenge to explore the interaction between printmaking and sculpture in order to establish a bridge between the relatively two-dimensional world of printmakers and the three-dimensional world of sculptors. Sculptural etching can also range from deep embossment (5 mm) to etchings approximately (0.5 mm).

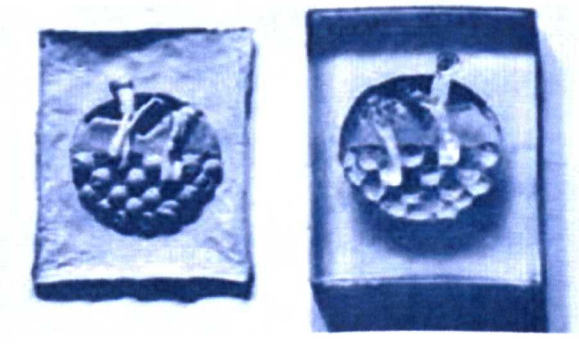

Fig .2.16. Print from resin mould.

In etching, the plate is simply pressed on the soft surface of the paper causing a slight emboss. The paper can be embossed through this technique either by being pushed out as intaglio printing or in as relief printing. Most embossed prints are designed not to be

inked. Usually an inked plate is printed on plain white paper, resulting in an embossed form similar to Butters and Fontana's works that uses the play of light and shadow to reveal the image. Low relief embossing, whether on paper, canvas or plastic, is similar to low relief sculpture. Higher relief or additional areas of embossment can be made on a print with a second plate specially constructed out of layers of boards, woods, metals, resin or any suitable materials(fig.2.16).

Pulp image and Deep etch

Pulp and paper sculpture can also be counted as a printmaking technique. The creation of a form of paper sculpture or relief utilized in this technique can be achieved by pouring liquid paper over a low relief shape or shapes. When the paper is dry the mould is gently removed revealing a negative or positive impression in the paper. Although achieving a high relief form through pulp and paper sculpture is easier, the most popular technique is *deep etch.* [vi] A deeply etched plate is printed in relief, intaglio or both together. It is the intaglio process that makes the most of the actual depth and even greater illusion of depth and the range of tone and colour. Similar technique to *deep etch* is r*elief etching.*

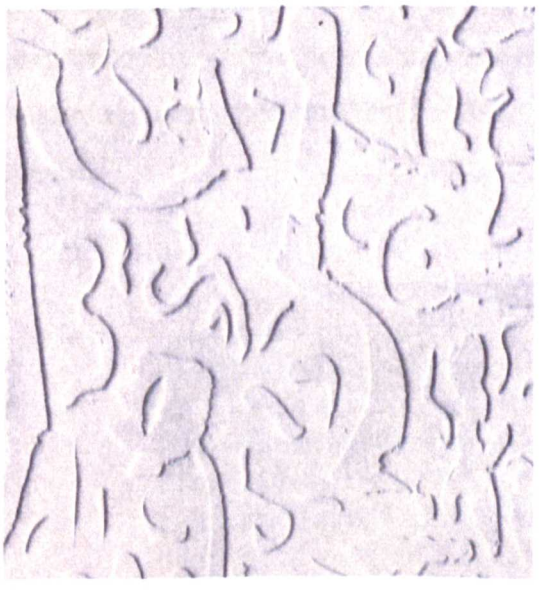

Fig. 2.17. Relief Etching,
Georges Levantis,
25 x 19 inch.

When an image is drawn directly onto the plate by protecting material and leaving the surrounding area unprotected, the drawn image is left in raised relief. Technically, the etching process may be exactly the same as a deep etch, but visually the emphasis is on the more positive relief; the corroded metal has become the negative area.

A number of other techniques such as inkless intaglio and blind image have the same style of plate and all are emboss prints, distinguished by the height of the relief. It is always possible to find a print in which the effect obtained and the actual materials and techniques used are virtually impossible to detect. Indeed, a more anonymous surface effect may be deliberately sought in preference to others that are recognizable.
Most of these techniques and all relief prints can be taken from many kinds of surface other than etched metal, the most obvious being wood and lino.

Many artists and printmakers were also interested in making their own paper to expand their style. Paper is generally made by the layering of short vegetable fibres to form sheets. Materials such as cotton, artichoke, straw and bamboo are capable of being reduced to a state suitable for paper forming. The fibre must be shortened and separated into fine fibrous of strands similar to bamboo after it has been crushed and beaten with a mallet. After two to five hours of simmering the liquid is drained off and the pulpy mass then poured into a tube or tray and ready for casting or forming the sheet.[47]

Among hand made papers and relief print works, *Frank Stella*'s paper reliefs marked a radical departure in his approach to papermaking and printmaking. He sought for a greater variety in relief print and graphic expression by using coloured paper pulp. Stella made his paper relief compositions based on corrugated cardboard collage with felt, paper, unpainted wood and painted canvas[48].

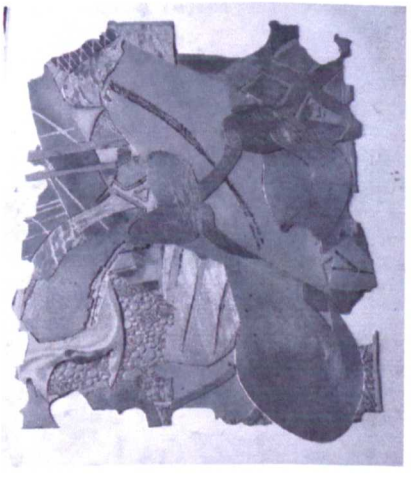

Fig. 2.18. The central part of the assembled plate for Stella's print *The Affidavit*, from the series *Moby DickDecke Edges*.

Stella also constructed three-dimensional papermaking moulds using brass screening and mahogany slats sewn together with brass wire that inspired the researcher in his

own work. The mould configurations were based on the original small wood maquettes that he had constructed for his larger relief works[49]. In some of his relief work he collaged coloured papers on selected sections of each relief, colouring the pulp both at the wet stage and after it was dried and removed from the moulds.

The Paper Reliefs introduced Stella to the craft of papermaking by hand. He discovered the great sculptural and colouristic flexibility of hand made paper, the 'object-like' substrate that presented unparalleled compositions. Two of his series, the *Circuit Series* and the Swan *Engraving*, show the way in which his paintings and prints related to each other was fundamentally relief technique. Both series connect to a number of relief – paintings, collectively titled *Circuits*, on which Stella worked between 1980 and 1984. They are assertive, colourful reliefs that appeared to leap off the wall[50].

Fig.2.19. *Roncador*
Frank Stella
lithograph, screen print,
etching, and relief on paper
1998
542x 554 mm

The American printmaker *Kenneth Tyler* also collaborated with Stella and helped him to create different techniques in large scale prints[vii], including relief prints. In *Swan Engravings series* for instance; Stella assisted by Tyler, produced a dynamic combination of etching and relief techniques printed on thick handmade paper.

Fig,2.20. Kenneth Tyler and Frank Stella
pulling an impression of *The Affidavit*
from the assembled plate,
November 1992.

Tyler's involvement with the making of Stella's original reliefs led to the workshop making sculptural papers, which in turn Stella used in producing models in his studio. The printed-paper reliefs, made after his paper relief project, were based on these studio models. In 1976 Tyler also invented an archival paper honeycomb structural panel for use in making relief models and experimented intensively with paper-making, as well as expanding the boundaries of printmaking[51]. Tyler also made a plate for Stella's *Juam* (Fig.2.21) showing its composite construction of different materials collaged onto the base support to produce relief print.

Fig.2.21. Kenneth Tyler made *Juam's* plate for Frank Stella to produce relief print.

Frank Stella was also influenced by the work of the most enduringly influential Abstract Expressionists, *Barnett Newman*[ix]. Stella admired the use of colour and compositions of this American artist and stated "holding Barnett Newman's *Ulysses* (fig.2.21) back, trying to keep its pushy blueness from toppling the Empire State Building". [52]

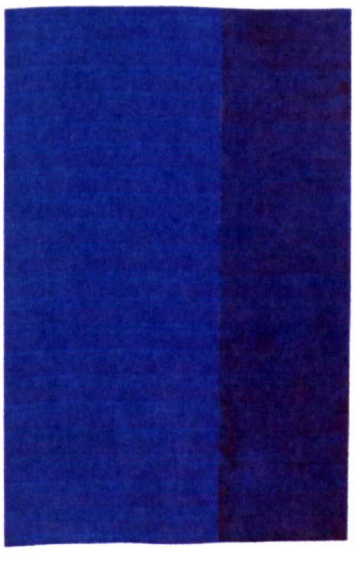

Fig.2.21. Ulysses, 1952,
Barnett Newman,
Oil on canvass,
336.6x 127.3cm

The design and composition of the final work of this research was also greatly inspired by the work of *Barnett Newman* and his compositions. Like vertical elements in Islamic compositions, Newman considered the elements in most of his compositions to be equally vertical. He created a series on the theme of *The Station of the Cross*, which can be equally compared with the vertical motif in Islamic design. In Islamic compositions blue or green usually dominate the surface area of a panel and bands or stripes are in a symmetric format. Single line in a composition, refers to the interplay of the actual letters that expands the meaning of a text. In Blue Mosque panel (fig .2.23) for instance, vertical strips with a slight relief added the contrast of cream and blue, compared with *The Station of Cross* (figs.2.25 and 2.26).

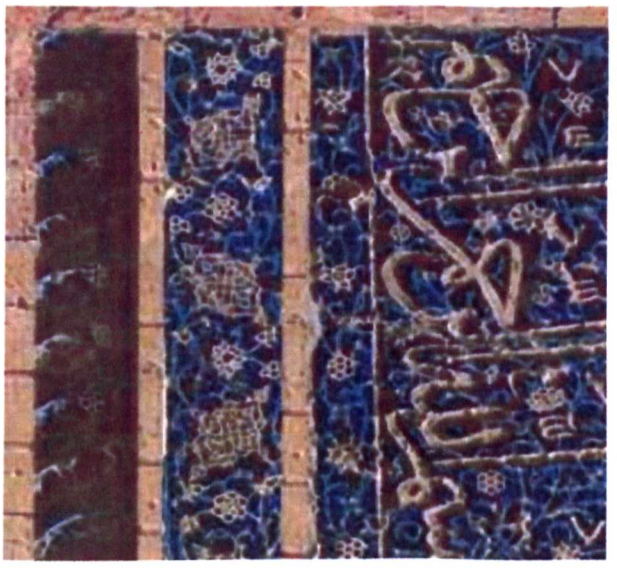

Fig .2.23. Blue Mosque, Tabrize, 1465.

Newman explored the different ways in which his stripes could be used in compositions. In *The Station of Cross* (Figs 2.24, 25, 26) ,the stripe varies enormously in character throughout the fourteen paintings. It can be "positive", a painted vertical band or "negative", a band of raw canvas between two painted areas, whether brushed bursts of paint or clean lines (*Second Station* fig. 2.24). The stripes can be broad bands, as seen at the left of the *Sixth Station* (fig 2.25), or pencil- thin stripes.[53]

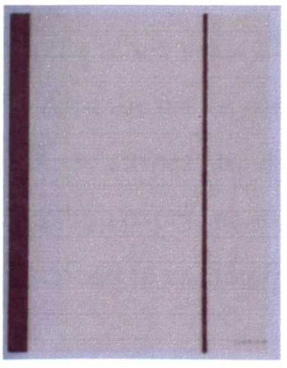

Fig.2.24. Second Station
Barnet Newman, 1958
Magna on canvas
198.4 x 153.2 cm

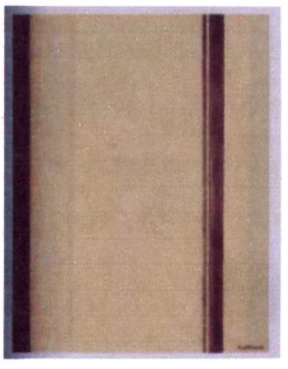

Fig.2.25. Sixth Station
Barnet Newman, 1962
Oil on canvas
198.4 x 152.1 cm

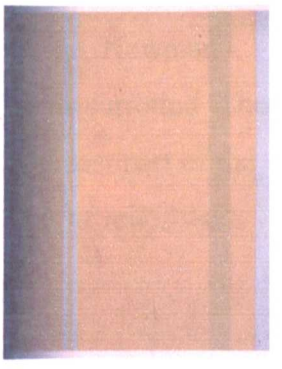

Fig.2.26. Ninth Station
Barnet Newman, 1964
Acrylic on canvas
198.1 x 152.7 cm

In *The Voice* (fig 2.27) for instance, Newman explored a composition of one stripe in this piece of work. The white field was made in egg tempera, and the one stripe, near the right edge, was cream-coloured enamel paint. However, in another white painting, *The Name II* (fig.2.28), there were four bands, two at the outer most edges and two on either side of the middle.

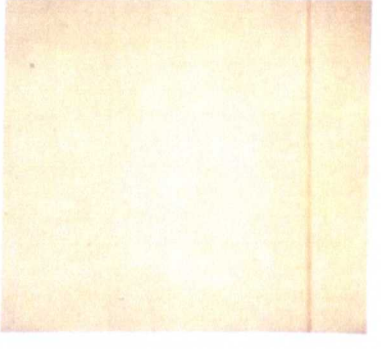

Fig.2.27. *The Voice*, 1950
Barnett Newman,
Egg tempera and
enamel on canvas.
244.1 x 268 cm

It seems that the format of *The Name II* is the inverse of *The Voice,* and in this work oil and acrylic paint that called Magna were used.

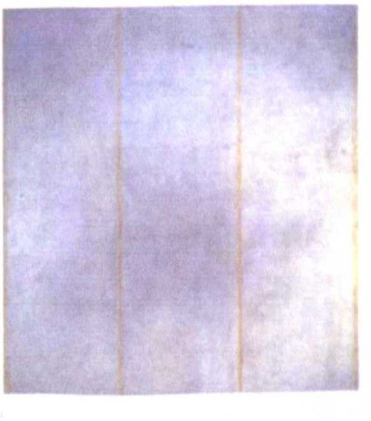

Fig. 2.28. The name II,
1950,
Barnett Newman,
Oil and Magna on canvas,
274.3x 243.8 cm

In some of his work like *Joshua*, a black painting with a scarlet stripe, Newman explored the use of coloured stripe that so brilliantly contrasted to its surround. These coloured stripes and their compositions influenced considerably the last part of the workshop experiments and the structure of the final demonstrations of relief work (described in section 5).

Conclusion to section 2

The most important achievement of this section was the exploration of relief techniques and the work of artists who succeed in attaining images through accentuated relief. This review enabled the researcher to develop high relief image and to print an increased pronouncement of convexity and concavity in paper during the studio experiment by using heat and releasing the paper's fibres while pressing. Approaching these techniques and the study of previous attempts also facilitated this research to discover and resolve remaining problems of embossing in combination with heat. Although the researcher did not manage to find any artist working with high relief through printmaking techniques, some other low relief techniques were identified in this review that were useful to the research such as deep etch, relief on paper (Fig.2.14.) and relief etching (Fig.2.17).

Among western artists, Alberto Butters is the only known artist who used heat to pronounce and form his relief and sculptural images. He also tried to transcend the confines of the two –dimensional surface through heat. Although Butters utilized direct flame on his fabrics and papers, German artist Johannes Schreiter developed this energy through his prints by smoke and fire in the same period as Butters' investigations on combustion. His burnt works are unique because flame is uncontrollable on the surface.

The creation of the sculptural form on a flat canvas, holes and pierced works by Italian artist *Lucio Fontana* who cut his painted canvas to add dimension was motivating for this research. Fontana's exploration of the way of producing holes and concave form, which he called *Buchy*, became one the most important part of my studio experimentation. Like Fontana and Alberto Butters who both tried to bring a third dimension to their works by piercing, cut, puncture and slashing the surface of their works and canvases, breaking the membrane of two dimensionality was also motivating.

The work of Piero Manzoni who investigated the surface in relief was also interesting. Like many of renowned mid twenty minimalists who raised the surface of their works with white materials; he utilized chalk, cotton, bread or polystyrene in his works. He applied only white materials in order to create an aria of liberty; a surface, which is, and nothing else. Like Manzoni, Enrico Casellani, was another artist who had artistic experimentation to the overcoming of the traditional limits of the painted picture. He works with reliefed image built up from nails. His works, together with the works of preceding artists, Alberto Butters' combustions, Fontana's slashes and Manzoni's Achromes, the surfaces in relief constitute one of the most outstanding stylistic developments.

Frank Stella was also interested in expanding the boundaries of the two–dimensional surfaces in order to meet new artistic and technological demands. Among most attempts to create three–dimensional images through printmaking techniques, the sculptural print was remarkable. Stella's paper reliefs marked a radical departure in his approach to papermaking and printmaking. He sought for a greater variety in relief print and graphic expression by using coloured paper pulp. He discovered the great sculptural and colouristic flexibility of hand made paper, the 'object-like' substrate that presented unparalleled compositions. Kenneth Tyler also collaborated with Stella and helped him to create different techniques of prints in large scale including relief prints.

Frank Stella was also influenced by the work of the most enduringly influential Abstract Expressionists, Barnett Newman. Like vertical elements in Islamic compositions, Newman considered his elements in most of his compositions equally vertical. He created a series on the theme of *The Station of the Cross*, which can be equally compared with the vertical motif in Islamic design. Newman explored the use of coloured stripe that so brilliantly contrasted to its surround. These coloured stripes and their compositions influenced considerably the last part of the workshop experiments and the structure of the final demonstrations of relief works.

SECTION 3

Classifying Colour Materials

Preparing a system for achieving new effect of colour through heat

Chemical materials

Natural materials

Oil based colour

Water based colour

Chemical Colour (Synthetic)

Natural Colours (Biological)

Organic and Inorganic Origin

Vegetable and Animal Origin

SECTION 3

CLASSIFICATION OF COLOUR MATHERIALS

Knowledge of colour theory based on scientific principles is the only sure guide to the artist in preparing colour schemes. For example, colour specialists, scientists, technologists and biochemical experts such as Eugen Chevreul the French scientist, chemist and naturalist, Faber Birren the great historian of colour who linked colour science with painting, Oden Rood an American scientist, physicist, chemist and Art historian presented different tables and colour schemes and tried to develop and proposed new variety of the latest colours. Johannes Itten, Albert H. Munsell, Faber Birren and Wilhelm Oswald are also an elite group of artists and scientists who are renowned for their doctrines in colour schemes and presented primaries, spheres and various contrasts but they provided inadequate steps of saturation. Also, none of them went further to present an over layer scale or examine the effect of heat on the colours in the schemes. By reviewing colour systems, it was obvious that the view of artists to systemize the colour were different to the scientist's description. In fact, the expressions of colour discussed in this section used by artists such as Le Blon, Philip Otto Runge and Johannes Itten who were engaged in practical work connected with the appearance of colours differs considerably from strictly scientific terminology used by colour scientists.

The terms for colours which were described by colour scientists such as the English physician J.H. Lambert, German mathematician Tobias Mayer and American scientist Ogden Rood were based on the physics of light. Though extremely precise for the use of scientists, scientific colour terminology is often incomprehensible to the artist.(Enid Verity,1980). To some extent these differences are bridged by terms used in colour systems and applications. Although this project was involved with the measurement of colour (section 4) for anyone engaged in the measurement and specification of colour in art, a working knowledge of colour systems and classifications is essential.

This section provides an underpinning for the development of proposed saturations and heated samples to various tints, which were examined through studio investigation in section 4. The gradations and reflections the adaptability and practicality of the effects are also considered necessary to the presented colour schemes.

During the study for the literature of this research, I reviewed primaries and spheres in order to build a proper structure and also to build up a reinforced underpinning for its colour schemes and presented swatches. The organisation of surface colours into colour systems, and demonstrating by means of colour solids is probably not possible as a single solution. Collectively, the various systems are very useful for the classification of colour in this project.

By studying colour systems it can be accepted that presented systems, charts and schemes are representational of the physical spectrum and chemical characteristics of colour. There are certain factors, which must be clarified in order to be able to follow and build a structure for the colour tables and schemes of this project (studio investigation in section four). The most difficult challenge was to make an exact colour using printmaking techniques with several colours. The difficulty was that the colours change from one gradation to another with the implementation of various degrees of heat on each sample.

Reflecting upon the achievements from the colour schemes, the main principle was to inform or to suggest an expansion of new effects in printmaking and suggest a new classification of colour materials. Arranging a system of these materials was vital. In this classification colours have been categorized based on their vehicles and solutions. Through proposed colour arrangement the use of colour in studio experiment became systematic.

Preparing a system for achieving new effect of Colour Through Heat

From the experience of the initial trial of heating the colour, it was clearly necessary to set up a comprehensive classification of colour materials that I was not able to find through the literature review. It was therefore decided to classify colour materials based on their solvent and vehicles [X]. This classification prepared an appropriate structure for studio experiment and also allowed to devise and print the most possible gradient for each group of colours. Heating the samples at the highest degree of control and subsequently recording the results of every sample that gradually changed to a lighter or darker colour through the application of heat.

Classifying Colour Materials

The classification planned to cover the most materials that can be used as ink in printmaking techniques and originally divided into two groups. The solvent for the first group (3.1 Synthetic) was chemical and the second group (3.2 Biological) was water.

3. Colour Materials Classification:

3.1- Chemical materials

3.2- Natural materials

3.1: Chemical Colour (Synthetic)

3.1A: Water based

3.1A I: Acrylic

3.1A II: Powdered Pigment [xi] (organic and inorganic origin)

3.1B: Oil based

3.1B I: White Spirit

3.1B II: Thinner (cellulose)

3.1B III: Retarder (PVC)

3.1B IV: Coal tar (carbonised oil)

3.1BV: Powdered Pigment [xii] (Synthetic origin)

Luminous Inks (Fluorescent and phosphorescent colours) are other group of synthetic colours that could be mixed with either oil or water based materials.

3.2: Natural Colours (Biological)

3.2A: Organic (vegetal)

3.2A I: Lake pigment (vegetable and animal origin)

3.2B: Inorganic origin (mineral)

The most prominent result of the classifying colours

The main aims of this classification were firstly, to find a suitable ink and vehicle in order to build a structure for its presented colour tables, swathes, schemes and heated samples. Secondly, to be able to build up a reinforced underpinning for the colour of final relief experiment when combined with heated colour.

Therefore, from this classification, two groups were selected for studio experiment to examine the effect of heat on them. Firstly, white sprite ink (3.1BI) from oil based inks were chosen for the printing of tables and the final projects of this research and secondly, Acrylic group (3.1AI) from water based inks were chosen for the combination of the scheme samples because of their striking react to the heat (described in section 4).

Being an adherent of Persian colour, the colours which were exploited in the final work of the project were chosen from the most frequently used colours of this land. This is not to say that I chose to adhere rigidly to the ancient taste of Persians. However, the reachness of these colours encouraged me to apply this palette to the final work. This approach was used in order to find an authentic source for selecting colour and not to conform to one particular nation, land, culture and taste.

The colour most frequently used by Persians are Prussian blue (Bokara), Cotton green, Shah gold (Siena), Persian orange and Persian turban.

Fig.3.1. The most frequent colour of Persians.

For the colour of relief demonstration, a combination of grey and three shades of Prussian blue, Grey green blue, Cotton green, and two tint of pale Shah gold were employed for the stripes of these works.

Colours represent religion, cultural, racial and also convey iconic meaning in relation to the ethnic and cultural background. Since the Persian artists drew not from nature but according to the accepted artistic convention (ref 54), the colours they used came from an idealised world. In Persian culture, colours convey various massages. For instance, in *Ashora,* a ceremony that occurs extensively in Iran, Persians use many coloured sheets and flags every year. Red flag symbolizes war and sacrifice, green loyalty and black a flag is indicative of mourning for *shahid* (martyr). Black also in Persian culture symbolises virtue and grief. This colour is full of mystery, death and determination and has also negative connotations that is such as; "black magic" and " the black plague".[55]

Conversely, green evokes positive notions such as energy, life and growth. The S*hiey Moslem* also took green as their colour, to symbolize their allegiance to *Emam Ali* and wear usually green scarf of green belt, as they believe the cloak of the prophet had been green.[56] Green is also the traditional colour of Persians and stands for new year (*Eid*), freshness and renewal.[57]

Blue and gold are respected in sacred buildings and Persian art. The value of loyalty, rejuvenation and integrity are often associated with blue. Gold is applied in front of prayer, and associated with desire for power, mystic power, higher power, love of sprit, wisdom, wealth and safety. The use of Persian blue and gold have had a radical influence on the eastern art. The Persian blue background and wide gold border in the Indian and Chinese work are clear evidence of Persian influence.[58]
Red is a highly visible colour that traditionally symbolises the strength of evil and sin, passion and power. Orange and red are presented with their thousands of shades and hues but people seldom agree on these colours. Wisdom, optimism, and jealousy are often associated with yellow[59].

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SECTION 4

PRACTICAL INVESTIGATION
OF COLOUR

Practical research

Studio investigation

Experiment of water based group

Acrylic ink

Experiment of oil based group

Achromatic colour

Chromatic colour

Semi transparent colour

Creating tactile texture through heat

Over layer colour

SECTION 4

STUDIO AND PRACTICAL INVESTIGATION OF COLOUR

Practical Research

This section discusses the influence of heat on printmaking inks to produce gradations of colour. This was achieved through applying variations of heat over different lengths of time. The investigation of the ability of heat to enhance the pronouncement of relief is discussed in section five.

The focus of the investigation in this section was: printmaking colour often has a hidden potential effects, that can be revealed by the application of heat. In other words, the colour of printmaking inks can be changed to other colours through heat. Investigations focused on acrylic and Pantone printmaking inks to determine the depth of the influence of heat on the inks. The methodologies used for the experiments consisted of directing different intensities and duration of heat on to the print surface of samples. Prior to this research, I used heat in printmaking works to achieve various colour effects. This led me to become increasingly interested in the identification of new effects that can be revealed or changed through heat.

The initial research involved closer examination of the heated samples out of the devised classification (described in Section 3) and, ultimately, using these colours, combined with, in the final work of this research. In the studio investigation suitable substances such as sugar, lemon juice and vinegar were mixed with these inks to facilitate a faster reaction when heated. The investigation also developed a method of mixing colours and agents for the purpose of enhancing the standard colour systems that allowed the production of an extensive list of colour samples and their ingredients.

A: Studio investigation

Project 1

Experiment of water based group

AI: Acrylic ink

The aim of the first project of the studio investigation was to discover what happened to printed acrylic ink when heated. Daler ~ Rowney (System 3*)* ink was selected for this experiment and was undertaken through the silkscreen technique. An enhancer medium was mixed with printing inks to cause a faster reaction. The ingredients of the enhancers depended on the solvent of inks (chemical or water based). For acrylic ink the following mixture was formulated and the main ingredients for every sample of this group were:

Acrylic ink	*Daler ~ Rowney (System3)*	40%
Acrylic printing medium[xiii]	*Daler ~ Rowney (System3)*	40%
Sugar	(soluble in water)	10%
Vinegar and lemon juice	(50% - 50%)	10%

In this investigation fourteen colours of acrylic ink were mixed in a precise combination to set out a gradation of primary colour. This resulted in 65 samples that covered many of the major colours used in printmaking techniques. Ultramarine, Cadmium red deep, Cadmium yellow, Phthalo blue, Cobalt blue, Black, Hookers green, White, Lemon yellow, Burnt umber, Burnt sienna, Mars

black, Cobalt blue, Coeruleum, Emerald and Leaf green, were the main colours of these studies. These colours were divided into seven groups (based on the colour circle of sixteen pigments, (Violet, Blue, Green, Yellow, Orange, Red and Yellow orange) and each group consisted of eight samples. Following this the intensity of change due to heating and the effects of heat on every sample were examined.

Study No. 4.1

The aim of the first study was to assess the effect of the application of heat on the specific mixtures of cadmium red deep, ultramarine, phthalo blue, cobalt blue and black. Each specified mixture of these colours was a sample for examination. All colours were printed by silkscreen on to a non-gloss 220g white paper (14x 9cm). Every printed sample was heated from a distance of 15cm with a gas flame. The heat, which was up to180°c, was aimed at the bottom of every sample for 55 seconds. This caused the colour to change through a gradation of effects from the bottom to the top of each sample. The extent and strength of change which appeared after heating was used as a measure of success in every sample.

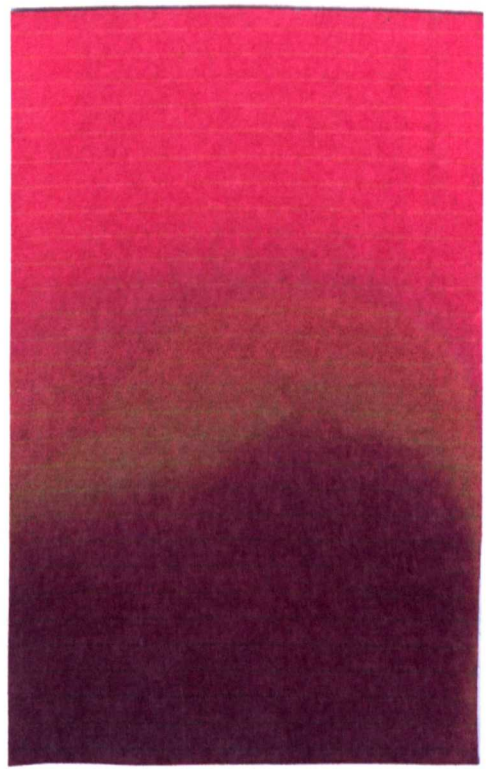


Fig.4.1. The effect of heat on the mixture of cadmium red deep 35% and ultramarine 5%.

The proportion of the mixtures are set out below:

Group I:

I-1: Ultramarine 5% Cadmium red deep (Hue) 35%
I-2: Ultramarine 30% Cadmium red deep (Hue) 10%
I-3: Ultramarine 30% Cadmium red deep (Hue) 5% Phthalo blue 5%
I-4: Ultramarine 35% Phthalo blue 5%
I-5: Ultramarine 25% Phthalo blue10% Cobalt blue 5%
I-6: Ultramarine 5% Phthalo blue 5% Cobalt blue 30%
I-7: Cobalt blue 35% Black 5%
I-8: Cobalt blue 30% Black 10%

Observations

The effect of the heat on this group of colours (*group I)* was in keeping with the expectation of this study. In this series, all colours became darker with the application of heat and then merged to a metallic effect through further heat. Cadmium red, phthalo blue and cobalt blue for instance, became darker and by the application of more heat merged to dark brown. The result of heat on the cadmium red (samples I-1, I-2 and I-3) also made a new effect resembling a metallic spectrum shadow.

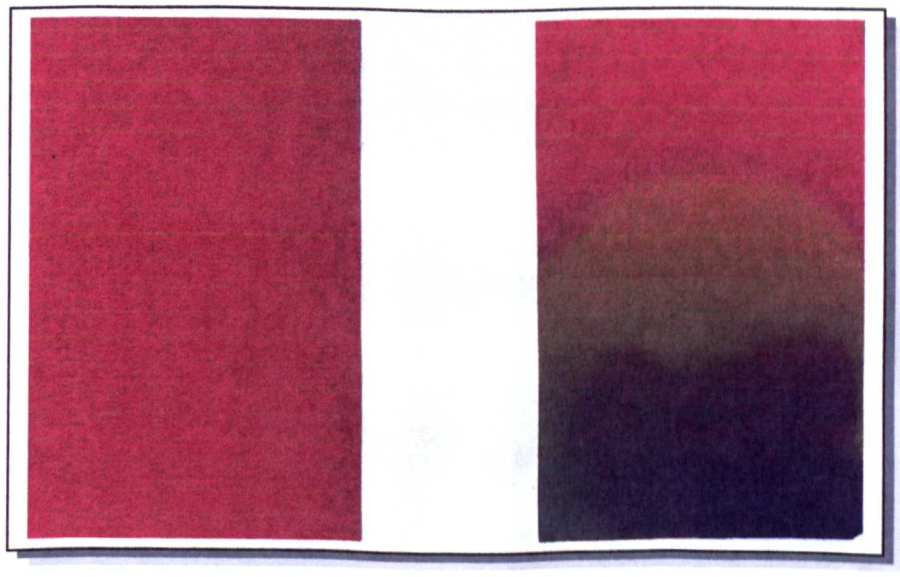


Fig.4.2. Original sample of ultramarine30% and cadmium red 10% compared with heated sample.

Ultramarine also showed a metallic spectrum, stronger than cadmium. The effect of heat on the mixture of ultramarine 35% and phthalo blue 5% was more interesting when cobalt blue 5% was added to this mixture (sample 1-5), in this

case the metallic effect disappeared from sample 1-3. This experiment proved that by using a mixture of ultramarine and cadmium red, a subtle metallic shadow could be achieved. The strength of the shadow was also transformed by the change in direction of the heat. In study No.1, a metallic spectrum appeared in the mixture of ultramarine and cadmium red which was similar to a shade of gold and silver. In print techniques the metallic effects cannot be achieved with ordinary inks (Red, Blue and Yellow).

Study No.4. 2

The aim of the second study was to discover the effect of the application of heat on the specific mixtures of Phthalo blue, hookers green, cadmium yellow and white.

The proportions of the mixtures are set out below:

Group II :

II-1: Phthalo blue 35%	Black	5%	
II-2: Phthalo blue 35%	Hookers green	5%	
II-3: Phthalo blue 20%	Hookers green	20%	
II-4: Phthalo blue 10%	Hookers green	30%	
II-5: Phthalo blue 5%	Hookers green	30%	Cadmium yellow 5%
II-6: Cadmium yellow 10%	Hookers green	30%	
II-7: Cadmium yellow 25%	Hookers green	15%	
II-8: Cadmium yellow 25%	Hookers green	10%	White 5%

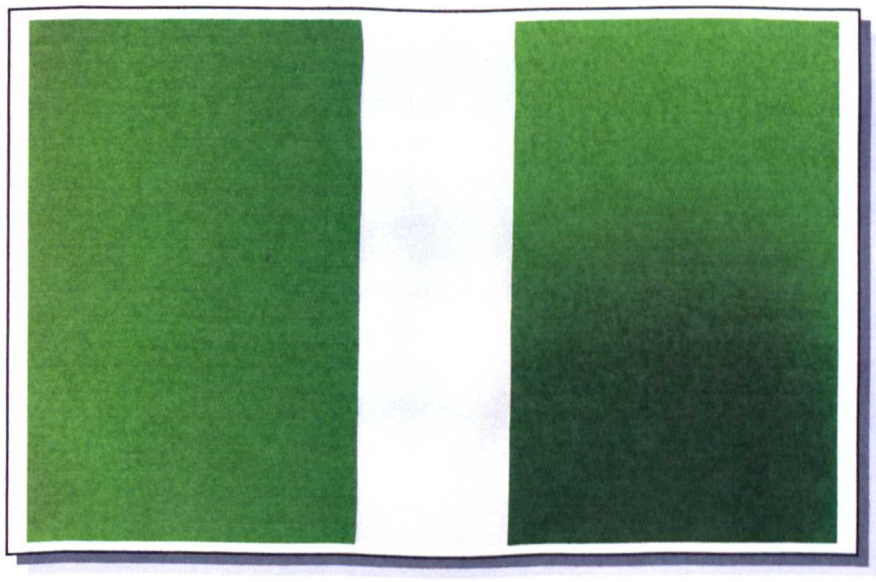


Fig.4.3. Original sample of hookers green 30% and cadmium yellow 10% compared with heated sample.

Observations

In sample II-1, no significant change appeared in the mixture of phthalo blue 35% and black 5% when heated at 180°c over 50 seconds. This colour remained the same and did not change with heat. In sample II-2, when hookers green 5% was added to phthalo blue 35% instead of black the heat made it darker. In sample II-3 and II-4, by reducing the percentage of phthalo blue into 10%, the green burned faster and a yellow effect appeared. In sample II-6, cadmium yellow merged into deep green during the first 30 seconds of heating and then transformed to a yellow brown effect by the application of further heat. In sample II-7, the effect of heat on this colour showed that cadmium yellow changed to a green shadow. In sample II-8, cadmium yellow changed to a forest green colour and its yellow shade merged to deep brown when heat was applied.

Study No. 4.3

In this study I continued to investigate what effect could be created by the specific mixtures of lemon yellow, cadmium, sienna, umber and mars black. The aim was to identify and record the effect of heating on the following samples in group III.

The proportion of the mixtures for group III are set out below;

Group III:

III-1: Lemon yellow	35%	Cadmium yellow	5%	
III-2: Lemon yellow	30%	Cadmium yellow	10%	
III-3: Lemon yellow	35%	Burnt sienna	5%	
III-4: Lemon yellow	5%	Burnt sienna	0%	Burnt umber 5%
III-5: Burnt umber	30%	Burnt sienna	10%	
III-6: Burnt umber	30%	Burnt sienna	5%	
III-7: Burnt umber	30%	Mars black	10%	
III-8: Burnt umber	20%	Mars black	20%	
III-9: Burnt umber	10%	Mars black	30%	

Observations

The change of colours in group III was different from the preceding groups. In sample III-1, lemon yellow merged to a red effect within the first thirty seconds of heating and then changed to brown with further heat. It was also remarkable that in sample III-3, the effect of lemon yellow changed significantly to a deep brown when 5% sienna was added. The effect of umber was also transformed to a deep brown and then changed to black when more heat was applied.

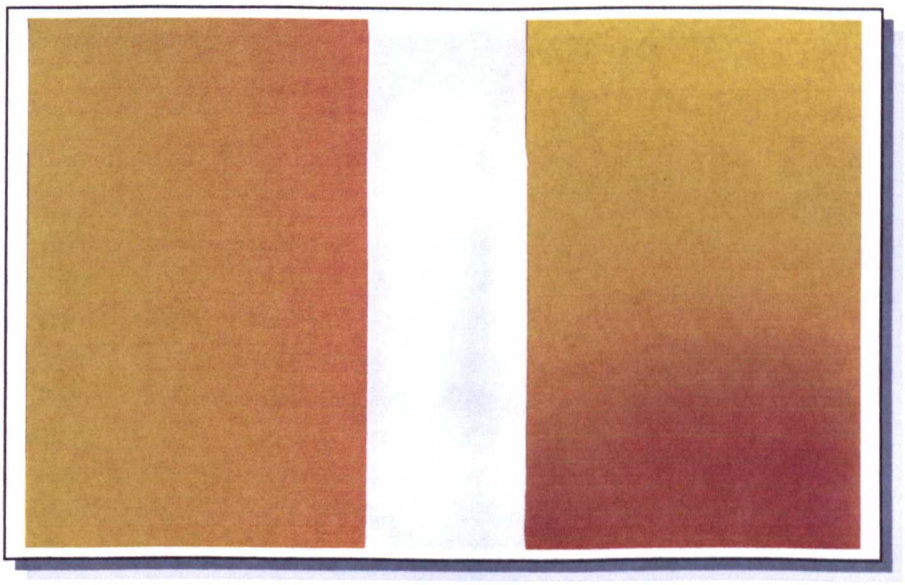


Fig.4.4. Original sample of Lemon yellow 35% and burnt sienna 5% compared with heated sample.

In sample III-8 when an equal percent (20%) of burnt umber and mars black were mixed, the result was deep brown. This colour darkened slightly when heated at 180°c over 50sec. In sample III-9 the percentage of mars black increased by 10% but no change appeared when heat was applied the same as in sample III-8. This examination showed that when the percentage of black in the mixture of colours increased, the effect of heat decreased.

Study No.4. 4

The aim of this study was to identify the effect of the application of heat on the specific mixtures of mars black, hooker green, emerald, leaf green, lemon yellow and white. For the purpose of comparison between group 4 and 5 the first sample continued with mars black at the same percentage as the last sample of the third group but hookers green was mixed with this colour instead of umber in order to identify the potential of black through heating.

The proportion of the mixtures for group IV are set out below:

Group IV:

IV-1:	Mars black	30%	Hookers green	10%
IV-2:	Mars black	20%	Hookers green	20%
IV-3:	Mars black	10%	Hookers green	30%
IV-4:	Mars black	5%	Hookers green	35%
IV-5:	Emerald	30%	Leaf green	10%
IV-6:	Lemon yellow	5%	Leaf green	35%
IV-7:	Lemon yellow	10%	Leaf green	30%
IV-8:	Lemon yellow	30%	Leaf green	10%
IV-9:	Lemon yellow	35%	White	5%

Observations

Although the alteration through heating was not extensive in the first sample, a significant change resulted in the sample IV-4. A green shadow appeared through heat when the percentage of green colours was increased in sample IV-5. In samples IV-6 and IV-7, the subsequent effects mostly tended towards green shadows. Therefore, the effect of heat on 5 out of 9 samples resulted in green shades and only changed to an even darker colour when heat was extended by 60 seconds. Lemon yellow and leaf green in samples IV-8 and IV changed slightly to brown, and progressively darker through heating.

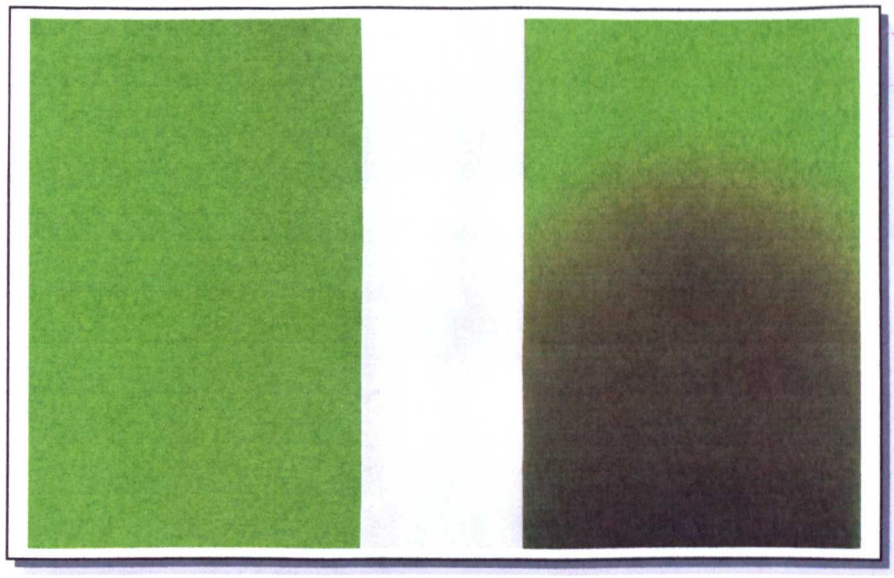


Fig.4.5. Original sample of lemon yellow 5% and leaf green 35% compared with heated sample.

It was interesting that lemon yellow in sample IV-9 merged to brown at the first stage of heat and progressively merged to a brown green shade. It was also noticeable that the colours in this group changed faster through the application of heat compared with the previous groups in this study.

Study No.4.5

The aim of this study was to identify the effect of heat on the following mixtures of Lemon yellow, Cadmium yellow, Burnt sienna and White. The proportion of these mixtures are:

Group V :

V-1:	Lemon yellow 20%	White 20%
V-2:	Lemon yellow 30%	White 10%
V-3:	Lemon yellow 35%	Cadmium yellow 5%
V-4:	Lemon yellow 30%	Cadmium yellow 10%
V-5:	Lemon yellow 5%	Cadmium yellow 35%
V-6:	Cadmium red deep 35%	Cadmium yellow 5%
V-7:	Cadmium red deep 35%	Burnt sienna 5%
V-8:	Cadmium red deep 30%	Burnt sienna 10%

Observations

Although in this group the gradations of the tones moved to the next sample slightly, the effect of heat on each sample was significantly different to the following samples in the same group.

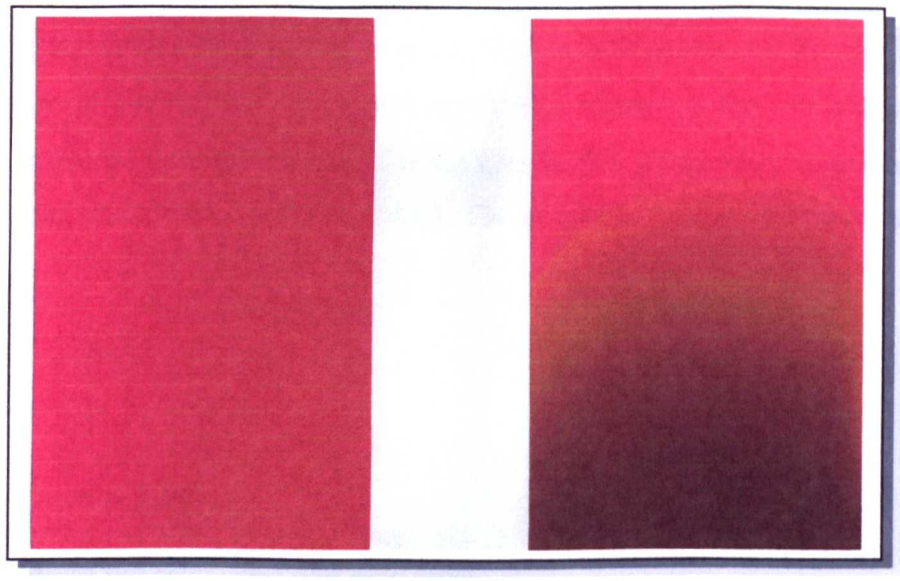


Fig.4.6. The combination of cadmium red and sienna changed very quickly to black deep in the first stage of heating.

In sample V-2, when the percentage of white was reduced by half, the effect of heat was doubled compared to the previous sample V-1. By this examination the researcher realized that white initially could not assist other colours to produce noticeable effect through heat. It means, when white was mixed with other colours, the white reduced the strength of the effect produced through heat. The gradations from these samples (V-1 and V-2) also had a warm hue. The result was in contrast to the effect from lemon and cadmium yellow in samples V-3, V-4 and V-5, which took a cold effect in the same process.

The same result also took place in samples III-1 and III-2 throughout study 3. In these samples lemon yellow merged to a red effect with a warm shade within the first thirty seconds of heating and then changed to a cold brown with further heating. Effects in samples V-7 and V-8 were stronger compared with previous

samples. A significant change appeared in the combination of cadmium red and sienna in the first stage of heating and this colour changed very fast to deep black.

Study No.4.6

In this study three colours were mixed and four samples of various gradients of violet were achieved by a different percentage of cadmium red and Prussian blue. The aim was to identify the extent and strength of change in the colours red and blue that appeared through heating. The colours in this group were cadmium red, Prussian blue, phthalo blue and mars black. The proportions of the mixtures are:

Group VI:

VI-1: Cadmium red 40%
VI-2: Cadmium red 35% Prussian blue 5%
VI-3: Cadmium red 30% Prussian blue 10%
VI-4: Cadmium red 15% Prussian blue 15% Phthalo blue 10%
VI-5: Cadmium red 10% Prussian blue 15% Phthalo blue 15%
VI-6: Cadmium red 5% Phthalo blue 30%
VI-7: Mars black 30% Phthalo blue 10%

Observations

The effect of heat on the devised mixtures of cadmium red and Prussian blue resulted a metallic shadow in 4 out of 5 samples of this series. It was also interesting that in 2 samples of cadmium red (VI-2 and VI-3), the effect of heat produced a golden shade and in the other two samples (VI-4 and VI-5), a silver shade appeared through heating.

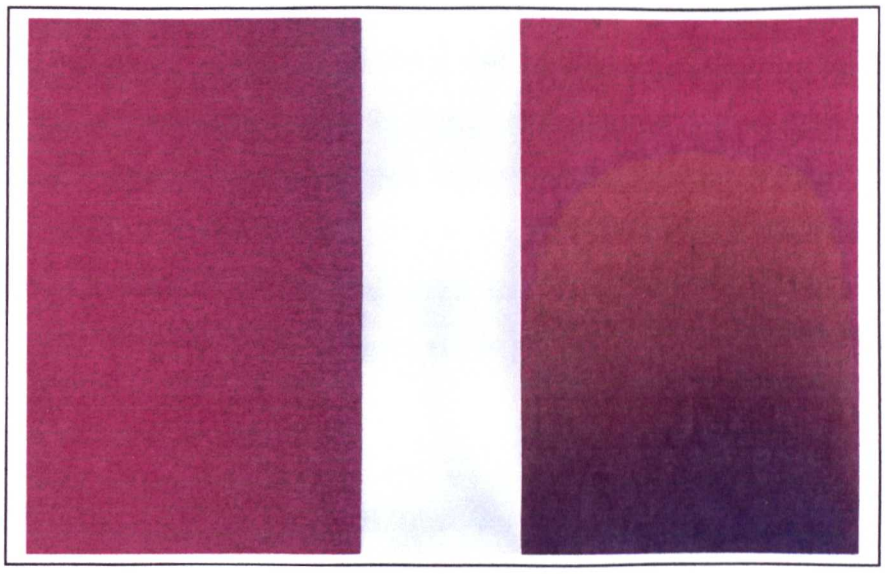


Fig.4.7. A metallic shadow appeared in the combination of cadmium red 30% and Prussian blue 10% through heating.

The result of heat was different in samples VI-4 and VI-5 when Phthalo blue added to the mixture of cadmium red and Prussian blue. In these samples a silver shade appeared and the colour changed to a deep dark red and violet colour. The metallic effect had also appeared in 3 samples of study1. The metallic effect also disappeared when the percentage of cadmium red was reduced to 5% in VI-6.

Study No.4.7

The last study of acrylic inks concentrated on the mixtures of cobalt blue. In this study cobalt blue was mixed with a different percent of coeruleum and white to achieve a gradient of cobalt blue. The aim was to identify and record the effect of the application of heat on these mixtures.

The proportion of the mixtures for group VII are:
Group VII :

VII-1: Mars black 10% Coeruleum 30%
VII-2:Cobalt blue 20% Coeruleum 20%
VII-3:Cobalt blue 20% Coeruleum 10%
VII-4:Cobalt blue 30% Coeruleum 5% White 5%
VII-5:Cobalt blue 35% White 5%
VII-6:Cobalt blue 20% White 20%
VII-7:Cobalt blue 10% White 30%
VII-8:Cobalt blue 5% White 35%

In the last group of acrylic inks, there was not any significant change when heat was applied. In sampleVII-2 when an equal percent of cobalt blue and Coeruleum were mixed, the effect of heat changed this colour to deep dark blue and then merged to black by further heating. From sample VII-5 to VII-8 when white added to cobalt blue a grey effect appeared which was completely obvious in sample VII-8. In samples VII-6 and VII-7 this grey shade gradually darkened through further heat and then changed to black.

The prominent results of this experiments

Through the application of heat, 6 out of 8 samples in this study became deeper and progressively darker through further heat. Ultramarine and cadmium red in samples I-2 - I-4 and VI-2 through to VI-5 had the strongest effect. The most noticeable effects were metallic shadows both golden and silver which appeared in I-2, I-3, VI-3 and VI-4 when these colour samples heated for 55sec at 180°c. In study No.1 and No.4, the metallic shadow which was achieved through heat could not be produced or printed using ordinary inks. In studies III, V and VII, Blue and yellow changed to a green shadow after heating and then merged to a deep brown green with the application of further heat. In study IV, the effect of heat on lemon was very deep and strong. This colour changed to a red shadow in the first stage of heating and then changed to a deep brown shadow through further heating. Green did not display any notable effects because green colours mostly produced a green shadow while both original colour and achieved effect are the same. Therefore, green showed only a deeper effect and merged to brown with further heating.

Greying was the consequence of heating the white colours, changing from grey in the first stage of heating and then merging into brown effect at the end. The effects from every combination with yellow was different in each sample, this colour mostly merged to brown, and progressively became darker through heat and then ultimately merged to black *(Group II, III, IV, V)*.

Project 2

Experiment of oil based group

BA: oil based printmaking inks

The second project sought to discover and obtain the effects of heating oil based colours through experiment (The second group of the chemical colour- category 1B I). The main aims of these experiments were firstly, to develop a method of mixing oil based colours and agents, that allowed for the production of a comprehensive list of ingredients and the percentage of every mixture prepared for heating. Secondly, to carry out surveys on the oil based printmaking inks and to investigate the effects shown by the colours when heated. The studio experiments enabled the codification of the results in terms of the precise mixture of each ink and its characteristics when exposed to varying degrees of heat. Recording results of oil-based colour, which had been printed and heated, were catalogued in seven categories consisting of 1600 colour samples. The samples catalogued were Achromatic- BA scheme (Black & White), Chromatic- CA (Red), CB (Blue), CC (Yellow) and CD (Green), DA Metallic (silver based) scheme and EA Metallic (gold based) scheme. The colours were mixed with combinations of pantone inks to set out a gradation of primary colours. Colour samples in project 2 involved most of the predominant colours that are used in print making techniques. These tables can be used as a colour guide and an indicator in twelve steps. The steps represent the gradation of every colour and are indicated from xx1 to xx12. In these tables every sample represents the codification of the results in terms of the precise mixture of each colour and its characteristic when exposed to varying degrees of heat. The horizontal rows show the proportion of used inks and the verticals represent the precise degree of heat in the eleven stages of every row.

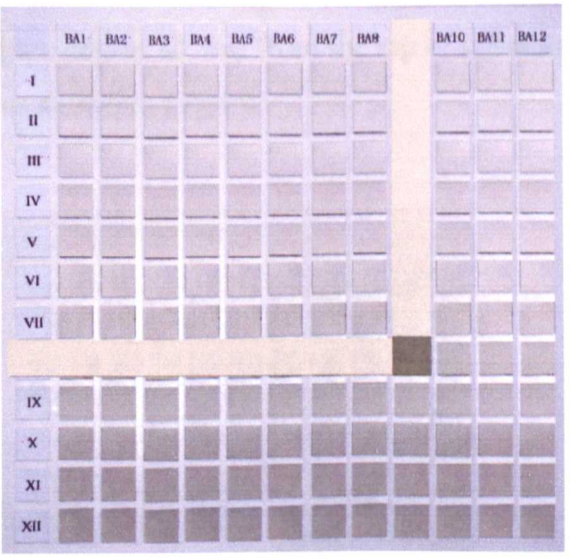


Fig.4.8. The codifications of result represented by every sample.

In order to cover most colours used in printmaking techniques, 72 main tones out of 3 principles (blue, red and yellow) were printed on Fabriano white paper 180grams through mono print technique. When printed samples were prepared for heating, the important operation of employing heat came to the account. The samples which had been cut to squares 4cm x 4cm were heated from a distance of 15cm from a gas flame. The degree of heat and duration of heating was dependant on the anticipated out come. A digital thermometer used to measure the accuracy of heat and a digital timekeeper for duration.

Study No 4.8

The experimentation of Acrylic inks that had been thoroughly investigated in project 1 resulted in new effects of colour through heat. In this study the researcher sought to investigate the effect of the application of heat on the oil based colour. The aim of this investigation was to identify what happened to printed achromatic colours when heated. Twelve steps of gradient were printed from white to black (from left to the right) achieving ten gradients of grey, which merged into the next tone by increasing the percentage of black. The aim was achieved by heating the printed samples in various degrees of heat and duration. To assess the effect of heat on the samples, the original colours of every row were not subject to heat and

are shown on the top of the tables(row I). The remaining eleven samples were heated in a vertical row by increasing the degree of heat from the top of the table to the bottom (samples BA2-BA12), as shown in Fig.4.9.

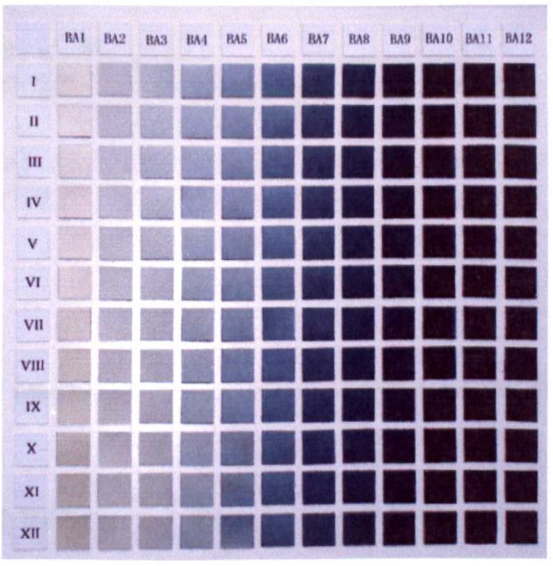


Fig.4.9. Table BA, Achromatic Colours (White and Black).

The gradients of achromatic colours in table BA were achieved by the following mixtures:

BA1	Pantone White (Opaque) LGSO 0612	100%
	Pantone Black LGSO 07082	00%
BA2	Pantone White (Opaque) LGSO 06121	98%
	Pantone Black LGSO 07082	2%
BA3	Pantone White (Opaque) LGSO 06121	96%
	Pantone Black LGSO 07082	4%
BA4	Pantone White (Opaque) LGSO 06121	93%
	Pantone Black LGSO 07082	7%
BA5	Pantone White (Opaque) LGSO 06121	88%
	Pantone Black LGSO 07082	12%
BA6	Pantone White (Opaque) LGSO 06121	75%
	Pantone Black LGSO 07082	25%
BA7	Pantone White (Opaque) LGSO 06121	45%
	Pantone Black LGSO 07082	55%
BA8	Pantone White (Opaque) LGSO 06121	20%
	Pantone Black LGSO 07082	80%

BA9	Pantone White (Opaque) LGSO 06121	10%
	Pantone Black LGSO 07082	90%
BA10	Pantone White (Opaque) LGSO 06121	6%
	Pantone Black LGSO 07082	94%
BA11	Pantone White (Opaque) LGSO 06121	3%
	Pantone Black LGSO 07082	97%
BA12	Pantone White (Opaque) LGSO 06121	00%
	Pantone Black LGSO 07082	100%

In order to achieve the effect of heating on these colours, eleven stages of heat were applied as follows[1]:

I (original sample), II- heated at 70°c for 10", III- heated at 80°c for 15", IV- heated at 80°c for 20", V- heated at 90° for 25", VI- heated at 100°c for 30", VII- heated at 110°c for 35", VIII- heated at 110°c for 40", IX- heated at 120°c for 45", X- heated at 120°c for 50", XI- heated at 130°c for 60" and XII- heated at 130°c for 70".

Observations

Eleven samples with different shades were developed out of an original colour in BA1 row (white 100%) through heating. The white merged slightly to yellow from stage III and then darkened at stage VII when heat was increased at 110°c for 35". With the application of further heat at stage XII, a dark ochre colour appeared which was completely different from the original white. In samples BA3, 4, 5 and 6 the yellowish effect was also reduced when the percentage of white decreased to 75%.

[1] (° C) Celsius was the scale for measuring the degree of heat and (") represents for the duration of heat in seconds.

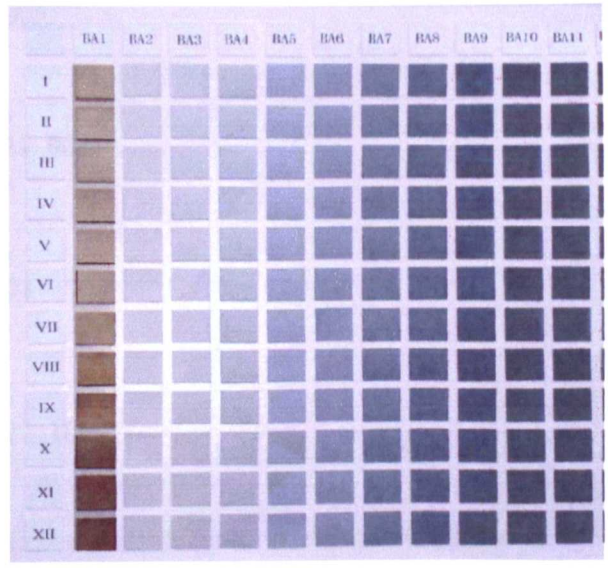


Fig.4.10. The heated row of sample BA1 highlighted to show that white inclined to go to ochre colour when heat was applied at 70°c for 10".

It was also seen that while the percentage of black ink from sample BA7 to BA12 increased by 50%, no remarkable change appeared through the application of heat. In this investigation the researcher realised that black and dark colours demonstrated that their effects remained nearly the same through out the heating process.

Study No 4.9

As the consequence of previous studies, the researcher was particularly keen to investigate the influence of heating on chromatic colours. The aim of this study was to examine the effect of heat on a series of yellow colours where yellow was traversing to green. Twelve gradations were printed from yellow to green (from left to the right) achieving four gradients of yellow, four gradients of bright green and four gradients of dark green. Every colour of the main row (I) merged into the next tone by increasing the percentage of Process Blue.

The gradients of chromatic colours in table CA were achieved with the following mixtures:

CA1
Yellow LGSO 07001 100%
White (Opaque) LGSO 06121 00%
Process Blue B26420 00%

CA2
Yellow LGSO 07001 90%
White (Opaque) LGSO 06121 7%
Process Blue B26420 3%

CA3
Yellow LGSO 07001 85%
White (Opaque) LGSO 06121 10%
Process Blue B26420 5%

CA4
Yellow LGSO 07001 80%
White (Opaque) LGSO 06121 10%
Process Blue B26420 10%

CA5
Yellow LGSO 07001 75%
White (Opaque) LGSO 06121 10%
Process Blue B26420 15%

CA6
Yellow LGSO 07001 70%
White (Opaque) LGSO 06121 10%
Process Blue B26420 20%

CA7
Yellow LGSO 07001 65%
White (Opaque) LGSO 06121 10%
Process Blue B26420 25%

CA8
Yellow LGSO 07001 55%
White (Opaque) LGSO 06121 5%
Process Blue B26420 40%

CA9
Yellow LGSO 07001 40%
Black LGSO 07082 5 %
Process Blue B26420 55%

CA10
Yellow LGSO 07001 30%
Black LGSO 07082 10 %
Process Blue B26420 60%

CA11
Yellow LGSO 07001 20%
Black LGSO 07082 10 %
Process Blue B26420 70%

CA12
Yellow LGSO 07001 10%
Black LGSO 07082 15 %
Process Blue B26420 75%

In order to achieve the effect of heating on these colours eleven stages of heat were applied as follows:

I (original sample), II- heated at 70°c for 10", III- heated at 80°c for 15", IV- heated at 80°c for 20", V- heated at 90° for 25", VI- heated at 100°c for 30", VII- heated at 110°c for 35", VIII- heated at 110°c for 40", IX- heated at 120°c for 45", X- heated at 120°c for 50", XI- heated at 130°c for 60" and XII- heated at 130°c for 70".

Observations

Again the studies demonstrated that pure yellow in step I, sample CA1, became darker when heat was applied at 70°c for 10". It was interesting that the shade was inclined to go to green and brown in sample IV when heat was increased to 80°c for 20".

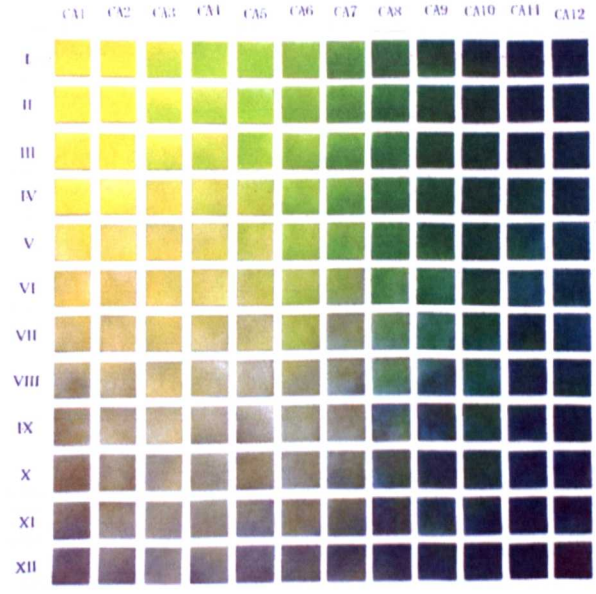


Fig.4.11. Table CA, Chromatic Colours (Yellow and Process Blue).

From sample X a strong glossy brown appeared when further heat was applied to pure yellow (CA1) at 120°c for 50". It was astonishing that the effect of heat on samples CA3 and CA4 were opposite to the pure yellow. CA3 at stage VIII merged to a lighter colour while heated at 110°c for 40". A lighter effect also appeared in the same stages of CA4 and CA5 but the colour of these samples tended to blend to dark brown when heated at 130°c for 70". By increasing the percentage of Process Blue, the fluctuations of CA8 and CA9 were remarkable in

stage X-XII as these colours merged faster to a darker shade compared with achromatic series. An outstanding effect appeared in samples CA11 and CA12 at stages VI and VII when these samples were heated at 110°c for 35"and 40". In this case dark green colours which were close to black were inclined to go to light green at 110°c and by the application of further heat approached black.

Study No 4.10

The aim of this study was to investigate the effect of heat on a series of blue colours when merged from light to darker blue. Twelve steps of gradient were printed from process blue to reflex blue (from left to right). These two colours were chosen, as they are the main blue colours in printmaking inks. The mixture of these two blue inks with white resulted in six gradients of bright blue and six gradients of dark blue (Fig.4.10, Table CB). Every colour of the samples merged into the next tone by increasing the percentage of process blue.

Through the following mixtures a gradient of blue colour were achieved which constructed twelve samples of chromatic colours for table CB:

CB1 Pantone Process Blue B26420 5%
Pantone Yellow LGSO 07001 10 %
Pantone White (Opaque) LGSO 06121 80 %

CB2 Pantone Process Blue B26420 10 %
Pantone Yellow LGSO 07001 5 %
Pantone White (Opaque) LGSO 06121 85 %

CB3 Pantone Process Blue B26420 15 %
Pantone Yellow LGSO 07001 2 %
Pantone White (Opaque) LGSO 06121 83 %

CB4 Pantone Process Blue B26420 25 %
Pantone Yellow LGSO 07001 0 %
Pantone White (Opaque) LGSO 06121 75 %

CB5 Pantone Process Blue B26420 40 %
Pantone Yellow LGSO 07001 0 %
Pantone White (Opaque) LGSO 06121 60 %

CB6 Pantone Process Blue B26420 60 %
Pantone Yellow LGSO 07001 0 %
Pantone White (Opaque) LGSO 06121 40 %

CB7 Pantone Process Blue B26420 80 %
Pantone Yellow LGSO 07001 0 %
Pantone White (Opaque) LGSO 06121 20 %

CB8 Pantone Process Blue B26420 100%
Pantone Yellow LGSO 07001 0 %
Pantone White (Opaque) LGSO 06121 0 %

CB9 Pantone Process Blue B26420 90 %
Pantone Yellow LGSO 07001 0 %
Pantone Reflex Blue LGSO 07051 10 %

CB10 Pantone Process Blue B26420 80 %
Pantone Yellow LGSO 07001 0 %
Pantone Reflex Blue LGSO 07051 20 %

CB11 Pantone Process Blue B26420 70 %
Pantone Yellow LGSO 07001 0 %
Pantone Reflex Blue LGSO 07051 30 %

CB12 Pantone Process Blue B26420 60 %
Pantone Yellow LGSO 07001 0 %
Pantone Reflex Blue LGSO 07051 40 %

The gradation of colours in table CB were heated in eleven stages as follows: I (original sample), II- heated at 70°c for 10", III- heated at 80°c for 15", IV- heated at 80°c for 20", V- heated at 90° for 25", VI- heated at 100°c for 30", VII- heated at 110°c for 35", VIII- heated at 110°c for 40", IX- heated at 120°c for 45", X- heated at 120°c for 50", XI- heated at 130°c for 60" and XII- heated at 130°c for 70".

In order to expand the experimentation of green colour and to make a connection with the colours of the previous study, 10% yellow was added to the mixture of the first sample of this table (CB1) and then the percentage of this colour decreased by 5% and 2% in the samples CB2 and CB3. Process blue was also integrated as a main colour in CA series and its appearance was investigated in Study No 9.

Observations

In previous studies such as the CA table, the gradient of yellow colours and consequently the tones resulting from the mixture of yellow were examined through the application of various degrees of heat. In study No 9 the mixture of yellow with gradations of process blue were experimented.

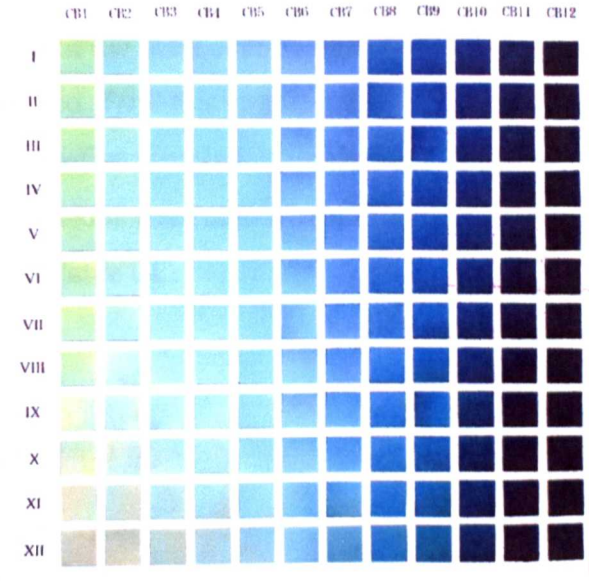


Fig.4.12. Table CB, Chromatic colour (Process Blue and Reflex Blue).

In this study through the repetition of heating yellow, mixed with reflex blue, it was noted that when yellow was mixed with any shade of blue, the resulting colour merged to ochre or brown with slight heating and then went to dark brown when heat was increased to 130°c for 60".

In sample CB4 when the percentage of yellow was reduced to 0%, Process blue became lighter in the first stage of heating and then merged to a darker shade with the application of further heat. However, sample CB4 in stages X-XII changed to a shade of ochre which slightly merged to light green when heated at 120°c for 50". A slight shade of ochre also appeared in the last stage of heating in samples CB6, CB7 and CB8. In sample CB9, by adding 10% reflex blue, the result was a colour similar to cobalt blue with a warm effect which only darkened in stages VIII and IX and then took a cold effect with the application of further heat in stages XI and XII. In samples CB11 and CB12, no remarkable effect appeared through heating when the percentages of reflex blue was increased to 40 % and process blue was decreased by 60%. These samples only darkened in stages VIII - XII.

Study No 4.11

In this study the researcher continued to mix blue colours from the previous study with red colours. The aim was to investigate the effects shown by the mixture of reflex blue, Rubin red and their characteristics when exposed to varying degrees of heat. It was planned to investigate the effect of pure red in another study therefore; the mixture began with the combination of the most common red from printmaking inks, Rubin red and warm red. With this strategy, the most mixture of blue and red possible were achieved in twelve samples. With the following mixtures gradients of purple and violet colour were achieved which constructed twelve samples of chromatic colours for table CC:

CC1 Pantone Reflex Blue LGSO 07051 0 %
Pantone Rubin Red LGSO 07021 30 %
Pantone Warm Red LGSO 07011 70 %

CC2 Pantone Reflex Blue LGSO 07051 0 %
Pantone Rubin Red LGSO 07021 60 %
Pantone Warm Red LGSO 07011 40 %

CC3 Pantone Reflex Blue LGSO 07051 0 %
Pantone Rubin Red LGSO 07021 85 %
Pantone Warm Red LGSO 07011 15 %

CC4 Pantone Reflex Blue LGSO 07051 5 %
Pantone Rubin Red LGSO 07021 90 %
Pantone Warm Red LGSO 07011 5 %

CC5 Pantone Reflex Blue LGSO 07051 10 %
Pantone Rubin Red LGSO 07021 85 %
Pantone White(Opaque) LGSO 06121 5 %

CC6 Pantone Reflex Blue LGSO 07051 20 %
Pantone Rubin Red LGSO 07021 70 %
Pantone White(Opaque) LGSO 06121 10 %

CC7 Pantone Reflex Blue LGSO 07051 30 %
Pantone Rubin Red LGSO 07021 55 %
Pantone White(Opaque) LGSO 06121 15 %

CC8 Pantone Reflex Blue LGSO 07051 5 %
Pantone Rubin Red LGSO 07021 40 %
Pantone White(Opaque) LGSO 06121 15 %

CC9 Pantone Reflex Blue LGSO 07051 60 %
Pantone Rubin Red LGSO 07021 25 %
Pantone White(Opaque) LGSO 06121 15 %

CC10 Pantone Reflex Blue LGSO 07051 75 %
Pantone Rubin Red LGSO 07021 15 %
Pantone White(Opaque) LGSO 06121 10 %

CC11 Pantone Reflex Blue LGSO 07051 90 %
Pantone Rubin Red LGSO 07021 10 %
Pantone White(Opaque) LGSO 06121 0 %

CC12 Pantone Reflex Blue LGSO 07051 95 %
Pantone Rubin Red LGSO 07021 85 %
Pantone White(Opaque) LGSO 06121 0 %

In order to achieve the effect of heating on these colours eleven stages of heat were applied as follows:
I (original sample), II- heated at 70°c for 10", III- heated at 80°c for 15", IV- heated at 80°c for 20", V- heated at 90° for 25", VI- heated at 100°c for 30", VII- heated at 110°c for 35", VIII- heated at 110°c for 40", IX- heated at 120°c for 45", X- heated at 120°c for 50", XI- heated at 130°c for 60" and XII- heated at 130°c for 70".

Observations

Samples CC1-CC3, which were mixtures of rubin red and warm red, became a darker warm shade at stage III when heated at 80°c for 15" and then tended to go towards black at stages IX-XII. In sample CC4, when 5% reflex blue was added to this mixture, the result was a tone of purple (in the original sample) but no significant changes appeared through heating as with previous samples.

Starting from sample CC5 by increasing the percentage of reflex blue, white was added to this mixture to be able to control the tone but still no change appeared compared with previous samples when heat was applied.

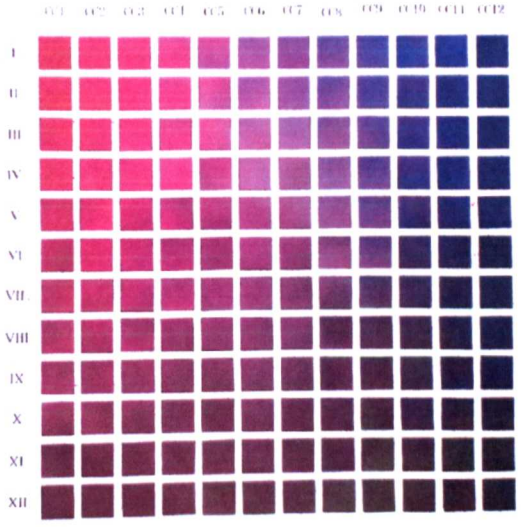


Fig.4.13. Table CC, Chromatic colours (Rubin Red and Reflex blue).

In this series of colour the most significant change appeared in sample CC10 while heated at 120°c for 50" and 60". A shade between violet and purplish-blue appeared in stages IX-X and then merged to black when heated at 130°c for 70".

Study No 4.12

In this study the gradations of red that were continued from study No 11 were combined with the gradations of yellow colours in order to cover the most mixtures possible from this combination in twelve samples. The result of this combination were gradations of orange from a light tone to a stronger tone towards red. The main intention of this study was to investigate the appearance of orange when exposed to varying degrees of heat. Through the following mixtures gradients of yellow, orange and strong red were achieved which constructed twelve samples of chromatic colours for table CD:

CD1 Pantone Yellow LGSO 07001 100 %
Pantone White(Opaque) LGSO 06121 0 %
Pantone Warm Red LGSO 07011 0 %

CD2 Pantone Yellow LGSO 07001 90 %
Pantone White(Opaque) LGSO 06121 5 %
Pantone Warm Red LGSO 07011 5 %

CD3 Pantone Yellow LGSO 07001 80 %
Pantone White(Opaque) LGSO 06121 5 %
Pantone Warm Red LGSO 07011 15 %

CD4 Pantone Yellow LGSO 07001 75 %
Pantone White(Opaque) LGSO 06121 0 %
Pantone Warm Red LGSO 07011 25 %

CD5 Pantone Yellow LGSO 07001 70 %
Pantone White(Opaque) LGSO 06121 0 %
Pantone Warm Red LGSO 07011 30 %

CD6 Pantone Yellow LGSO 07001 60 %
Pantone White(Opaque) LGSO 06121 0 %
Pantone Warm Red LGSO 07011 40 %

CD7 Pantone Yellow LGSO 07001 45 %
Pantone White(Opaque) LGSO 06121 0 %
Pantone Warm Red LGSO 07011 55 %

CD8 Pantone Yellow LGSO 07001 30 %
Pantone White(Opaque) LGSO 06121 0 %
Pantone Warm Red LGSO 07011 70 %

CD9 Pantone Yellow LGSO 07001 10 %
Pantone White(Opaque) LGSO 06121 0 %
Pantone Warm Red LGSO 07011 90 %

CD10 Pantone Yellow LGSO 07001 0 %
Pantone Black LGSO 07082 5 %
Pantone Warm Red LGSO 07011 95 %

CD11 Pantone Yellow LGSO 07001 0 %
Pantone Black LGSO 07082 10 %
Pantone Warm Red LGSO 07011 90 %

CD12 Pantone Yellow LGSO 07001 0 %
Pantone Black LGSO 07082 15 %
Pantone Warm Red LGSO 07011 85 %

Samples from these combinations were heated in eleven stages as follows:

I (original sample), II- heated at 70°c for 10", III- heated at 80°c for 15",

IV- heated at 80°c for 20", V- heated at 90° for 25", VI- heated at 100°c for 30", VII- heated at 110°c for 35", VIII- heated at 110°c for 40", IX- heated at 120°c for 45", X- heated at 120°c for 50", XI- heated at 130°c for 60" and XII- heated at 130°c for 70".

Observations

The investigation of this study began with pure yellow. The effect of heat on yellow was already investigated in Study No 9 (CA Table). In CA samples, yellow was mixed with blue to produce gradients of green while in this study by mixing yellow with warm red the intention was gradients of orange. In sample CA1, Yellow 90% was mixed with warm red 5% and when the printed sample was exposed to heat the result was a greenish ochre effect. By the application of further heat the ochre effect merged to brown in stage IX and then when heated at 130°c for 70" a dark brown effect appeared in stage XII. From CD1 the percentage of warm red began to increase, while at the same time, the percentage of yellow decreased in every sample.

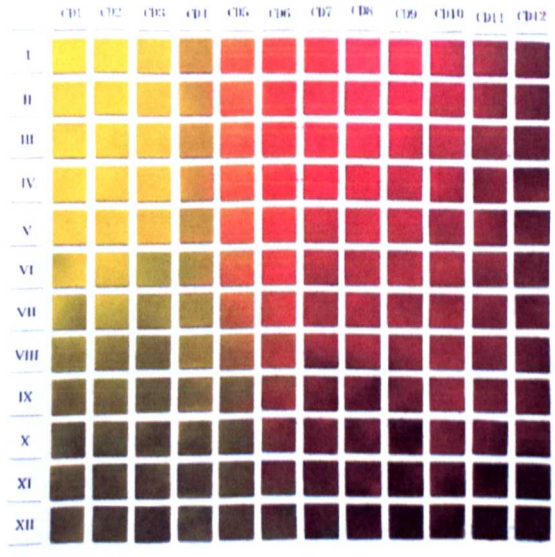


Fig.4.14. Table CD, Chromatic colours (Yellow and Warm Red).

However, in sample CA6 when the percentage of yellow decreased to 60%, the green and ochre shade, which appeared through heat, merged to a warm brown shade.

Starting from sample CD8, the percentage of warm red was in excess of 70% resulting in a strong brown red shade when this colour was heated at 90° for 25". Through further heating in stage XI and XII, these samples (CD8-CD11) merged to a strong dark red. In the last sample (CD12) when the percentage of warm red rose to 85%, no remarkable effect appeared through heating. However, in this sample the original colour and the colour of the samples which were heated was nearly the same.

Study No 4.13

As printmaking inks are semi transparent, over layer colours are very common in printmaking techniques. The researcher sought to clarify the changes of over layer colours when heated and designed a table to show the gradations of original primaries compared with heated colours. The intention was to print a table to show the gradations of primary inks when combined and presented on top of each other to make an easy guide. In order to print a series of tints out of primary colours, seven gradients of each primary colour were printed in the same table. The gradients of primary colours were printed on the other displayed tones to illustrate new colours. Colours in this scheme were selected from Process Pantone inks and were printed by monoprint technique on to 220grs white paper (90x 90cm).

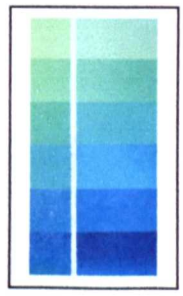


Fig.4.15. The colours of over layer inks out of Pantones primaries.

Observations

The result of the heat on the gradient of these colours was displayed in a comparative format that showed the original samples before and after heating and the variation of hue through saturation. All colours merged to a darker tone and the gradations of blue that became darker displayed a shade of green when heated. Yellow inclined towards brown and the gradation of red changed to a deep red colour. Black only took on a stronger shade and the greys merged toward brown. When the gradation of blue mixed with Yellows, a gradient of green appeared. The effect of heat on greens was a greenish brown shade. The blue also mixed with reds and blacks. When mixed with reds the result was a series of purples which when heated changed to violet. The gradation of black also mixed with yellows, blues and reds which made only darker colours.

In over layer experiment, a gradient of Red mixed with blue resulted a series of purple which changed to Violet when heated.

Generally, however, the appearance of these colours, which were printed layer by layer on the top of each other, did not change as much as expected. Although they were mutable by various degrees of heat, the inks were prevented from being heated properly due to the thickness of the achieved colour when the layers were joined together. The colour of some samples were printed with more than four layers of inks. Artists and printmakers may find these tints and colours useful as a key guidance. The researcher also tried to build a criterion that helps printers who are interested in the problems of over layers.

Project 3

Creating tactile texture through heat

Study No 4.14

Part of the studio investigation was involved in mixing printmaking inks with other substances to assist the colour to burn faster. During one of these explorations, the researcher realized that, the surface of the printed mixture was moving through heat, similar to boiling. By the application of heat, the medium that was printed on top of the sample moved together and made tactile spots or relief texture. As the results were notable, a series of examinations were organised. Five samples from every colour of oil-based schemes (experienced in studies 8 – 12) were selected, and then the devised medium printed on top of them. Various ingredients, percentage and mixture of materials were examined to reach the best result of textures. The ingredients of the final medium were:

Corn starch	5%
Sugar	30%
Vinegar (white)	10%
Water	55%

In order to avoid change in the original colour (colour of basis), a heat gun was used for heating. The examination also proved that a good result was achievable using a higher degree of heat for a shorter time compared with previous studies. In this series the temperature and duration was applied as follows:

The first sample showing the original substance on the top of the colour samples with a slight heat.
The second sample heated at 150°c for 5secs.
The third sample heated at 180°c for 8secs.
The fourth sample heated at 200°c for 10secs.
The fifth sample heated at 260°c for 14secs

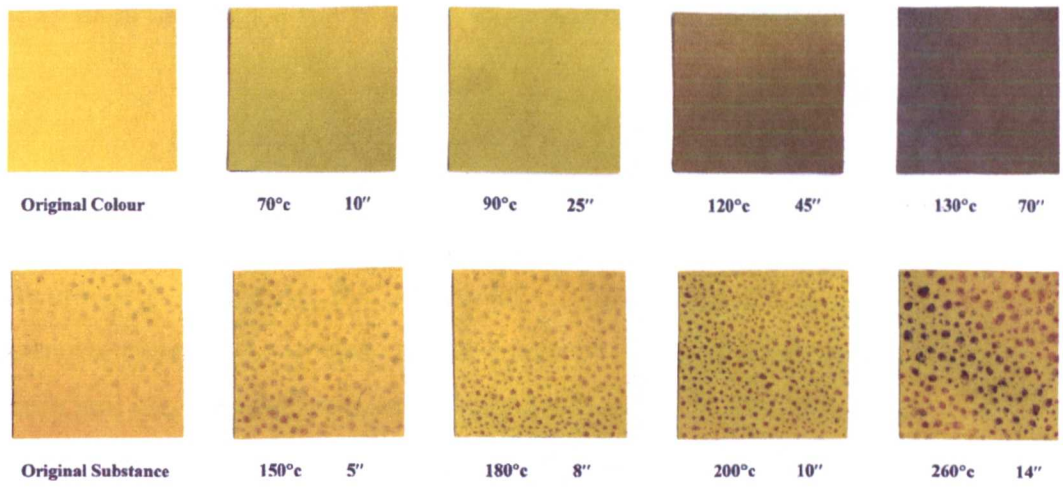


Fig 4. 16 Original and heated colour samples compared with heated substances.

Every set of heated samples presented in a landscape A4 size paper in two horizontal rows. The first row indicated the variations of heat on the original samples and the second row represented duration and degree of heat on the substance to produce tactile texture. All series were catalogued in appendix II.

Observations

The heat gun was able to blow the heat on the surface of the samples. In this case, the colour of the bases remained the same while the substances were much more sensitive to heat and burned faster. The substances in the original sample were gathered together and made spots when heated.

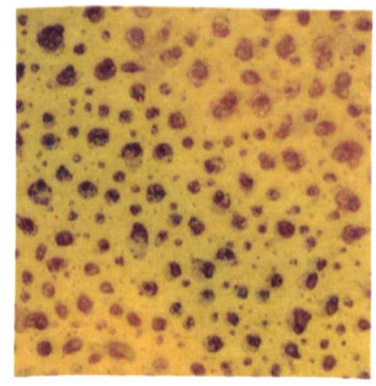


Fig4. 17 Detail of the heated spots in CA4.

In the second sample part of the spots were burned slightly and made various brown dots or textures when heated at 150°c for 5secs. In the third and fourth samples the colour of spots became stronger merged to brown, still the colour of some spots remained unchanged. The spots in the fifth sample changed to deep

brown and then merged to black when heated at 260°c for 14secs. The colour of the spots in the other samples were also similar when heated at the same degree.

Study No 4.15

The aim of this study was to demonstrate the ability of heat to create more extensive textures. As in study No 14, prepared medium(mixture of sugar, corn starch and vinegar) were printed on to a 60x50cm paper. Light blue colour was selected for the ground of the medium as this colour would present an excellent contrast with the medium when heated. The ink, which had been printed by monoprint technique, was dry and ready for further printing. When printing the substances over the light blue colour, a heat gun was used to heat the substances.

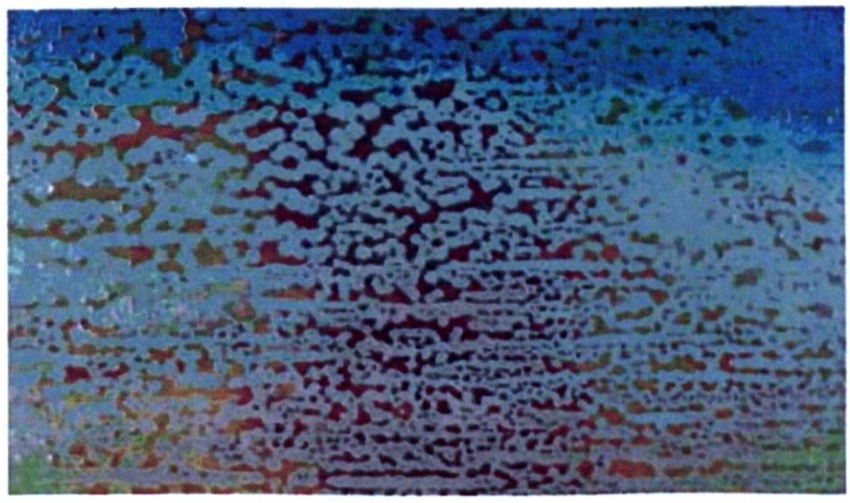


Fig 4. 18 Creating tactile texture through heating.

Observations

The layer of substance, which was transparent and flat, began to make spots when heated. during the first stage of heat different textures appeared which took on an ochre colour and then merged to brown. By the application of further heat the texture merged toward black.

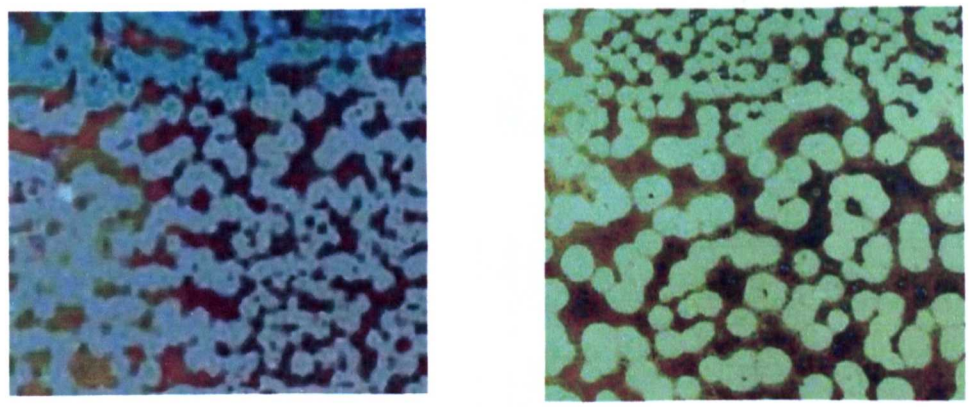


Fig.4.19. Detail of the tactile textures examined in study No 15

Study No 4.16

The intention was to create shade and colour on a printed-paper by an electric wall heater. The study also aimed to investigate whether the effect of flame on colours (As investigated in study No 8-12) was the same as the effect created by an electrical heater or not. In order to achieve a reasonable scale, a 50x60 cm paper was printed by mono print technique. The colour was an Orange from oil based printmaking inks.

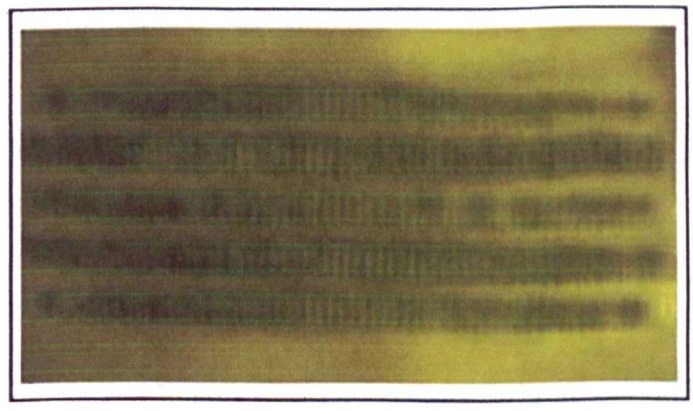


Fig.4.20. The paper was heated by an electric heater to create a series of horizontal lines.

The paper was put on the top of a heater for 30secs when the heat was at 140°c. As shown in figs.4.20 and 4.21 the result was a series of horizontal brown lines.

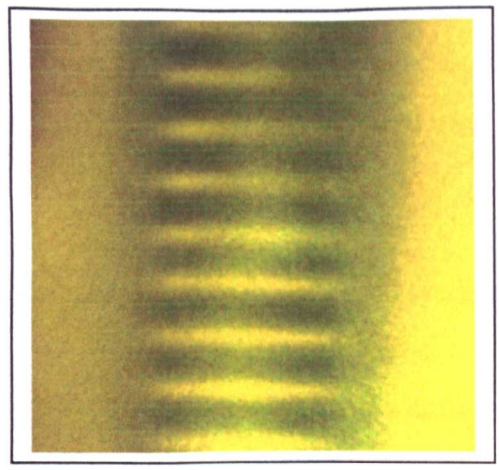


Fig.4.21. Detail of the horizontal lines burned by an electrical appliance(heater).

Conclusion to section 4

This section involved the influence of heat on printmaking inks and produced various gradations of colour through heating. This was achieved through applying variations of heat over different lengths of time. Through this investigation it was tried to reveal the hidden of colour by application of heat. The investigation also developed a method of mixing colours and agents for the purpose of enhancing the standard colour systems that allowed the production of an extensive list of colour samples and their ingredients. The most prominent result of heating colour were:

- Through the application of heat, 6 out of 8 samples in this study became deeper and progressively darker through further heat.
- Ultramarine and cadmium red in samples I-2 - I-4 and VI-2 through to VI-5 had the strongest effect. The most noticeable effects were metallic shadows both golden and silver which appeared in I-2, I-3, VI-3 and VI-4 when these colour samples heated for 55sec at 180°c. In study No.1 and No.4, the metallic shadow which was achieved through heat could not be produced or printed using ordinary inks.
- In studies III, V and VII, Blue and yellow changed to a green shadow after heating and then merged to a deep brown green with the application of further heat.

• In study IV, the effect of heat on lemon was very deep and strong. This colour changed to a red shadow in the first stage of heating and then changed to a deep brown shadow through further heating.

• Green did not display any notable effects because green colours mostly produced a green shadow while both original colour and achieved effect are the same. Therefore, green showed only a deeper effect and merged to brown with further heating.

• Greying was the consequence of heating the white colours, changing from grey in the first stage of heating and then merging into brown effect at the end.

• The effects from every combination with yellow was different in each sample, this colour mostly merged to brown, and progressively became darker through heat and then ultimately merged to black *(Group II, III, IV, V)*.

SECTION 5
STUDIO AND PRACTICAL INVESTIGATION OF RELIEF

As discussed in the introduction, relief pattern and concave or raised elements on paper has interested contemporary artists. In spite of the wide presence of relief works in all areas of Art, no comprehensive study has been undertaken into the potential of papers and their ability to support very high relief. To date the highest printed relief on paper seems to be no more than five millimetres[48]. This research therefore, set out to explore how relief printing involving paper could be developed.

The investigation of materials is often believed an important part of the process of making a piece of art. Close involvement with paper and production of high relief form through the development of appropriate techniques lead the researcher to the manipulation of the paper's fibre. This was achieved through pressing the paper into moulds or formers, through while major issue arose.

In these experiments heat was the main factor in releasing the strength of the paper's fibre. " Fibres commonly remain in balance where the average condition is 65% relative humidity and 24°c temperature"[49]. Through the application of heat in excess of 55°c, paper fibres release and become softer and the structure of the paper allows a greater depth of relief under pressure, whilst still allowing the paper to remain smooth and crinkle free.

Grain direction among paper is another factor for determining forming and stretching. The grain of a paper refers to the alignment of the fibres within the sheet. The vast majority of fibres in paper follow the same direction during the process of paper production. When a sheet of paper is dampened for the purpose of embossing , the fibres absorb water and swell and, as a result, the paper is at the weakest when pulled at 90° to the direction of the fibre. When a printing mould is subject to a stripy, ribbed, or wavy design, paper has to be pulled in the opposite direction of the stripe, in this case the paper's grain ought to be located in the opposite direction to the mould. In other words, fibre stretches more easily along the grain direction than across it. Paper made from highly beaten (or hydrated) fibre is usually weaker and less dimensionally stable and also less able to stretch. Paper made from less hydrated fibre tends to be stronger because fewer bonds are formed between fibres, but as they are less dense each fibre has freedom to move under pressure, giving the paper a greater capacity to stretch.

The studies began by examining the pressure of normal presses such as those for etching, binding and lino, in the printmaking studios. In studies No 5.1 and 5.2 the investigation involved pressing paper on the top of the slab without using heat in order to examine the potential of paper under strain. From study 5.4, the examination expanded the depth of stripe patterns by three centimetres, a particular press was needed with a larger tray and bigger mouth. Therefore I designed and

made a press with two hydraulic arms, a twenty centimetres mouth and an overall four-tone pressure on 110cm² tray. By using this press the process of printing high relief patterns became feasible.

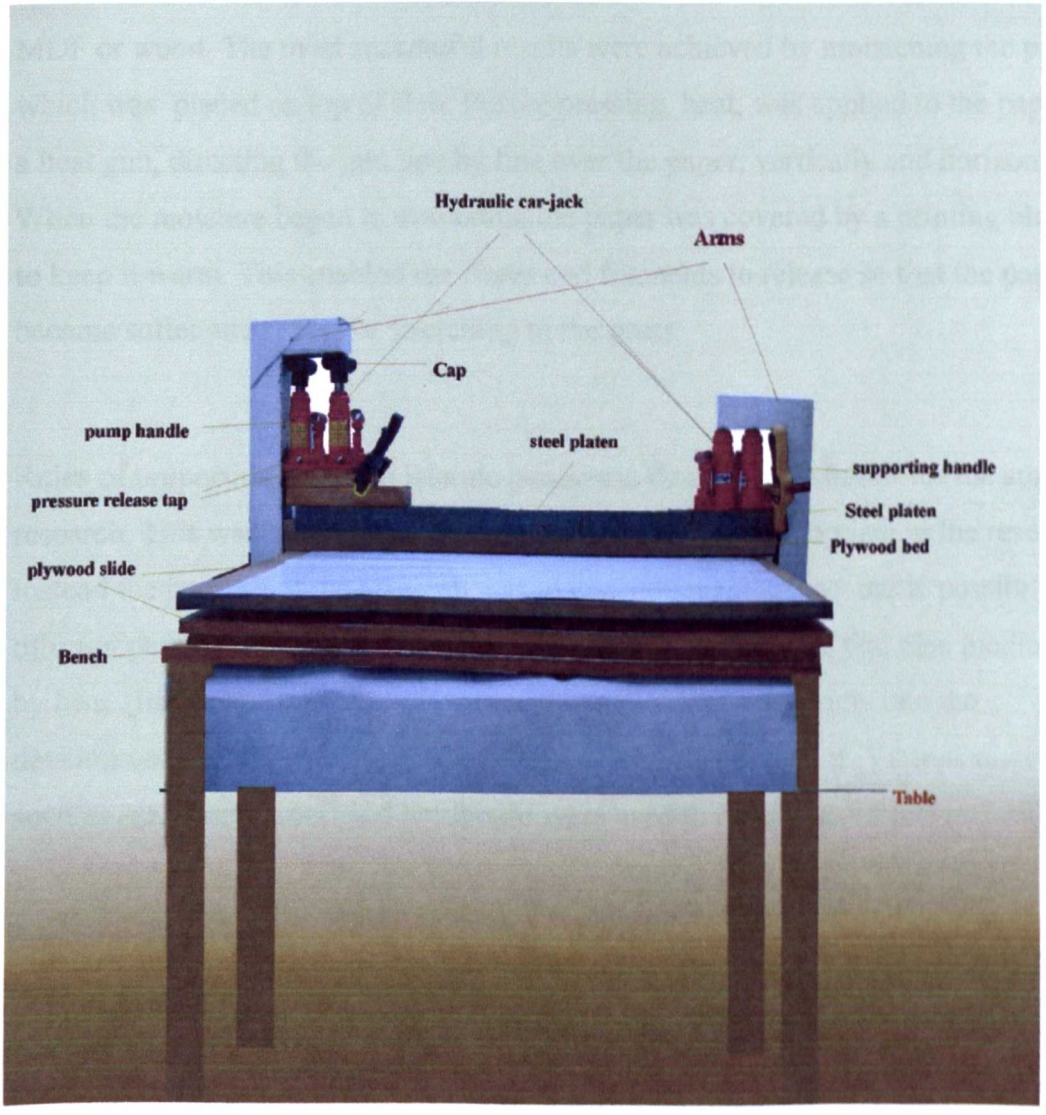


Fig. 5.1. General appearance of the hydraulic press modified for high relief printing.

The press was designed to work with two hydraulic jacks and then in the later stage of improvement, the pressure increased to 6000kg by adding two extra jacks. An extended wooden bed with a MDF slide board gave accurate positioning of the slab.

During the studio research various processes for printing high relief pattern were examined such as emboss print, pulp image and inkless intaglio. The processes of pressing was of central importance, as was the amount of pressure applied. Instead of an actual printing plate the latter became more like a mould consisting of two slabs, one with the positive, the other negative (male and female respectively). The actual relief on theses slabs was usually produced with layers of card, hardboard, MDF or wood. The most successful results were achieved by moistening the paper which was placed on top of slab. Before pressing, heat, was applied to the paper by a heat gun, directing the gun line by line over the paper, vertically and horizontally. When the moisture began to evaporate, the paper was covered by a printing blanket to keep it warm. This enabled the fibres and filaments to release so that the paper became softer and ready for stretching in the press.

Rules of proportion based on Islamic geometric design were chosen for the studio research. This was because no figurative elements were appropriate to the research, instead the purpose of the research was to concentrate on the aesthetic possibilities of relief pattern, in conjunction with fields and bands of colour that also mediated by heat.. Initial studio practice began with a series of experiments into the development of the mould and slab in order to print high relief. Various materials such as cardboard, wood and hardboard were used to make the moulds and different type of paper such as Fabriano 220g, Canson 300g and Cartridge 200g were used for printing.

Study No.5.1.

The first experiment aimed to print a high relief pattern on 200g rough cartridge paper. A question was also raised prior to the experiment in relation to the mould and what part, the higher or the lower, should be concave or convex. Firstly I began the study by producing a negative slab. The slab was made from three layers of industrial grey cardboards each 3 millimetres thickness. (Fig.5.2). A series of repeated parallel strips was made in three layers. The layers of the cardboard were laminated on the top of each other to make a negative slab of nine millimetres depth overall. The paper, which was soaked for 15 minutes in water, and then pressed on the top of the slab by a binding press.

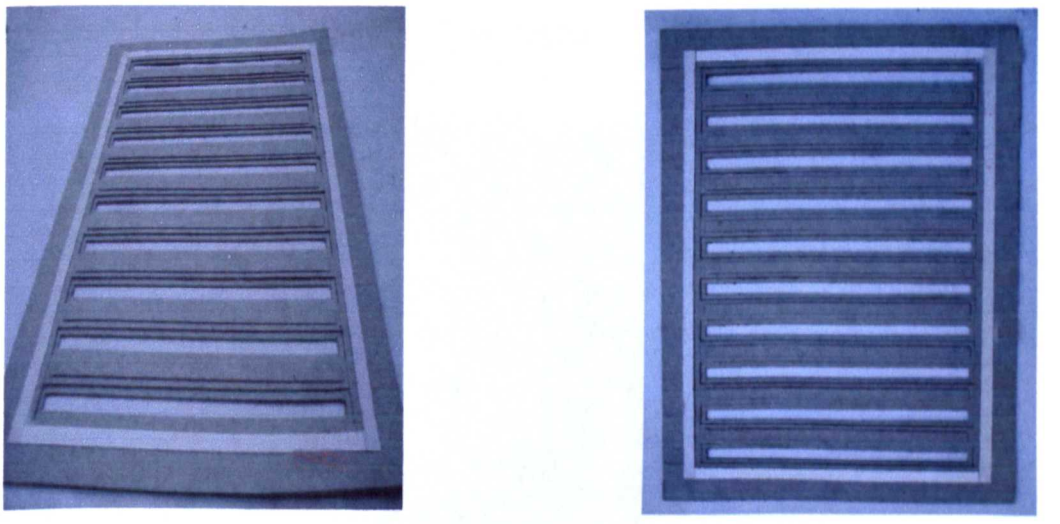


Fig.5.2. Three layers slab made from 3mm grey cardboard
for study No. 5.1.

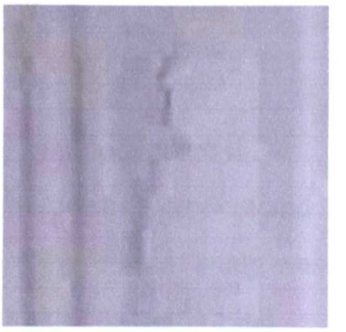


Fig.5.3. Detail of the fractures from a negative slab and Cartridge 200g paper.

Observations

The paper took the form of the slab after pressing, but only two layers were printed (two steps of the height from three steps). Although the paper was damp while printing, the rigidity of the fibres remained. This caused many small fractures in the deepest layer (third layer) and the edges of the stripes were also torn (Fig.5.3). The filaments in the negative space of the stripes were therefore not sufficiently relaxed to be stretched to this extent and finally broke.

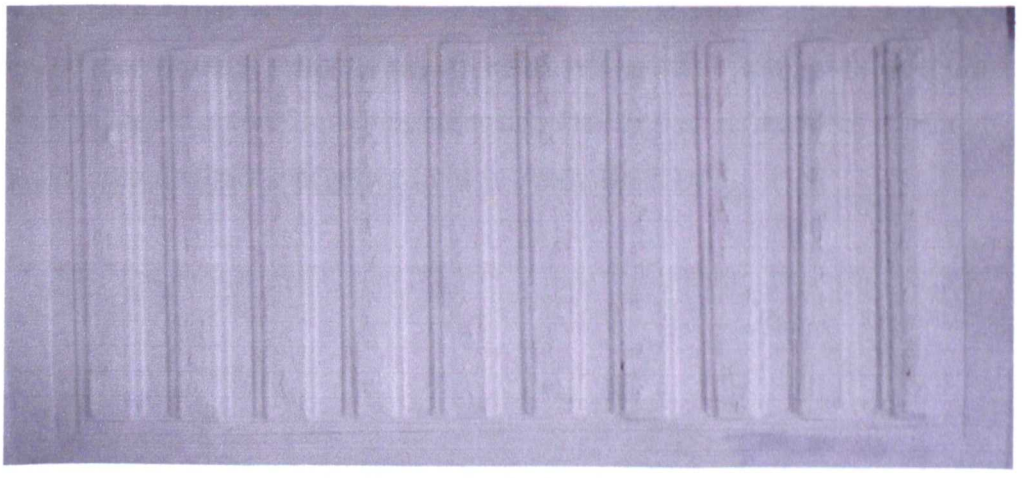


Fig.5.4. Study No 5.1, achieved result from a three layer negative slab. Cartridge 200g, 30cm x 65cm x 9mm

The results of this study did not fulfil the aim. In order to achieve the aim of this study, the height of the slab had to be reduced to be able to achieve a successful high relief or the work must somehow incorporative these torn fractures.

Study No.5.2

As a consequence of the previous study, I was particularly keen to resolve the problems of Study No.5.1 in which the paper tore during the printing process and did not reach to the full extent of the relief. The intention of this current study was therefore to use parallel curved lines instead of lines with angles as used in the previous experiment. In this study curved and rounded forms were used instead of sharp angles, as the pressure build up that caused the paper to fail occurred at these angles. This was done by repeating Study No.5.1, except that the slab was positive as the negative slab did not respond to reach the expected level of print. For this positive slab twenty pieces of wooden half- cylinders were used and glued on a board to make the slab, and the process of pressing as in study 5.1 was repeated.

Observations

Printing from the positive slab in this study proved that a better print could be achieved than printing from the negative slab because the result of print could reach to the level as expected. However, alongside the lines some fractures appeared as had occurred with the negative lines in Study No 5.1.

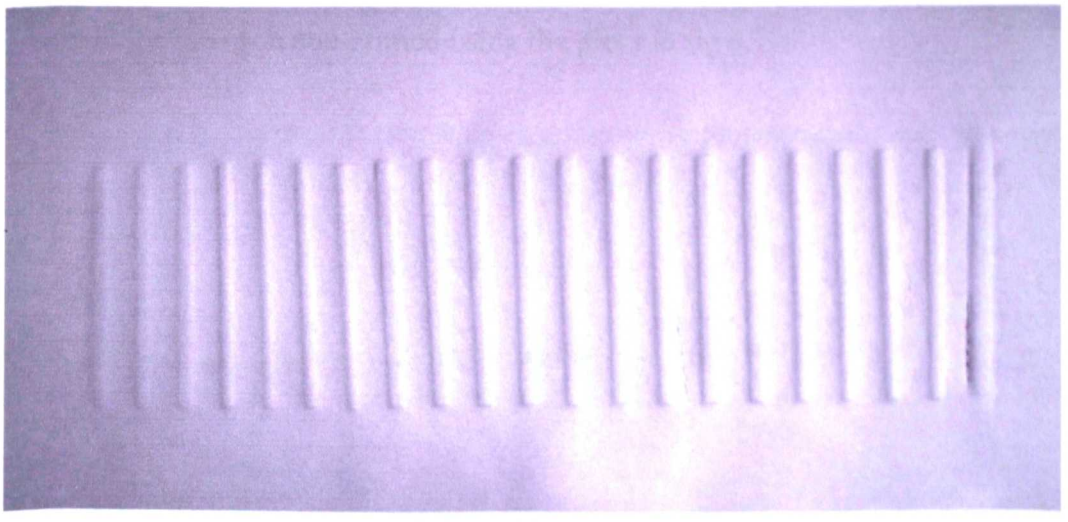


Fig .5.5. The result of a print from a positive slap made up of curved wood, 38 x 85 x 1.2 cm, Cartridge 200g.

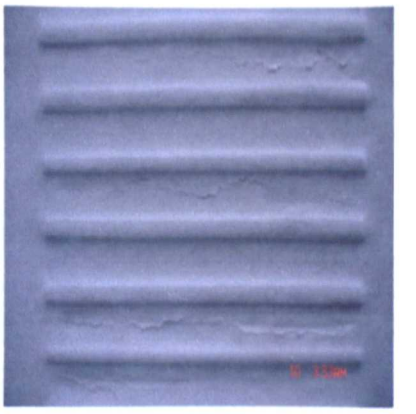


Fig.5.6. Detail of the fracture caused by a positive slab in study No .5.2. Cartridge paper 200g.

In the next stage of the study, the intention was to resolve the problem of fractures. Therefore, the experiments were repeated using different types of paper such as rough Fabriano and Canson, but results remained similar to the previous examples. In this situation a method had to be devised to relax the papers fibres. The next study, therefore, aimed to use the effect of heat on papers fibres.

Study No.5.3

It was suggested in the previous study that heating could affect the relaxation of the paper filaments. The aim of this study was to explore the ability of heat to release the strength of the fibres. A wooden slab, two centimetres in depth with curved edges was made which therefore increased the depth of the print. A 200g sheet of cartridge paper(45cm x 72cm) which had been soaked in water for five minutes, was heated by a heat gun and printed using the press in fig 5.1.

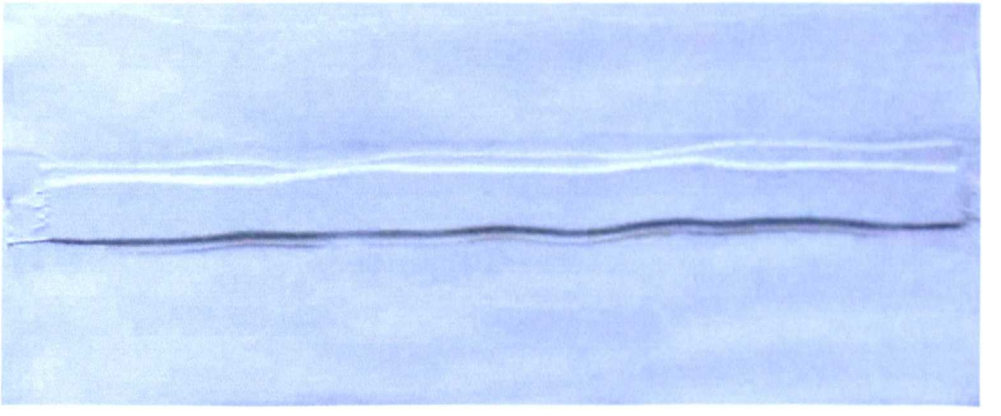


Fig.5.7.The paper stretched two centimetres when heated. Cartridge 200g, 45cm x 72cm x 2cm.

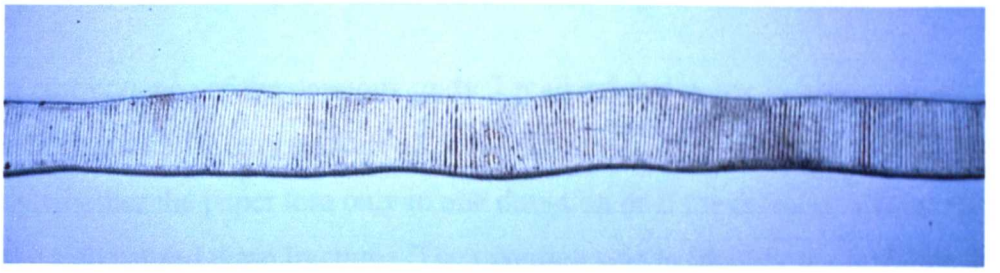


Fig.5.8. Detail of the positive slab with 2 cm height in study No .5.3.

Observations

The aim was achieved by heating the paper, using a heat gun while pressing on the slab. In this experiment consideration was given to the height of the slab and when the paper was stretched by approximately two centimetres, it took the form of the slab perfectly. However, there was still some minor tearing on both sides. Consequently, several further slabs were made using curved woods that pasted both horizontally and vertically on the hardboard to make positive slabs. The result of the printing from these slabs shown in fig 5.9. and fig 5.10 which still some fractures appeared on the edges.

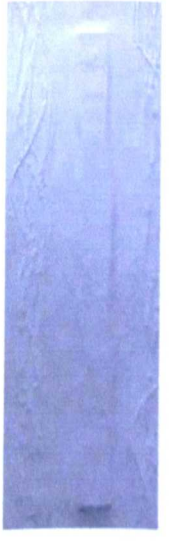


Fig.5.9.
Cartridge paper
200g,
72 x 25 x 2 cm

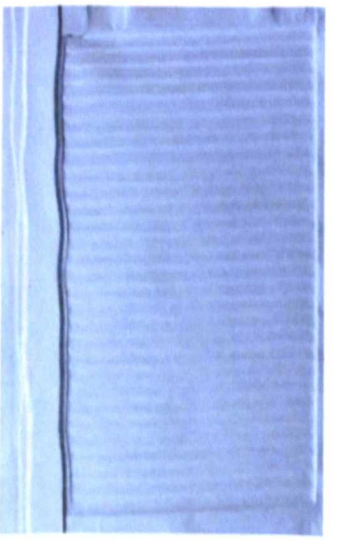


Fig.5.10.
Cartridge,
paper 200g,
72 x 45 x 2 cm

Study No. 5.4

As a consequence of the previous study, I realized that paper mostly stretched in one direction and tore in another direction when put under pressure. I began to study whether the paper tore only in one direction or if the direction of the elements on the slab caused these fractures. The intention was to identify the difference between one direction of the paper and the other, when the paper is placed on top of the slab. The examination involved making a round slab in order to be able to find the difference between the directions of the paper when pressed on the slab. For the mould, a positive round wood, flat-topped slab of 55cm diameter, height of 3 cm

and with a wavy positive line of 1 cm thickness was made. In order to measure and understand the paper's ability to stretch while printing, a series of wavy positive lines were added around the round shape. For printing, a piece of rough cartridge 200g paper (95 cm x 95 cm) soaked in water for 10 minutes and then when the moisture began to evaporate, heated by a heat gun vertically and horizontally. The paper was also covered by a printing blanket to keep it warm during printing process. This enabled the fibres to release so that the paper became softer and ready for stretching in the press. After the heating process, the paper was pressed on the slab with the press in fig 5.1.

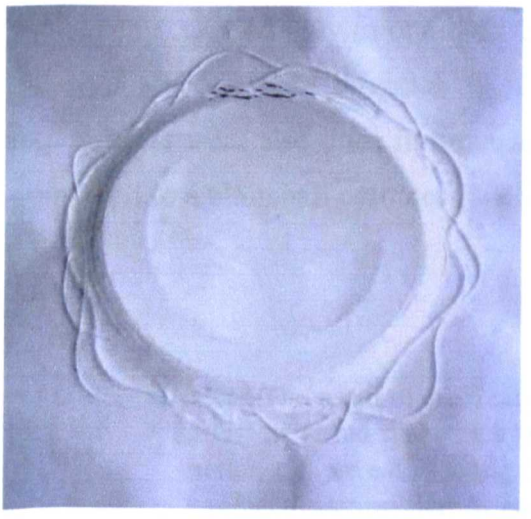


Fig.5.11. The appearance of the Horizontal fractures in the first study. Rough cartridge paper, 95 cm x 95 cm.

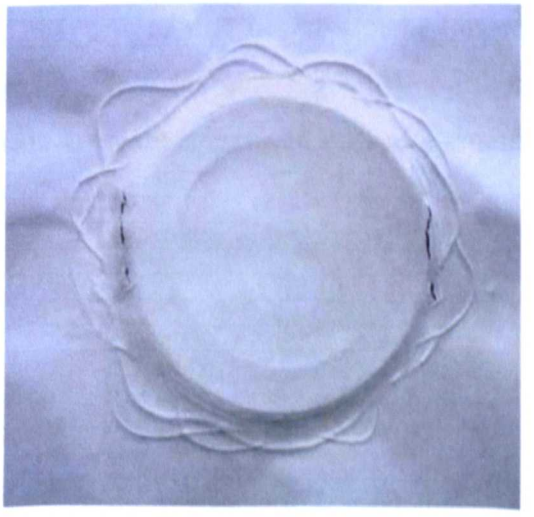


Fig.5.12. The appearance of the vertical fractures when the paper rotated by 90°. Rough cartridge paper, 95 cm x 95 cm.

Observation

Although the depth of the print succeeded in reaching the aims of the study, some fractures appeared on both sides of the round element (Fig.5.11.). However, these fractures occurred in one direction while in the other direction, the paper stretched satisfactorily and took the form of the slab. In this case another question was raised, whether these fractures appear in the same location if the paper is rotated in another direction. In the next stage, the paper was therefore rotated by 90° and placed in another direction so that the paper's fibre ran in the opposite direction. The result was predictable, fractures appeared in the opposite.

Fig.5.13. Diagram of the grain direction. Fractures appeared alongside the direction of the fibres.

This experiment proved that it was difficult to prevent fractures running in the same direction as the fibres. It also appeared that when the paper was dampened, the paper expanded only in one direction. It also proved that fibres stretched more easily along the grain direction than across it (Fig.5.11. and Fig.5.14). Further experiments were also done in order to experiment with a textured curved element compared to a plain half cylinder (Fig 5.16.).

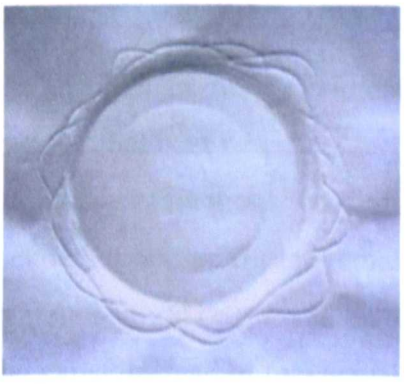


Fig.5.14.The result of the final print from the round slab which fibres stretched more easily along their direction than across it.

Study No.5.5

Following the appearance of the fractures in Study No.5.4, I began to look at how I might introduce a slash, cut or fracture into a print work, involving relief as well as three dimensions. Prior to this I was interested in the work of Alberto Butter and Lucio Fontana who created sculptural forms on a flat canvas or paper and produced work with fractures and holes (Sec 2). However, neither of these artists worked with printmaking techniques. Therefore, the previous experiment (Study No.5.4) raised the question how a print could be developed with tears, cuts and fractures. Consequently, several experiments were made using negative and positive slabs to produce slashes and fractures on the cartridge paper. The first experiment of this series aimed to use a positive mould in order to print high relief burlaps and bulges in combination with fractures which appear on the top of each bulge.

Fig.5.15. Detail of the fracture on the top of a burlap.

The bulge shape was chosen as a small scale version for the next studies and represented a basis for further experiment. For the slab, a few convex wooden oval shapes similar to egg-shapes were made in different heights between 2 and 5 centimetres. The height of the highest burlap in this experiment was 5 centimetres. As a consequence, the highest relief shape could be 2 centimetres higher than the elements in the previous study. For printing, a piece of 220g rough cartridge paper was pressed on the top of the mould and heated with a heat gun. In this experiment heat was used again as in study No.5.3 when it was proved that heat was an essential factor for high relief print. The slab was serving as a male mould (positive and convex) while a piece of polystyrene of 5 cm thickness was used for the female slab(As polystyrene is soft and forms easily under pressure, could be pressed on the top of a convex form as a negative slab to fill hols and gaps). Instead of two actual

printing slab the latter became more like a mould, one with the positive, the other negative (male and female respectively).

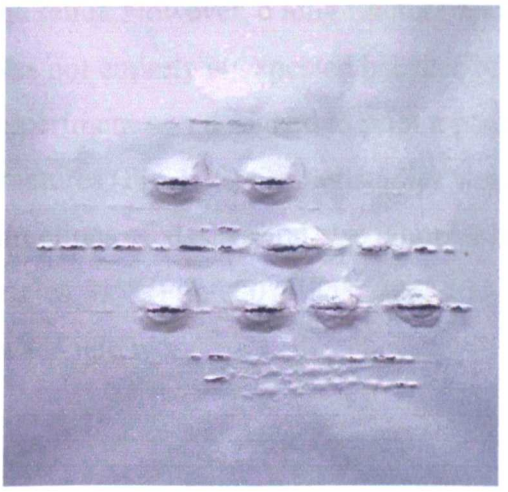


Fig.5.16. Horizontal Burlap
Cartridge paper, 200g, 70 cm x 70 cm.

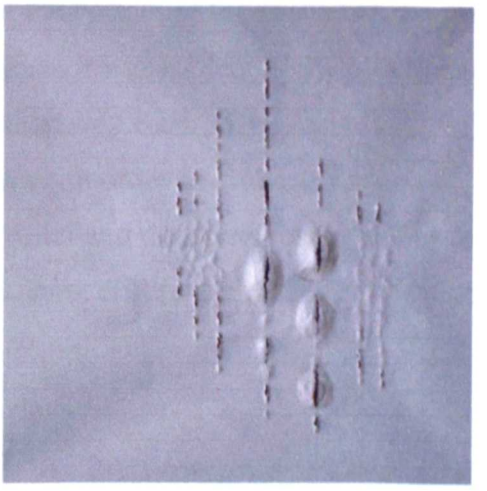


Fig.5.17. Vertical Burlap
Cartridge paper, 200g, 70 cm x 70 cm.

As the fractures appeared on the top of the relief in the first experiment, it was decided that this shape could be elongated and appear concave as well as convex. Therefore, the second experiment was designed as the aim was to assess the use of fractures on a piece of paper by slashing, puncturing and extending the dimension of the slash particularly the length of the relief element. For the negative slab, a piece of wooden board was formed to a concave curved shape to a depth of 6 centimetres; this was the female. A piece of 5cm thick polystyrene was used for the male mould. Instead of two actual printing slab, polystyrene worked more like a positive slab, wooden for the negative, polystyrene as filler under pressure.

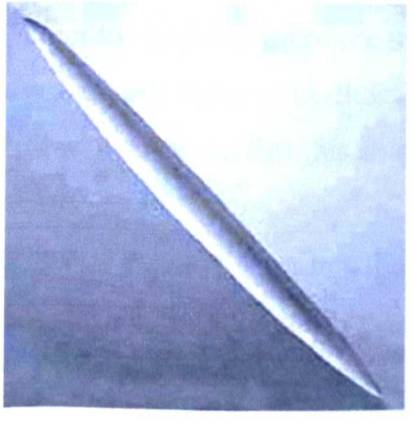


Fig.5.18. Negative Slash,
Canson paper, 300g, 60cm x 60cm.

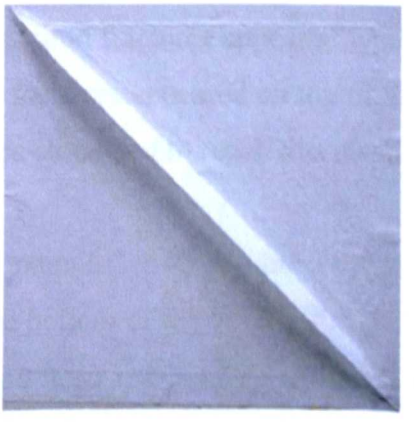


Fig.5.19. Positive Slash,
Canson paper, 300g, 60cm x 60cm.

In this experiment the same process of printing with heat was repeated as in Study No.5.4. The stronger Canson 300g paper was an appropriate choice. As before, the paper was heated prior to pressing. The result was that as the paper formed and took the relief. However, a long fracture appeared at the bottom of the printed shape that was not entirely unexpected because of the stresses it was subject to. A subsequent experiment was designed to print a positive and convex slash shape without fractures (Fig.5.19) Further studies were also done in order to evaluate various directions of slashes and also combinations of relief and punctured paper at varying angles, 45° (Fig.5.20), 135°, 225° and 315°, to show different direction of the slash in a single work.

Observation

These experiments were evaluated in terms of the development of the fractures on paper produced by pressure in order to explore how a fracture, tear or slash could be created as a motif. However, in the first experiment it was realised that paper ripped easily on the top of the convex element and created the desired fractures when the mould was under pressure. These fractures were consistent with the relief shape because they gave definition to its direction (Fig.5.15) and therefore suggested a basis for further experiments. In the first experiment of this study the direction of the fractures appeared alongside the direction of the grain within the paper. When the paper was placed on top of the mould while the direction of grain within the paper was opposite the mould's direction, the pressure caused many fractures that ran counter to the direction of the relief. The desired fractures appeared when the paper was placed in the right direction. As the fractures appeared on top of the relief shape, it was proposed that this shape should be elongated to reach to a slash shape.

In the second experiment, when the relief was extended in length and a negative and concave slash printed, fractures appeared in the bottom of the base of the slash suggesting a combination of depressed form and fracture (Fig.5.18). The concavity of the slash in this experiment was more than 5 centimetres deep. This depth prevented the fracture becoming obvious and while it was very narrow, the ripped

section could hardly be seen in the bottom of the elongated form. The punctured concaved form produced by the mould had similarities with Fontana's slash.

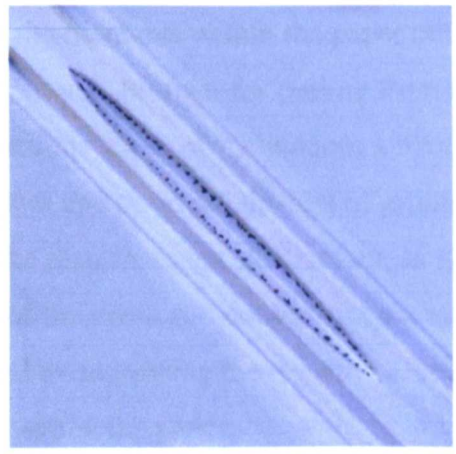


Fig. 5.20. Study for combination of punctured paper and relief.

Study No.5.6

Following the achievement of a higher and deeper relief in the previous study which had highlighted a negative and positive elongated form of 6 centimetres depth, I again returned to the practices of Study No 5.4. I wanted to find a solution to the problem of the paper tearing when printing textured and curved elements in study 5.4 and also to gain a more substantial understanding for the direction of paper against that of the slab. For printing a textured and curved element, I produced a slab with 2 pieces of half cylinder (curved shape) elements that were covered with some relief textures. The type of texture was similar to that used in study 5.4. The aim of using relief textures on the top of the curved elements was to measure the ability of the paper to stretch. To do this, two curved elements were used instead of one in this slab.

Fig.5.21. The use of textured half round wood as a round slab. 110 cm x 50 cm.

In order to identify the direction of the filaments within the paper, three simple methods were used; involving, ripping, pulling or dampening the paper. When a paper was dampened on one side it tended to curve or roll and made a tube shape. The experiment showed that the direction of the filaments within the paper ran along the length of the tube therefore, the paper was stronger for pulling from this direction. For this study, a piece of rough cartridge paper of 220g(45cm x 95cm) was used. It was floated on water for 10minutes and the same process of printing as in study 5.4 was repeated. In the first print, the result was not satisfactory, as the details of the slab, despite the high pressure of the press, did not transfer accurately. In the second print, this problem was resolved by increasing the duration of heating compared with the previous experiments of heating the paper.

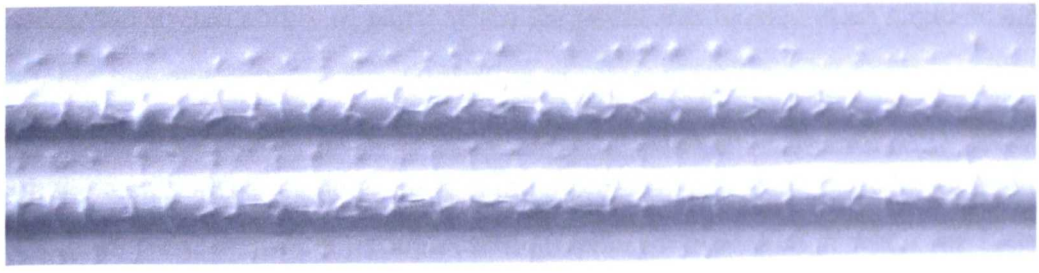


Fig.5.22. A well defined detail printed by textured half cylinder element.
Rough cartridge 220g, 105 cm x 45 cm

Observation

Having examined the direction of the fibres against the slab in study No 5.4, and now realizing in which direction paper could be placed on top of a slab to resolve the problem of tearing. The only problem still remaining was that the shape of the slab and particularly the relief textures had not been transferred perfectly. By repeating the printing process it was realised that after heating the paper with a heat gun, the stickiness of the cellulose and filaments were reduced and the paper became softer and suitable for printing. By extending the duration of heating until the paper become warm enough, the paper took the shape of the edges and textures.

Therefore, the achievements of this study were finally convincing and further experiments were also done with textured curved elements in addition to the plain half round.

Study No.5.7

The previous study drew attention to the fact that when a printing slab is subject to a stripy or wavy design, paper has to be pulled in the opposite direction to the stripe. In this case the direction of the paper's fibre ought also to be located in the opposite direction to the main direction of the relief. The aim of this study was to identify the stretch ability of paper when the paper was located at an angle designed slab. For this experiment a slab consisting of two-textured curved elements and two plain half cylinders was made at an angle of 40° in order to examine and compare with the result of the previous study using more elements and at a different angle. For printing, a piece of 220g rough cartridge paper was soaked in water for 10 minutes (the process was repeated as in study no 5.4) and after the heating process, the paper was placed on the slab and pressed (press fig 5.1).

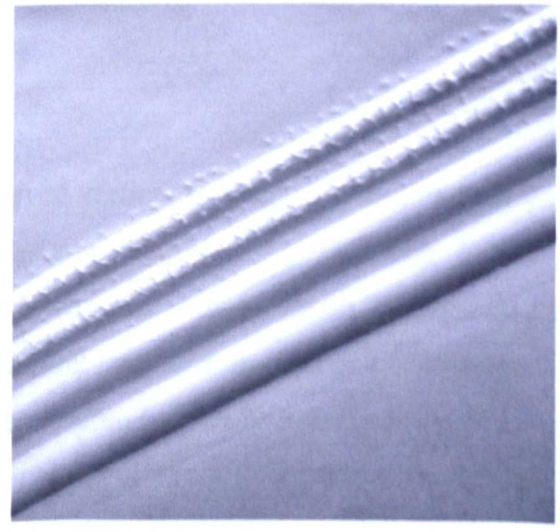


Fig.5.23. Study for the stretch ability of cartridge paper in a position of 40°. Cartridge 220g, 85cm x 85cm.

Observation

The study was evaluated in terms of the development of the element studied in the previous experiment (5.6) in a slanted composition. It was found that although an individual or double element was studied separately, by repeating and placing these elements in a slanted composition, the paper did not lose its ability to stretch and respond to the form of the relief as expected. It was also proved that a print could be achieved providing that the direction of fibres within the paper were placed at between 90 – 40 degrees to the direction of the relief.

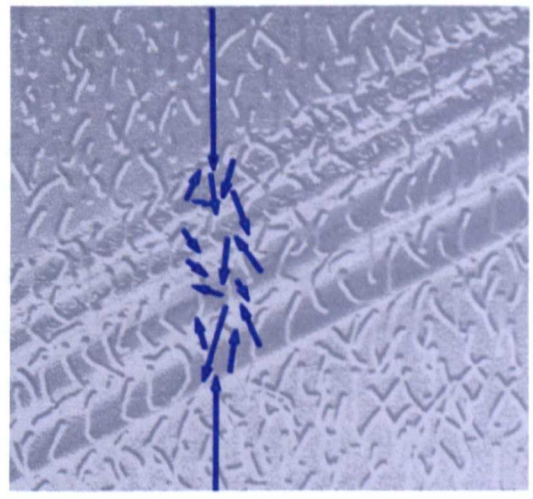


Fig.5.24. Diagram of stretch ability of Cartridge paper and the location of fibres against the direction of slab's design.

Study No.5.8

I decided to further explore the use of curved vertical elements in relief and carry out a series of studies based on Islamic design principles and proportions. In this I was also influenced by the work of artists such as Barnet Newman, Roger Ackling and David Nash who use sequences of parallel lines that are similar to those used in Islamic design. (Some of these works were highlighted in Section 2) The aim of this study was to construct and design a series of parallel relief lines of 5 centimetres height derived from curved half cylinder elements, which had been used in the previous studies. By repeating this element based on the rational system of growth (the ratio of 1: 2), the mould was made with hardboard of 120 x 90 centimetres and

5 cm depth. The ratio of elements and the distance between them was based on the relationship between the repeated line as a positive element and the negative space between. The mould was designed for reverse print, therefore the width of each element in every row was 3 centimetres and the gap between them was 6 centimetres.

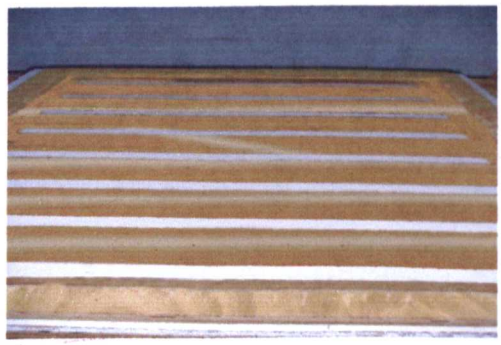


Fig.5.18. Horizontal and vertical slabs based on the ratio of 1:2.
6cm depth hardboard 120 cm x 90cm.

The width of the negative space was double the width of each positive element or in other words; the width of a positive element was half the negative space. The printing process began with soaking Fabriano paper 220g in water for 10 minutes and then the paper was heated repeatedly with the heat gun. This type of paper contains longer fibres and responded well under pressure during the trial. For this mould, a female mould was also needed and a piece of polystyrene with a thickness of 5 centimetres was used. The printing process was the same as in study 5.3 . Developing the work further led to a variety of compositions with the ratio of 1:2, in both vertical and horizontal directions (plate 7 & 9).

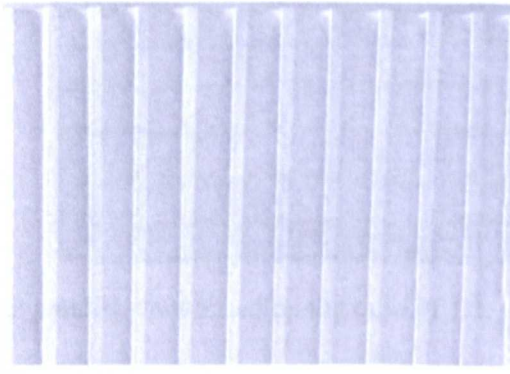


Fig.5.19. A harmonic proportion was designed based on the ratio of 1: 2.
Fabriano paper 220g,
90cm x 120cm.

Observation

The study was evaluated in terms of the development of a repeated positive element based on the proportion of harmonic ratio (1:2). A series of curved elements were printed on a piece of paper 90 x 120 centimetre to a height of 5 centimetres, as was intended. However, by printing these elements I realised that it was possible to stretch and pull the paper and create a firm crinkle free and rigid work without tearing. The result of this achievement also proved that the printed paper was stable because the relief elements had been set out in an equal row. Further study were also experimented in horizontal row (Fig.5.20.).

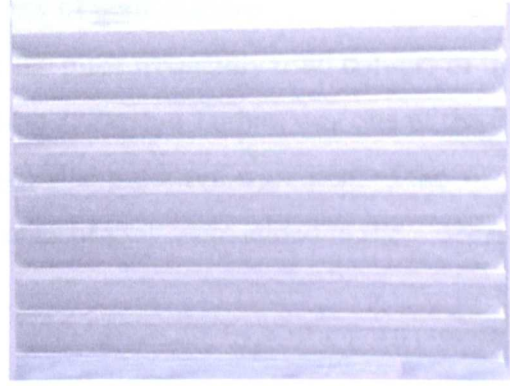


Fig.5.20. Parallel horizontal row based on the rational system of growth (1: 2). Fabriano paper 220g, 90cm x 120cm.

As the study progressed, other ratios and designs were explored using horizontal and vertical rows. Those that used the sequence 1:1 were the most successful, because the simple logic of these lines enabled the aesthetic qualities of the relief, its contrasts of light and shade and the texture of the paper, to become prominent.

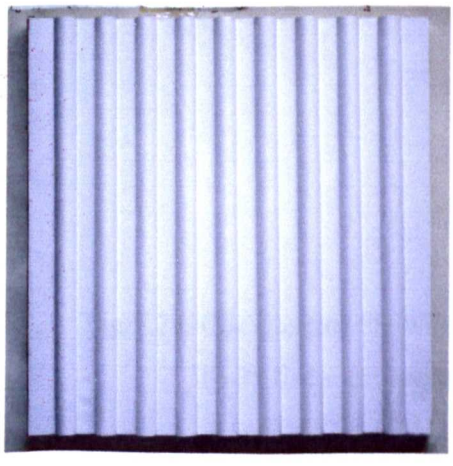


Fig .5.21 & 5.22. Vertical and horizontal parallel rows based on the ratio of 1:1.

Rough cartridge 220g, 100cm x 100cm.

Colour and relief demonstration

Reflecting upon the achievements obtained from the colour studies in Section 4 and the expansion of high relief from the previous studies, I decided to experiment with a combination of coloured surfaces and high relief elements.

As I had worked with the Islamic ratio and proportion prior to this research, this formed the basis of these compositions. As in Islamic design, the square has a strong structural role and is capable of a variety of permutations. For these compositions, the colours were chosen from the most frequently used colours of the Persian palette which were presented in section 3. Persian Turban was one of the most used colours, which mixed with Prussian blue produced a gradient of the desired colour with a shadow like quality. Tones of grey were added to the composition.

The combination of colour and relief began with the design on a square based on the proportion of 1: $\sqrt{2}$ and $\sqrt{3}$, 220g rough cartridge paper was chosen because the previous research showed it was suitable. The size of these works was 70cm x 70cm because this was just large enough for the basic proportions to be visually apparent. Each square was divided into 35 sections each 2cm.

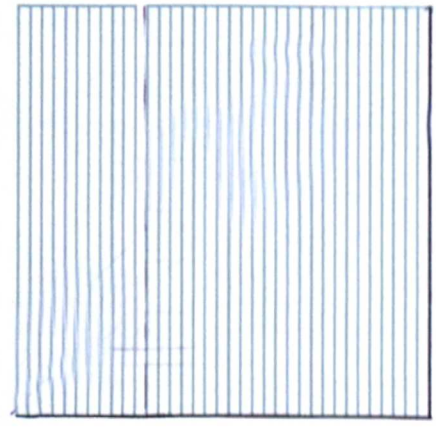


Fig.5.23. Composition showing
The 35 linear divisions.

For the first composition, two elements were used; a curved (half-round) relief of 4cm width and a slim band of 2cm width. The printing colour was 1part Persian Turban, mixed with 2 parts of chalk white, and for a gradient of darker colour, 2 shades of grey were added to the mix. The composition was based on the proportion of 1: √3=1.7320, as shown in the diagram(5.24).

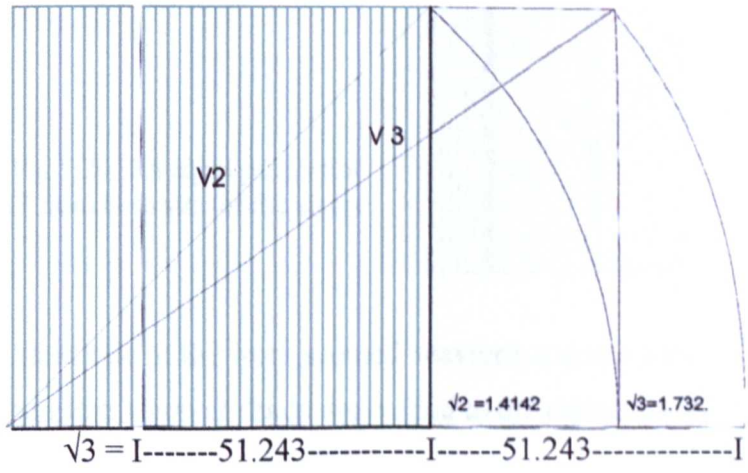


Fig.5.24. Drawing a √3 rectangle derived from double diagonal of the square.

The first proportion was based on
√3 = 1.7320 x 70 = 121.243,
121.243 - 70 = 51.24.
70 – 51.24 = 18.78

Therefore, from the right hand side of the work, at a distance of 51.24cm, a vertical strip of grey was printed. The width of this stripe was 2 cm, which covered one linear section in the main composition.

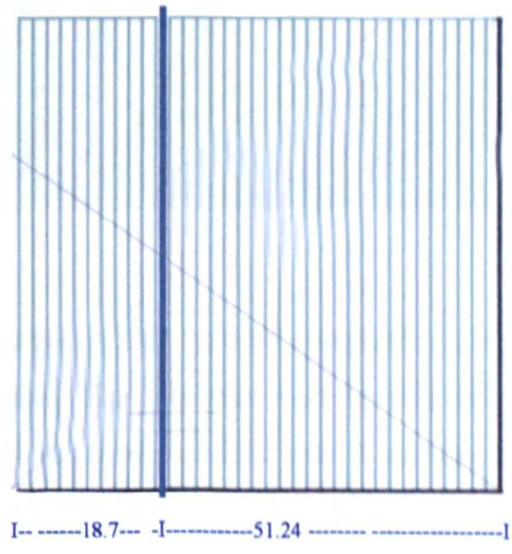


Fig.5.25. the location of the strip based on √3.

A concave relief element was introduced to the composition to balance it; the location of this was based on the golden section √3 as was the location of the grey band. repeated again from the left hand side. The relief element was therefore the same distance from the edge as the vertical band, except its width was double.

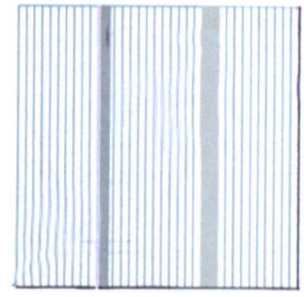


Fig.5.26. An equal proportion of √3 from both side of the squire.

In this composition, the left hand side of the work seemed heavier because of the lighter colour of the relief, therefore a greyer shade was added to the colour on the right.

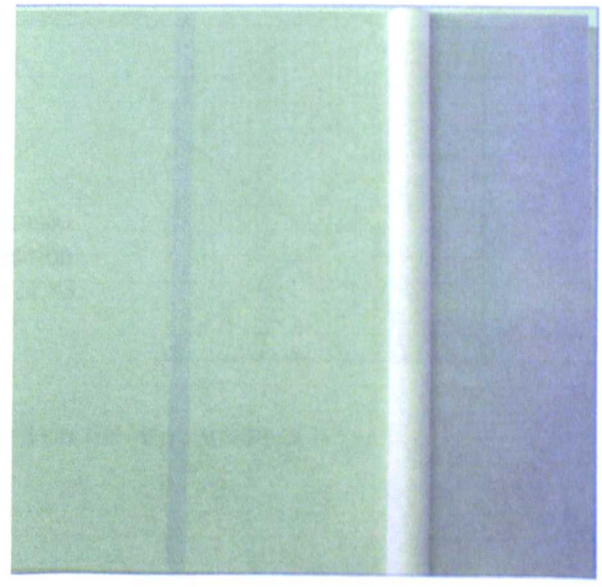


Fig.5.27. Combination of relief element and coloured surfaces based on the proportion of √3.

In order to show the effect of heat on colour in this type of composition, it was repeated without applying a relief element. The intention was to examine the shadowy quality of the colour. The composition was divided into 3 sections by 2 narrow vertical bands using proportion of √3. The first band was white (original

colour of paper) and the second incorporated the heated colour. The third part was also divided into 2 sections; the section which was close to the white band was heated and changed to a darker shade in order to balance the composition.

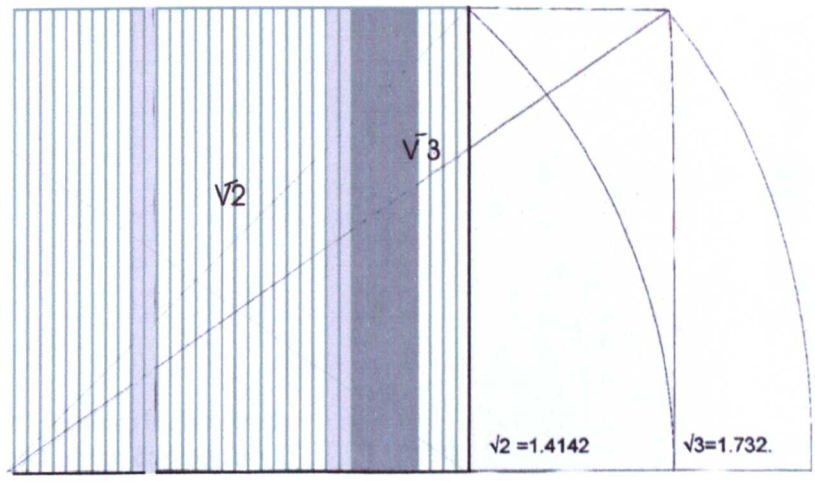
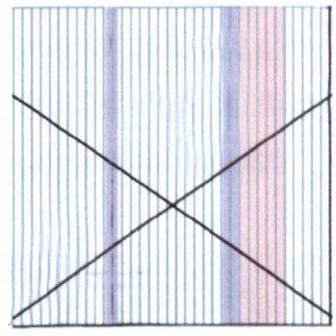


Fig.5.28. The location of the heated section compared with opposite strip.

Fig. 5.29. The concentration focused on the 2/7 of the composition based on the proportion of √3.



The composition of Fig. 5.29 was based on the proportion of √3.

√3 = 1.7320
1.7320 x 70 = 121.243
121.243 - 70 = 51.24,
70 - 51.24 = 18.76,
18.76 x 1/2 = 9.38.

The focal point was 18.76cm(A) from the right hand side and extended for ½ of this space, 9.38cm (B). Textures of this space were produced through heating printed colour (the process described in project 3), to highlight the focal point of the composition.

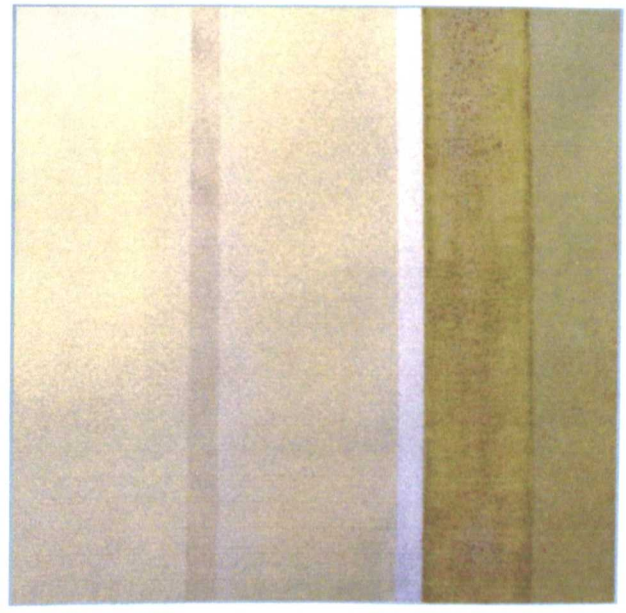


Fig.5.30. Tactile texture highlighted the focus point of the composition. The composition was based on the proportion of √3. 70cm x 70cm.

In the next print, the same process of proportion was repeated and a convex relief replaced the band of colour. In this work (5.31) the vertical strip was also represented as negative, both sides being heated to enhance this quality.

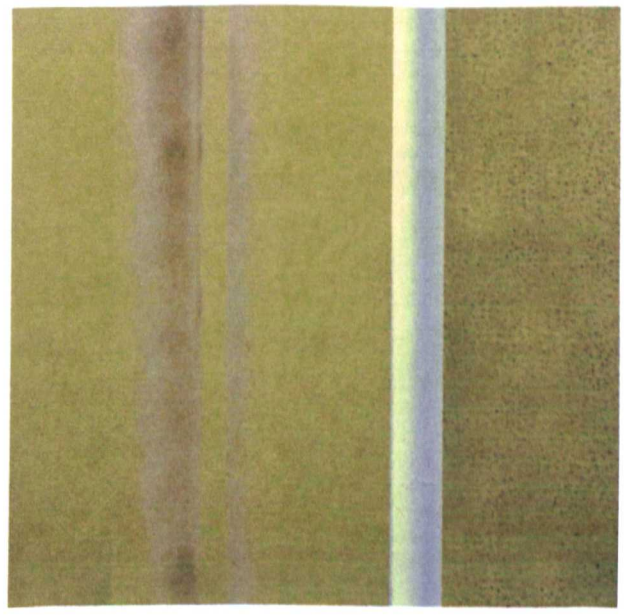


Fig 5.31.The combination of heated negative line, relief and tactile texture based on the proportion of √3. 70cm x 70cm.

The process of heating colour was extended in this work. The relief element and the band of colour were both located according to proportion of √3, as shown in the diagram.

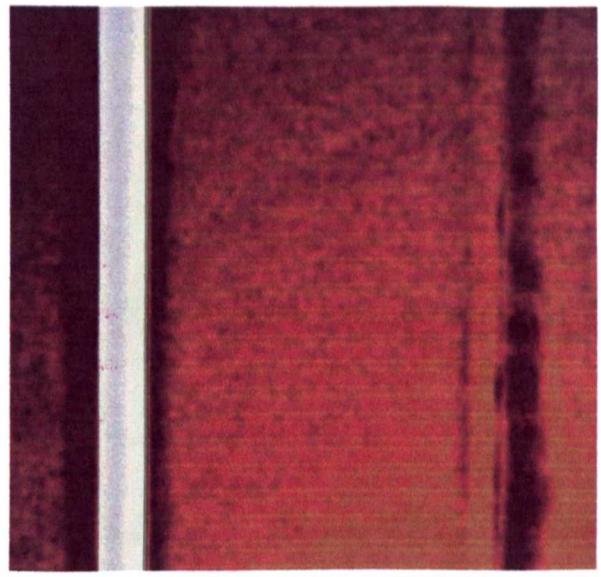


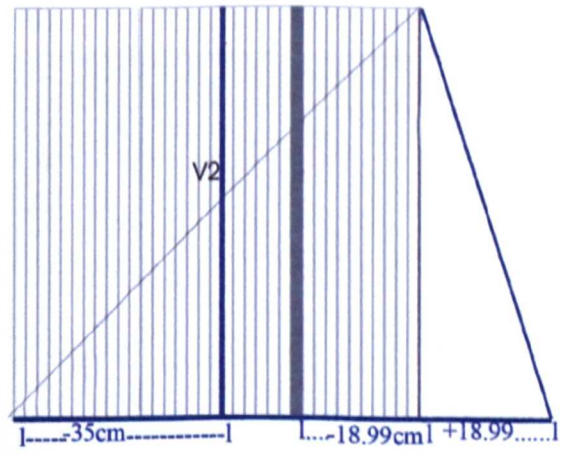
Fig.5.32. The focus points of the composition were placed on both sides based on the proportion of √3. 70cm x 70cm.

√3 = 1.7320 X 70 = 121.243, 121.243 - 70 = 51.24, 70a - 51.24 =18.76 x 1/2 = 9.38. Both elements in this work were placed 9.38 cm from either side.

The next composition (Fig.5.32) was designed with one convex relief and one white stripe on the surface, the latter with a gradation of purple. The focal point was detail around the middle of the composition, and was complemented by a secondary element as shown in the diagram.

√2 = 1.414,

70 x 1.414 = 98.99,
98, 99 – 70 = 18,99,
70 : 2 = 35,
35 –18.99 = 16.1.



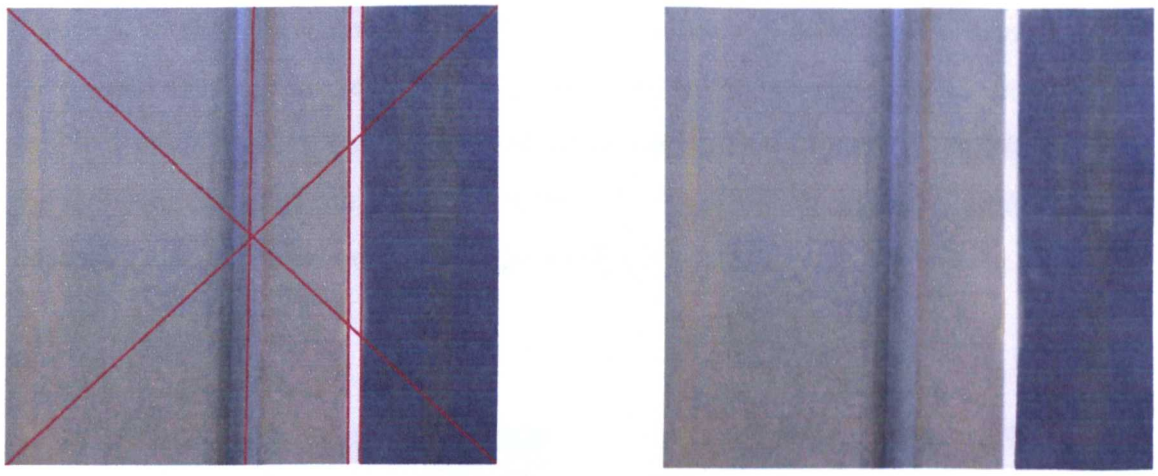
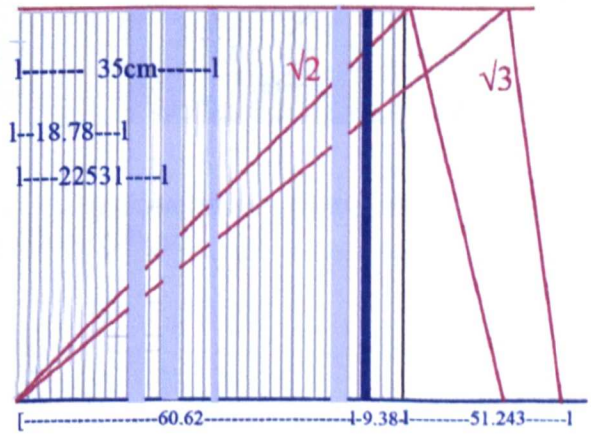


Fig 5.32. Concentration pointed to the middle of the composition and combined with the proportion of √2. 70cm x 70cm.

The compositions were expanded through the proportion of √2 and √3. Three convex relief elements, comprising a negative and a positive band were applied in gradations of purple.

√3 = 1.7320
1.7320 x 70 = 121.243
121.243 - 70 = 51.24,
70 - 51.24 = 18.76,
18.76 x 1/2 = 9.38.

√2 = 1.414,
70 x 1.414 = 98.99,
98, 99 – 70 = 18,99,
70 : 2 = 35,
35 –18.99 = 16.1.



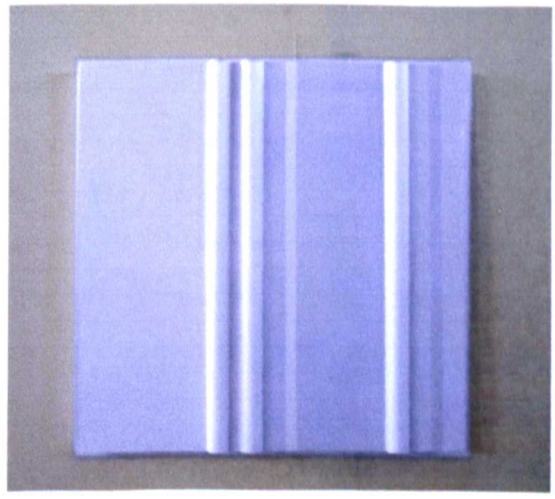


Fig.5.33. A complex composition based on the proportion of √2 and √3, using three convex relief comprising a negatives and positive strip.

The final work featured an illusion of concave and convex relief that contrasted with the printed coloured surface. The work was based on the proportion of $\sqrt{3}$, described in Fig.5.27. In the first work, a concave relief was used and a printed band similar to the real concave relief was printed alongside. The bands of colour suggested a three dimensional quality when viewed at a distance of only 1.5 m.

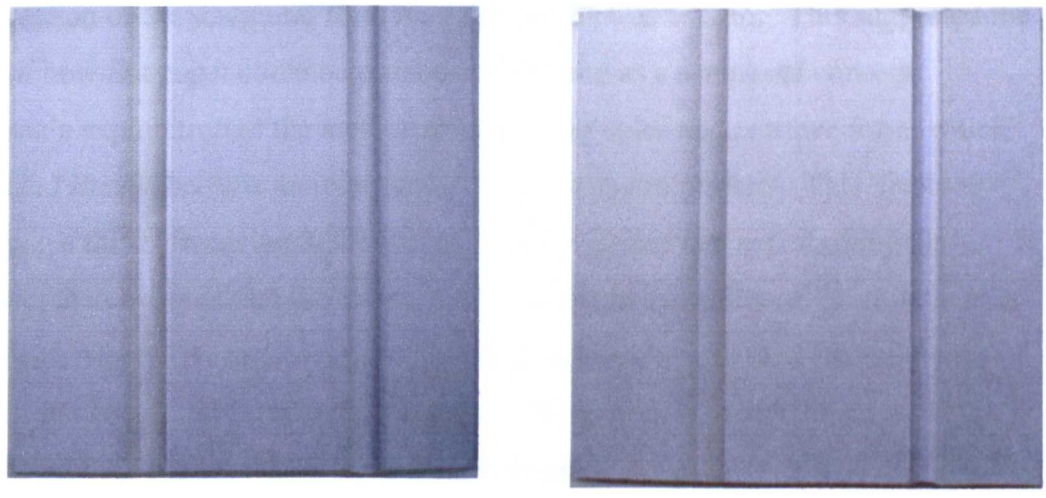


Fig.5.33. Illusion of concavity and convexity, comparison between printed strip, negative and positive relief, 70cm x 70cm.

Conclusion to section 5

Prior to this research I was familiar with the work of Lucio Fontana. In the summer of 2004 I saw his work for the first time in the Tate Gallery where I was not only intrigued by the simplicity of his motifs, but also inspired by his technique. For me, the creation of the sculptural form on a flat canvas was exciting. This suggested the idea of how flat paper could be printed and defined as a sculptural concept. Fontana's exploration of the method of producing holes and concave form, which he called *Buchy*, became an important part of my studio research. This involved bringing a third dimension to the works by piercing, cutting, and slashing the surface, thereby, breaking the membrane of two dimensionality of the paper. The fact that , Alberto Butters(described in sec 2) applied heat to raise his relief and detail, that he termed *Combustion*, led me to believe that it would be possible for this research to produce sculptural form with paper through printmaking techniques and heat (studies No 5.1.- 5.4).

The studio experimentation of producing high relief pattern on paper began with a concave form similar to what Fontana had used. This was then extended to the convex (study No 5.5). In these experiments heat upon wet or damp paper was successfully used to increase the height of relief. This was because the combination of heat and moisture, caused the paper fibres to release so that a greater depth of relief was possible, whilst the paper remained smooth and free from creases. This resulted in an extensive exploration of tearing, puncturing paper and printing burlap techniques (fig.5.15 – 5.17) and two successful compositions of high relief that show, a concave and a convex element (fig.5.18 and 5.19). Diagonal lines and textures on the top of curved lines was a further experiment prompted by Fontana's diagonal slash and pure lines (Fig.5.20-5.23). As the studies progressed, curved lines, which were derived from previous studies, led me to use and print parallel convex lines based on relational composition and serial elements in a square structure (fig.5.21 and 5.22). The final stage of the research progressed with the

development of compositions based on a proportional system that is derived from Islamic architecture. These compositions, that rely on actual convex and concave relief, in combination with coloured stripes, were influenced by Barnet Newman's 'Stations of the Cross'. However, whereas Barnet Newman's paintings are physically flat, the work that I have produced relies on the tension between the actual concave and convex, and the coloured band. Since the latter has an almost atmospheric quality through being heated, they can appear almost as shadow, thereby implying depth. This consequently adds to the ambiguity and tension between that which is actual relief and that which is flat.

Because these compositions rely on bands of colour and concave and convex relief there is an absence of narrative, and they increasingly rely in terms of their aesthetic quality on the formal arrangement of these elements, together with subtle changes in texture. As discussed earlier in relief demonstration work (sec.5), the disposition of these elements was based on $\sqrt{2}$ and $\sqrt{3}$. The proportion of one of the first compositions to use combinations of these elements is shown in fig.5.27, this was based on the dynamic rectangle $\sqrt{3}$, which was derived from the diagonal of a $\sqrt{2}$ rectangle. This subsequently determined. two focal points, around which the elements were located within the composition, one for the concave and convex element and another for the bands of colour.

The research in this section concluded with two compositions (Fig.5.33), which seek to heighten the tension between the actual concave and convex on the one hand, and flat bands of colour on the other. In this composition, there is a very deceptive ambiguity between the bands of colour and the actual relief. This begins at only 1.5 m from the work.

Missing page

CONCLUSION

This research began by reviewing those artists who, over the last 100 or so years, had worked extensively in relief and had often used heat to achieve it. In addition, I was also interested in artists who had used heat to produce colour or to change existing colour. It was noted that: Yves Klein was one of the first artists in the last century to use heat and fire to create tone and texture. He also used colour as an actual subject, not as an indicator for something else. The heat from the sun was also of interest, as in the work of Roger Ackling who creates work by focussing sun light through a magnifying glass and burning parallel lines in wood etc. This can be compared with the work of David Nash who, on a more extreme level, who burns and erodes the surface of his sculptures, many of which are in the relief. Perhaps heat and fire reach their most dramatic outcome in the work of *Cia Guo-Qiang* and L.C Armstrong where explosions and their heat create imagery. The review showed that in the history of contemporary art, there was no compelling evidence to suggest that artists had seriously taken into account the connection between heat, colour and relief.

Some of the first practical work in this research explored how heat could be used to create colour or to change existing colour, This resulted in a sequences of 1600 colour samples. This suggested there is almost no limit to the range of colour available to this process, as described in section 4. The importance of this part of the research, was that it provided a visual vocabulary of colour that could be used to support further research. At this point it nevertheless became apparent that there was a danger of concentrating on colour, at the expense of relief.

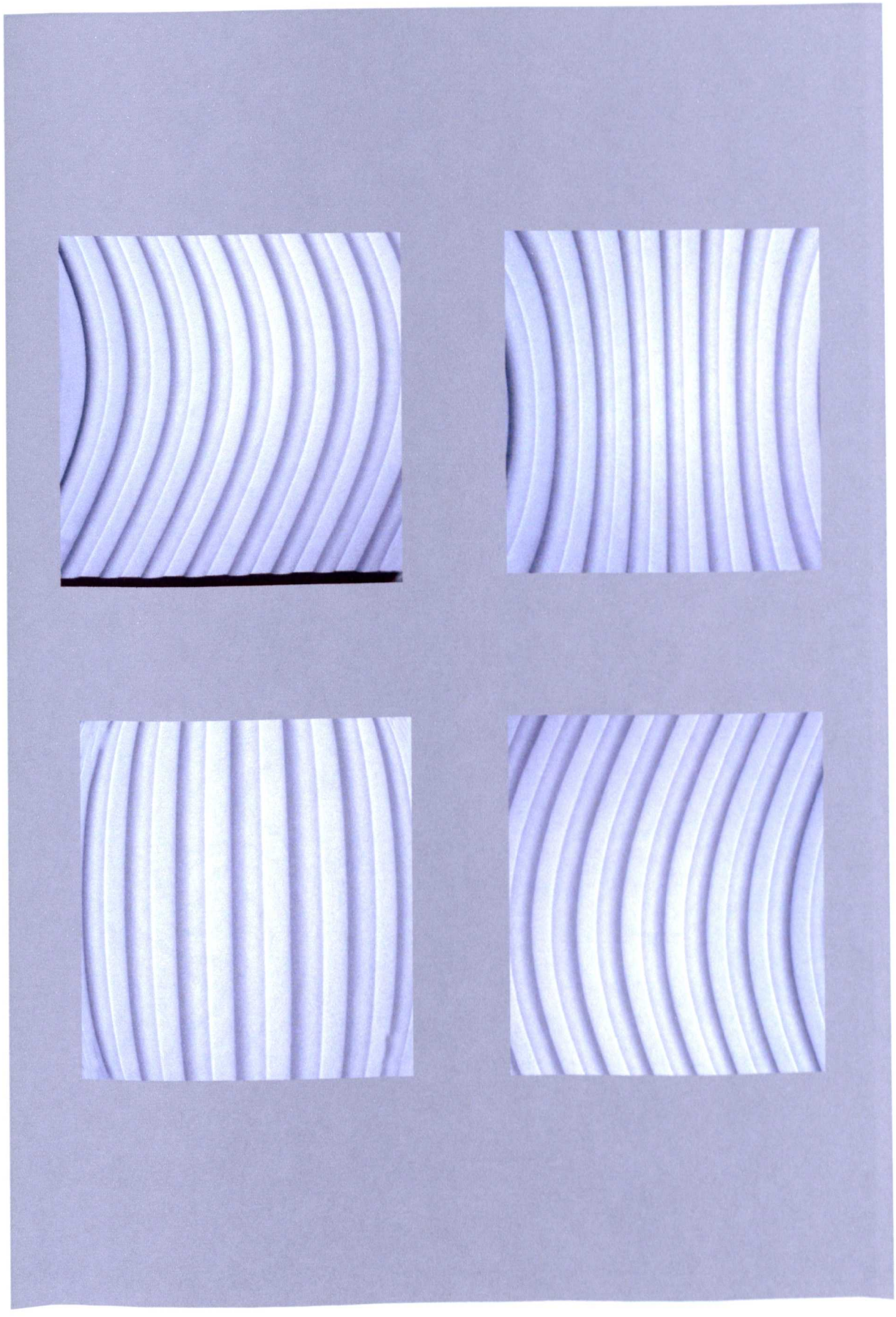
The concentration on colour in the previous section was given a balance in Section 5, which explored the ability of heat to relax and release paper fibres under pressure thereby achieving extremes of positive and negative relief; as well as embossed and textured surfaces. This was done by exploring different methods of pressing paper under heat to form and print a variety of high relief, involving concave and convex patterns. To aid this, a press was made that enabled pressure to be applied both evenly and unevenly, as required. The research also continued in this section with the printing of punctured paper, tears and embossed holes. The practical outcome towards the end of the project demonstrated that when heat was applied to moistened 220g cartridge paper, it could withstand relief to a depth or height of 50mm.

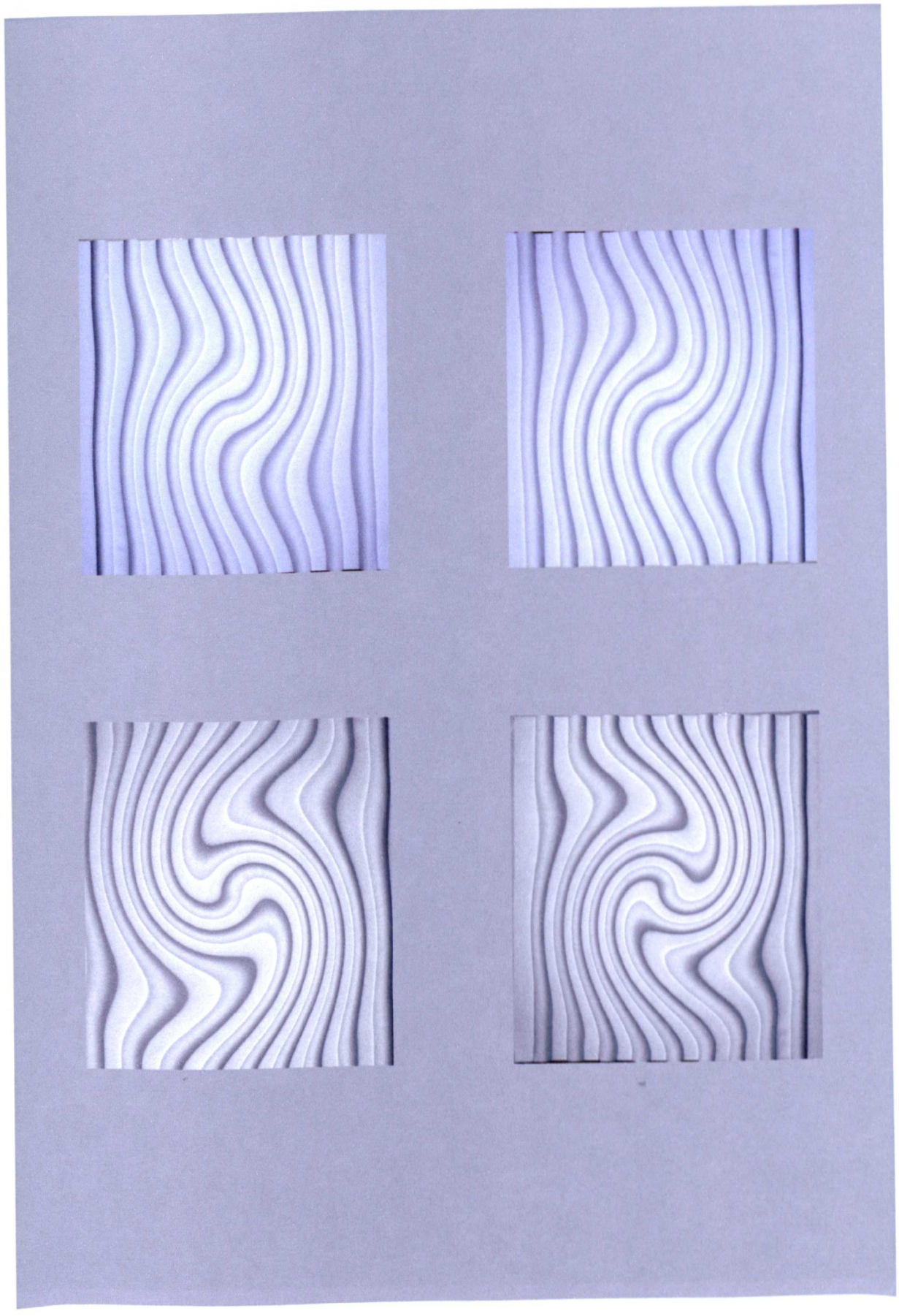
Previous to this research project my work had always had a narrative element; this is partly due to the cultural context in Iran with its emphasis on the literary and illustrative. Dispensing with this was therefore a significant step. As the research drew to a conclusion however, I began to realise that the relief detail I was creating with its concave and convex form, had a narrative that concerned perceptual ambiguity. It also became apparent that this ambiguity could be heightened by how the work was illuminated. If it was natural light, for instance, the definition of the relief would change significantly over the day as the position and intensity of the light source changed. To this was added the bands of colour, together with subtle changes in texture, which were at one time different from, and at another very similar visually, to the actual relief. The latter was partly because of the quality of the bands of colour, which in being subject to heat, had a slightly modulated appearance that could resemble a shadow. The disposition of bands of colour in relation to actual concave and convex relief was crucial if the ambiguity discussed above was to be successful. This was achieved by using proportional systems common to Islamic architecture that gave a geometric framework within which the elements could be located

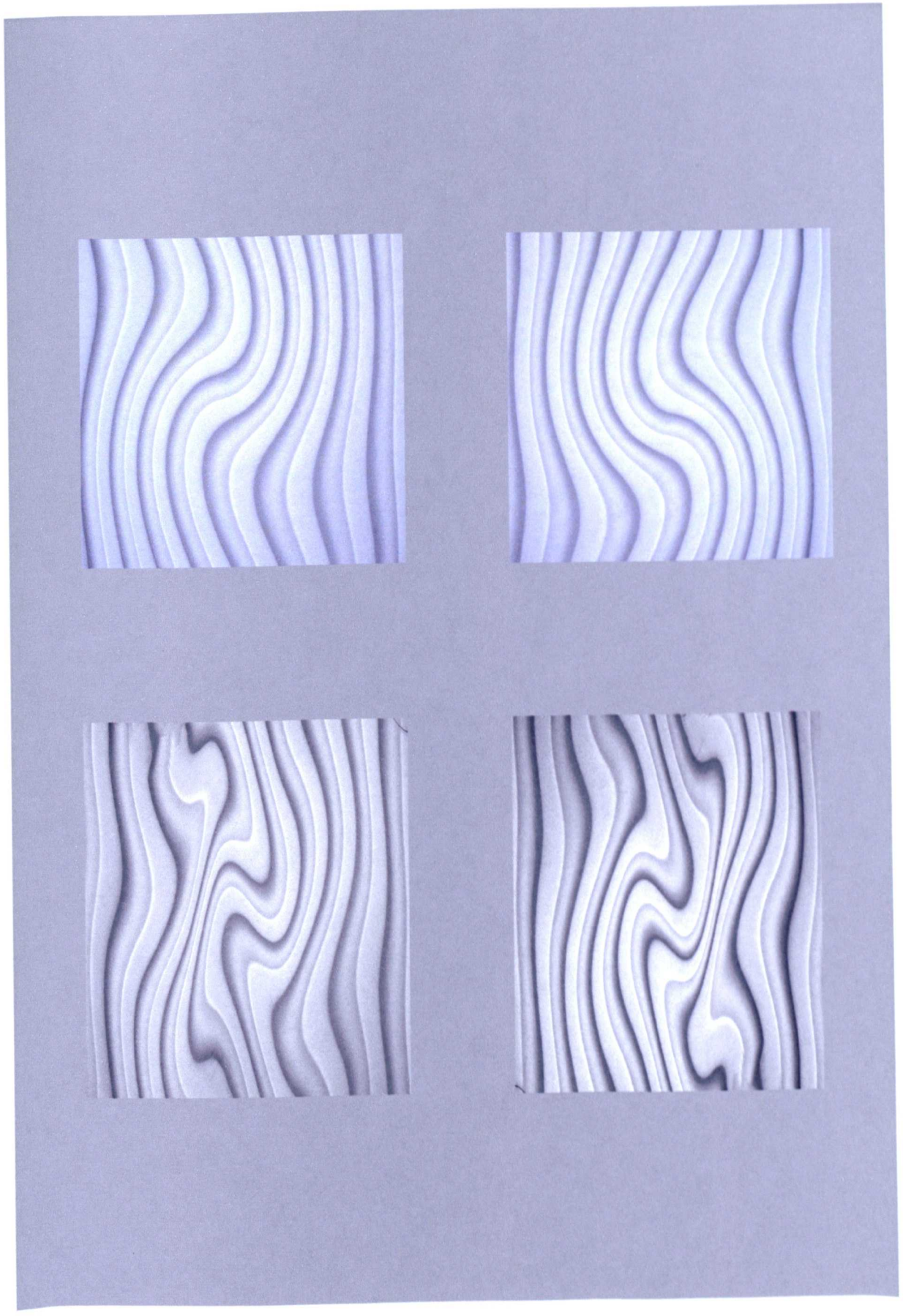
(Fig.5. 25-5.28). Here the geometry determined. two focal points, around which the elements were located within the composition, one for the concave and convex element and another for the bands of colour.

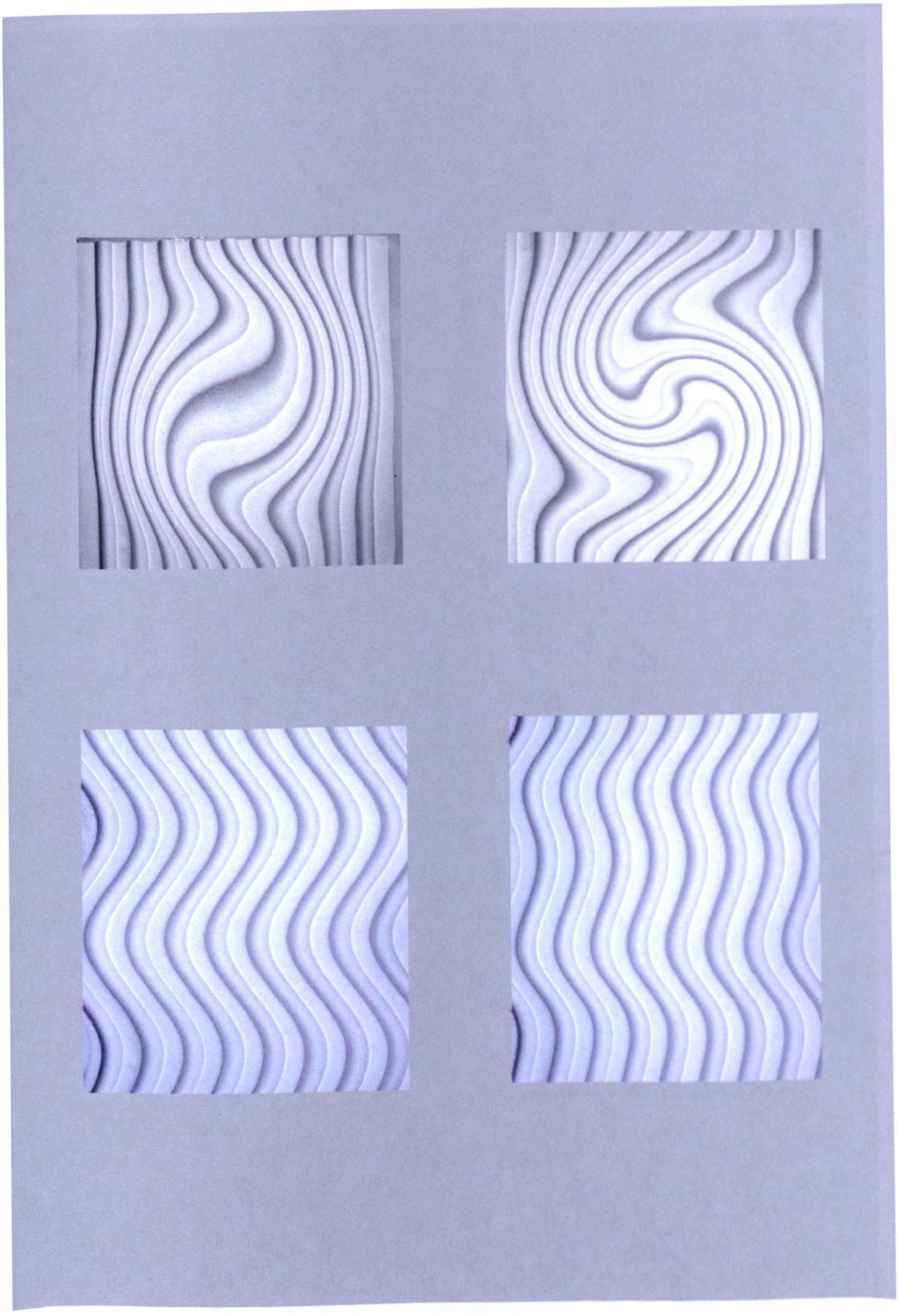
The research concluded with two compositions (Fig.33) which seek to heighten the tension between the actual concave and convex on the one hand, and flat bands of colour on the other. In this composition, there is a heightened ambiguity between the bands of colour and the actual relief. This begins at only 1.5 m from the work, and because of this it is one of the most important compositions in the research.

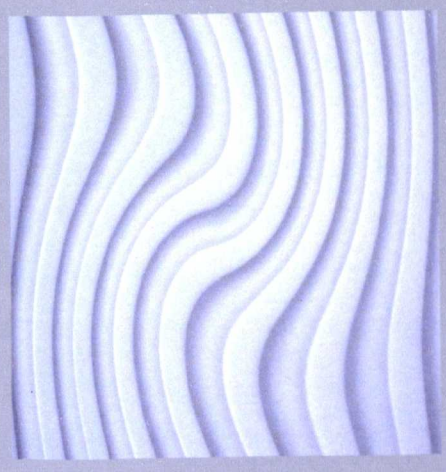
Through this research I have learned that it is possible to print relief to a height or depth of 50mm and that heat can generate and change a multitude of colours. In doing so it can cause subtle changes to the surface quality of the colour, that sometimes make it appear in two and a half dimensions as if it is a modelled surface. When starting on this research I knew that one of the ways to a successful conclusion was the interaction of colour and relief, but at that time I had no idea how this could be achieved, and certainly no idea how there could be ambiguity between colour and relief. What has been achieved is a heightened sense of perceptual ambiguity, where at times the compositions appear to have an inner life that enables them to transform, almost seamlessly, from the flat to the relief. It is this that I wish to continue in the future. Some of the issues that I will be exploring in this future work are shown in the vignettes over leaf.

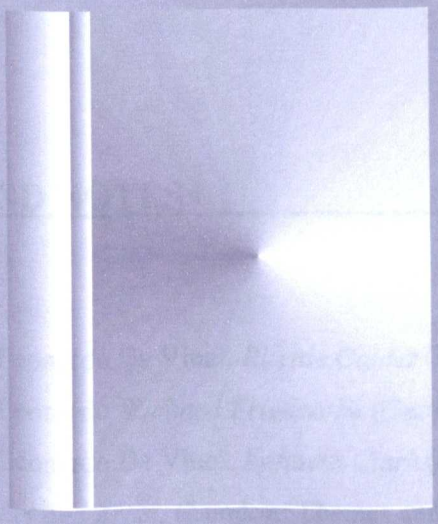


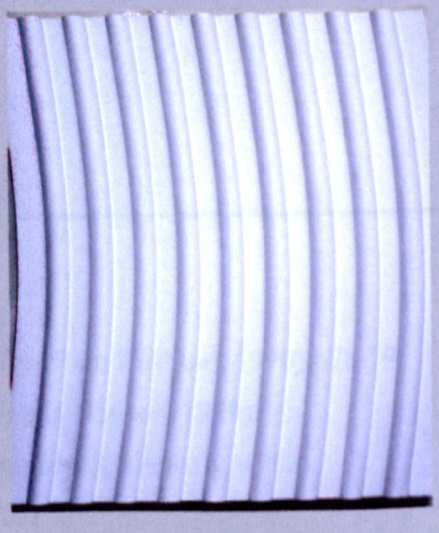












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[18] *The Sculpture of David Nash,* Andrews, Julian, The Henry More Foundation, London, 1960. p110

[19] Extract from Annely Juda Fine Art, Catalogue, Set Aside, 1998, London.

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i- I thought my works (holes & rips) have had some appeal to the world without constantly asserting as much. But my teacher, the late YASHIHARA Jiro, always used to say me, "our country was defeated in the war, and what's more, we are Japanese, a coloured race. Until we move to a foreign country and become naturalized citizen there, our art is never being considered as part of the best art."

ii- Theories of colour based on Newton's mathematical science of optics. Newton held that light consists of particles, but he was aware of the difficulties, anticipating the modern theory that light has the dual properties of particles and waves. He advised the first experiment to show that white light is a mixture of the spectral colours, and paved the way to an understanding of colour vision by elucidating the physical characteristics of colour. *Eye and Brain, the psychology of seeing,*(R.L. Gregory, Weiden Feld, Nicholson, 1977,London)

iii- Sunlight entering through a slit falls upon the prism. The ray of white light is dispersed into the spectral colours. The dispersed ray can be projected on a screen to display the spectrum. A continuous hand of colour rages from red through orange, yellow, green, blue, to violet. These colours are produced by refraction. There are other physical ways of generating colours, such as interference, diffraction, polarization and fluorescence.

iv- I thought my works (holes & rips) have had some appeal to the world without constantly asserting as much. But my teacher, the late YASHIHARA Jiro, always used to say me, "our country was defeated in the war, and what's more, we are Japanese, a coloured race. Until we move to a foreign country and become naturalized citizen there, our art is never being considered as part of the best art." 36

v - *Fontana's pierced works remind me of when I was thirteen; passionate for painting but my parents and even my older brother prevented me from doing any art works. I had to hide in a shed or the underground store, out of view, when painting on canvas. One day I found myself alone at home, decided to collect my works and hang them in my room and make an exhibition for enjoyment. My first private exhibition didn't continue for more than a few minutes because when my father came back home, it was a shock for him when he saw the works hanging around the room, he did not want me to be an artist. Without a word, he assaulted the canvases with a kebab skewer and made a few slashes through each of them. He even cut a white monochrome canvas in the corner of the room, which in fear, I had crept behind. The white monochrome canvas became an exact copy of *Fontana's Spatial series* paintings when he cut it. I hung this work for a few weeks without understanding the similarity between this work and Fontana's, but nonetheless it remained on the wall as an objection to this event.

vi- The term "deep etch" is relative to the thickness of the metal plate and even with gauge zinc, only a fraction of an inch separates deep from shallow.

vii- Achrome means colourless works and *monochrome* means one colour. A technique from the French word known as *grisaille meaning* grey. In such works the play of light and dark (*chiaroscuro*)enabled the artist to define form and create picture. 'From Tate modern glossary'.

viii-Their collaborations over 30 years have introduced the initially reluctant artist to the potential dialogue between printmaking and painting.

ix- Frank Stella greatly impressed by the blueness of Newman's work.

x- The term *vehicle* refers to those chemicals, resins, varnishes, and oils used as media for pigments. Many synthetic vehicles such as vinyl resins have replaced natural oils for a faster drying emulsion.

xi -Pigment is generic term and refers to a variety of white, black and chromatic compounds of organic and inorganic origin, soluble in water.

xii - Soluble in oil.

xiii - The ingredients of mediums are dependant on the kind of inks, it usually consists of an exact mixture of gums in solution or several gums, glycerine' and ox gall mixed together.

NOTES ON ARTISTS IN THE INTRODUCTION

Robert Rauschenberg born in 1925 at Port Arthur, Texas. From 1947 to 1948 he studied sculpture and music at Kansas City Art Institute. In 1948 he met Susan Weil in Paris, who was later to become his wife. His first one-man exhibition held at Bonwit Taller and Tiffany in 1951. His works went on world tour in 1981, including an exhibition in Moscow.

Yves Klein was born in 1928 in Nice. He was famous for his monochromic painting and images of fire, he tried out the throw of flames, by which it burned configurations out of paperboard. It exposed its images called "Cosmogonies" to the wind and the rain. Yves Klein influenced conceptual art and died in 1962 in Paris.

Cia Guo-Qiang, the Chinese born artist (1957), who first attracted public attention in Japan where he resided from late 1986, became internationally known in the early 1990s and has lived in New York since 1995.

Richard Wilson was born in London in 1953, attended Hornsey Collage of Art until 1974 and then studied at Reading University from 1974 to 1976. He was included on the unofficial shortlist in 1988 for his contribution to Television South West Art Exhibition.

Ana Mendieta (Havana 1948-New York 1985) The Cuban sculptor, photographer and painter, studied Art History at the University of Lowa in 1969, her works exhibited at Norton Museum of Art Centro Galego de Arte,Santiago de Compostela, Kansthalle

Dusseldrf,fondacio Antoni Tapies, Barcelona,Miami and MOCA, Los Angeles. She died at age thirty-six, the result of a fall from an apartment window in new York in 1985. She left over 200 works. New York Magazine, Art Review, 9525. Norton.org / archive.

Armstrong, Lille, born 1954, educated BFA, Art Centre College of Design, Pasadena, CA, Solo Exhibition, Marsha Mateyka Gallery, Washington, 1993, Postmasters Gallery, New York, 2001.

David Nash was born in Surrey, England, in 1945. He studied at the Kingston Art School. Nash has been well-known on the international art scene since the Guggenheim Museum in New York featured his art work in 1980. His works can be seen in collections in Britain, the United State and Australia.

Roger Ackling is an internationally known artist who born in Isle worth, London in 1947, lives and works at the edge of the North sea in Norfolk and teaches at Chelsea college of Art and Design and Norwich School of Art and Design, has been exhibiting his works since 1967 in Museums and Art galleries around the world.

Willie Cole, born 1955, New Jersey, studied at the School of Visual Arts and the Art Students League in new York, awarded the Augustus Saint-Gaudens Memorial Fellowship and in 2001 awarded a prize for his installations at the Bronx Museum of the Arts by the International Association of Art Critics.

Alberto butter (Burri), was born in Citta' di castello, Italy in 1915. Butters began not as an artist but as a doctor, earning his medical degree in 1940 from the University of Perugia. Following his unit's capture in northern Africa, he was interned in a prisoner-of war camp in Hereford, Texas, in 1944. After his release in 1946, he moved to Rome, where his first solo show was held at the Galleria La Margherita. He was awarded third prize at the *Carnegie International* in 1958. In 1959, he won *the peremio dell'Artiete* in Milan and the UNESCO prize in 1959. The artist died February 1995, in Nice.

Johannes Schreiter was born in Germany in 1930. Professor in fine arts, painter/ National University, Frankfort, Single and group exhibitions in Europe, USA, Canada, Africa, Japan, Brazil and the USSR.

Shozo Shimamoto, born 1928 in Japan, works on small bits of wood or fragments of glass and paper. He also works on smashed colour, fired at picture and action painting on canvas. While studying at Kansai University with the master painter Yoshihara Jiro, he was awarded the Asahi prize in 1953. In 1998 he was invited to exhibit his works at the Los Angeles Museum (MOCA) along with Jackson Pollock and Lucio Fontana.

Lucio Fontana was born in 1899 in Argentina. He was brought up in Milan, studied at the Accademia di Brera, Milan, followed the lessons of Adolph Wildth (1928-1930), and in 1935 signed the first Manifesto of Italian artist. Awarded great prize of the biennale of Venice in 1966 and died in 1968.

Piero Manzoni was born in Soncino (Cremona) near Milan in 1933. He studied at the Academia di Brera and lived in Milan until his death. He participated in a group show in1957 that was closely associated with the conceptual avant-grade of post war Europe. He died in his studio in February1963.

Enrico Castellani was born in Castelmassa (Rovigo) in 1930. In 1952 he moved in Belgium in order to attend the course of painting and sculpture where bachelor in 1956 and the same year moved to Milan. Participated in many important exhibitions, such as Zero, Stedelijk Museum and Venice Biennale in 1964 and 1966. recently he has had one- man exhibition at Italian Museums and Torento (1999).

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