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WORLDS BETWEEN DIMENSIONS:

Chaos, Fractals and the Work of William Latham.

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INTRODUCTION

I will be discussing how the phenomena of fractals and the chaos theory have brought the relationship between art and science closer together. How in the 1960's scientists began to investigate the transition zones between order and chaos. It was and still is believed that by developing new technologies i.e. super-computers, scientists could eventually control our physical environment.

In chapter one I will be examining how dynamic systems in nature are multifaceted, complex and interdependent. How they are constantly pushing and pulling at themselves to create irregularity and unpredictability. I will talk also about the ideas of evolution in relation to the holistic idea of everything interacting together.

In chapter two it will be discussed how the visualisation of complex mathematical equations has led to a new awakening in art and the use of computers for artistic means. Which leads me to consider why artists have started to use computers to help them with their work. Also how the images of fractal art have been pushed beyond being just scientific to being considered a new art form.

In William Latham's work, which will be discussed in detail in chapter three, the theories of chaos and fractal geometry are reflected, how his forms unfold and evolve into each other. By using computer graphics and developing his own software he portrays how life is built on the principle that evolutionary activity creates worlds within worlds, all moving, mutating, evolving and feeding back into each other from small scale to large scale, back to small scale. How he breeds forms which are suspended between dimensions, they are neither two-dimensional nor three-dimensional.

In the final chapter I will be recognising how the evolution of the computer has led to the development of interactive art and the illusionary world of virtual reality. How William Latham's work has advanced to evolve with the emergence of the cyber-culture of today. If technology can't control the physical environment at least it can control our virtual worlds.

CHAPTER ONE: CHAOS THEORY AND FRACTAL GEOMETRY

> Chaos theory tells the story of the wild things that happen to dynamical systems as they evolve over time, fractal geometry records the images of their movement in space.
>
> (Briggs 1992 p.22)

The aesthetics of chaos are now bringing the bond between art and science much closer for the future. Art is never fully separable from the science and technology of its time; without levers, there would be no Stonehange, no Pyramids. What may be considered the two most important developments in western art history, the Renaissance and the twentieth century birth of Modern Art, can be directly linked to perspective and non-Euclidean geometries which originated during these times. It's not just that new technology makes new projects possible, but that it makes new things thinkable. It was inevitable therefore, from the moment the first computer was produced, that artists would not only find it a useful tool but that, for some, it would become absolutely necessary to explore it. This has led to a new cultural revolution rooted in technology and dominated by the computer.

The early machines of the 1960's were created for their computing ability to record complex statistics and produce graphs which scientists were unable to produce manually. It has been scientists traditional task to "Simplify nature, expose its underlying logic and then use that logic as a means of control" (Briggs 1992 p. 14). It was believed that if they could gather enough information about the complex dynamical systems such as, the physical environment eventually their formulas and computers would tell them what to predict or how to control it. This obsession led to the development of supercomputers.

It also became obvious that these complex natural phenomena cannot be stripped down and studied under a microscope. An individual tree is the result of a kaleidoscope of influences such as gravity, soil, wind, sun, insects, humans, even other trees. Such systems i.e. physical environment, are multifaceted, complex and interdependent on other systems and are constantly pushing and pulling at themselves to create irregularity and unpredictability, which is the character of our physical environment. Apparently 'random' movements in nature led certain scientists to look into this phenomenon in more detail; thus, the chaos theory.

> Where chaos begins classical science stops.
>
> (Gleick 1987 p.3)

In the 1970's a few scientists in the United States and Europe began to find a way through the disorder of nature. They were mathematicians, physicists, biologists, chemists, all seeking connections between different kinds of irregularity. The insights that emerged led directly into the natural world, the shapes of clouds (Fig. 1), the paths of lightning (Fig. 2), the ripples left in the sand (Fig. 3) the microscopic intertwining of blood vessels (Fig. 4), the clustering of stars. It has only taken a decade later for chaos to become known everywhere and to begin to reshape the scientific establishment.

In order to understand this complex theory it would be easier to look at the weather as an example. The idea is that there is an "underlying order" in all "random" events but that this order is sometimes very subtle to detect. It is because of chaos exploration that special techniques of using computers and primitive kinds of graphic images were created – "pictures that capture a fantastic / delicate structure of underlying complexity." (Gleick 1987 p. 4).

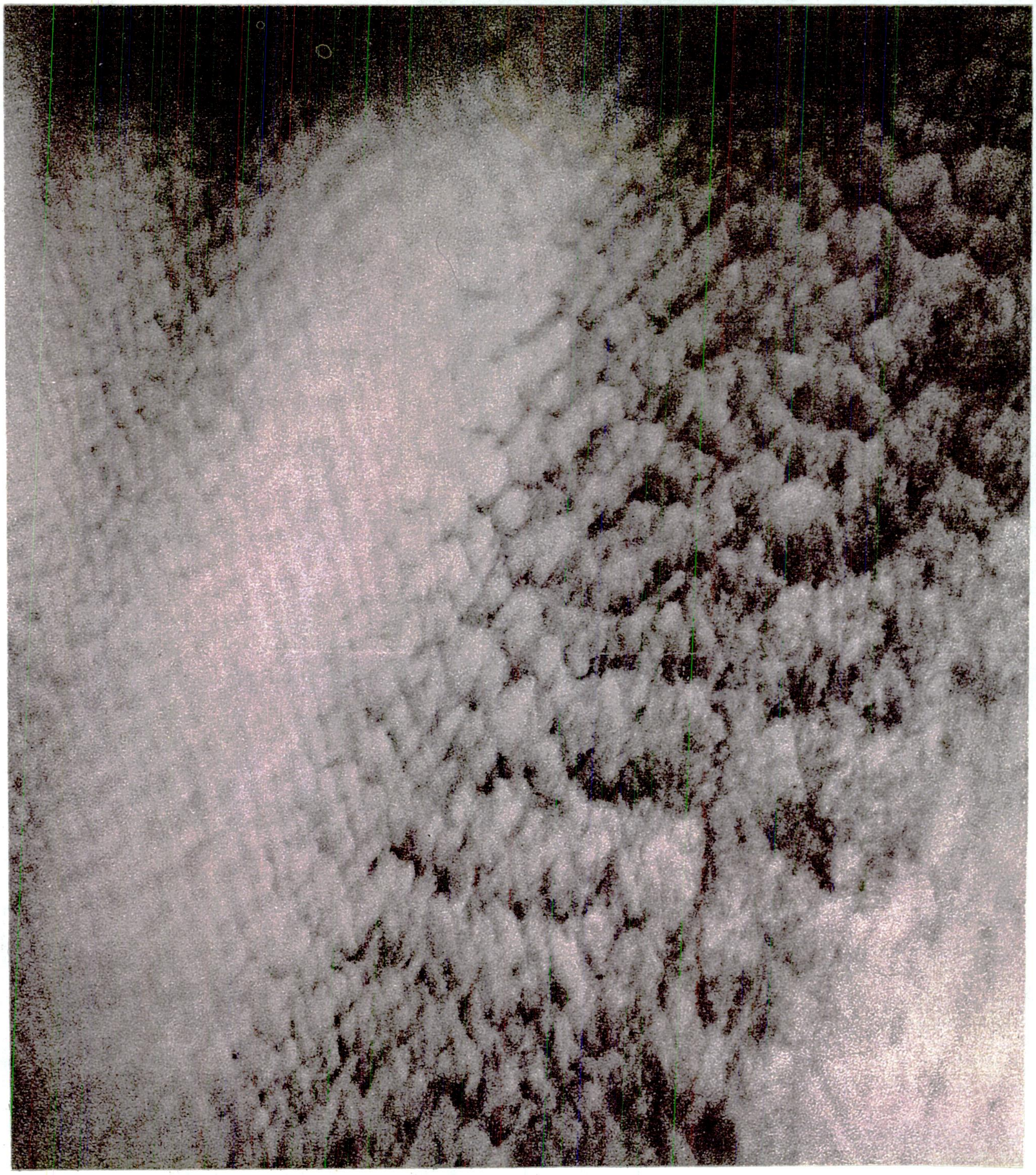


Fig. 1 shapes of clouds

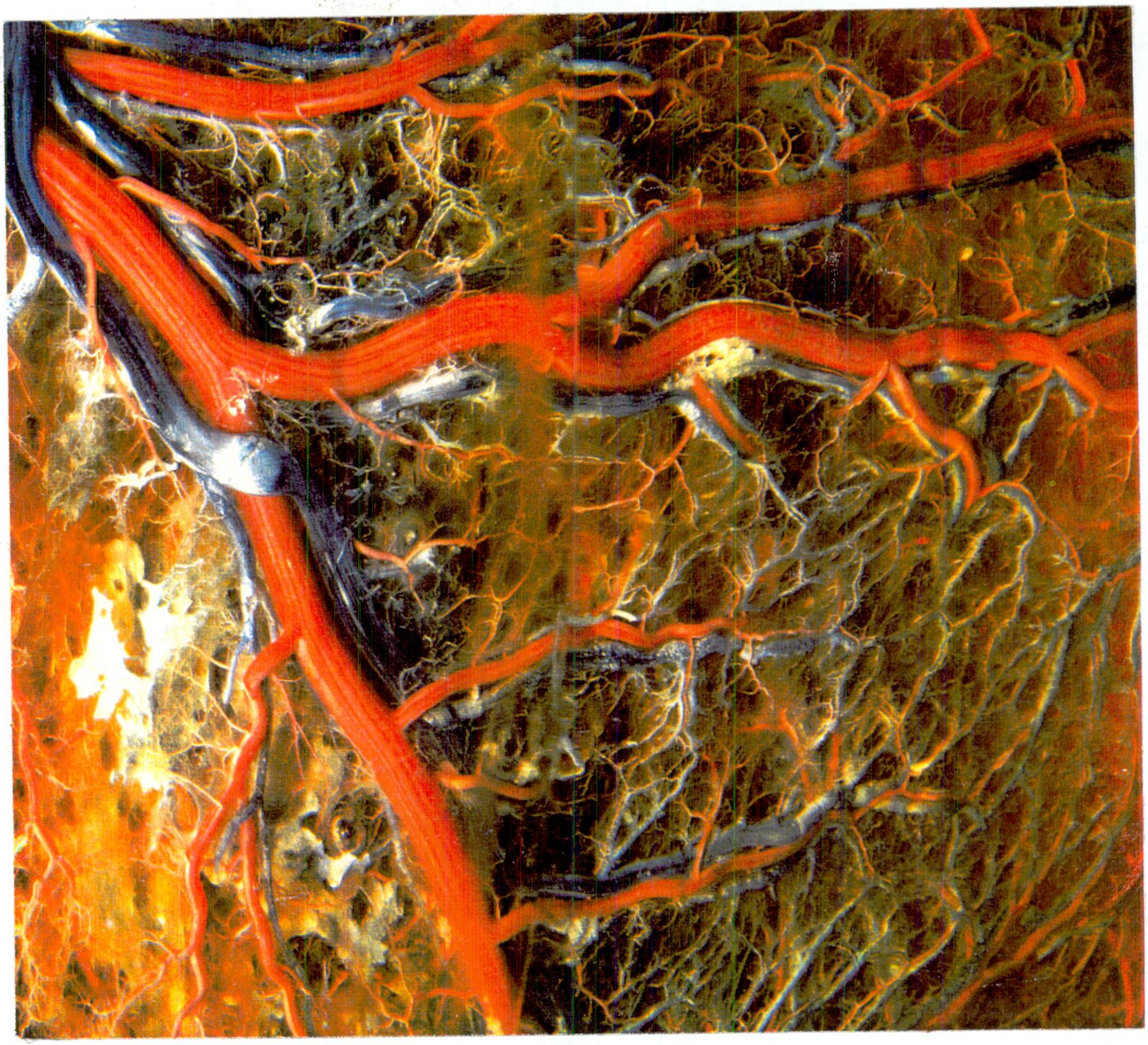


Fig. 2 **The paths of lightning**

Fig. 4 **Blood vessels**

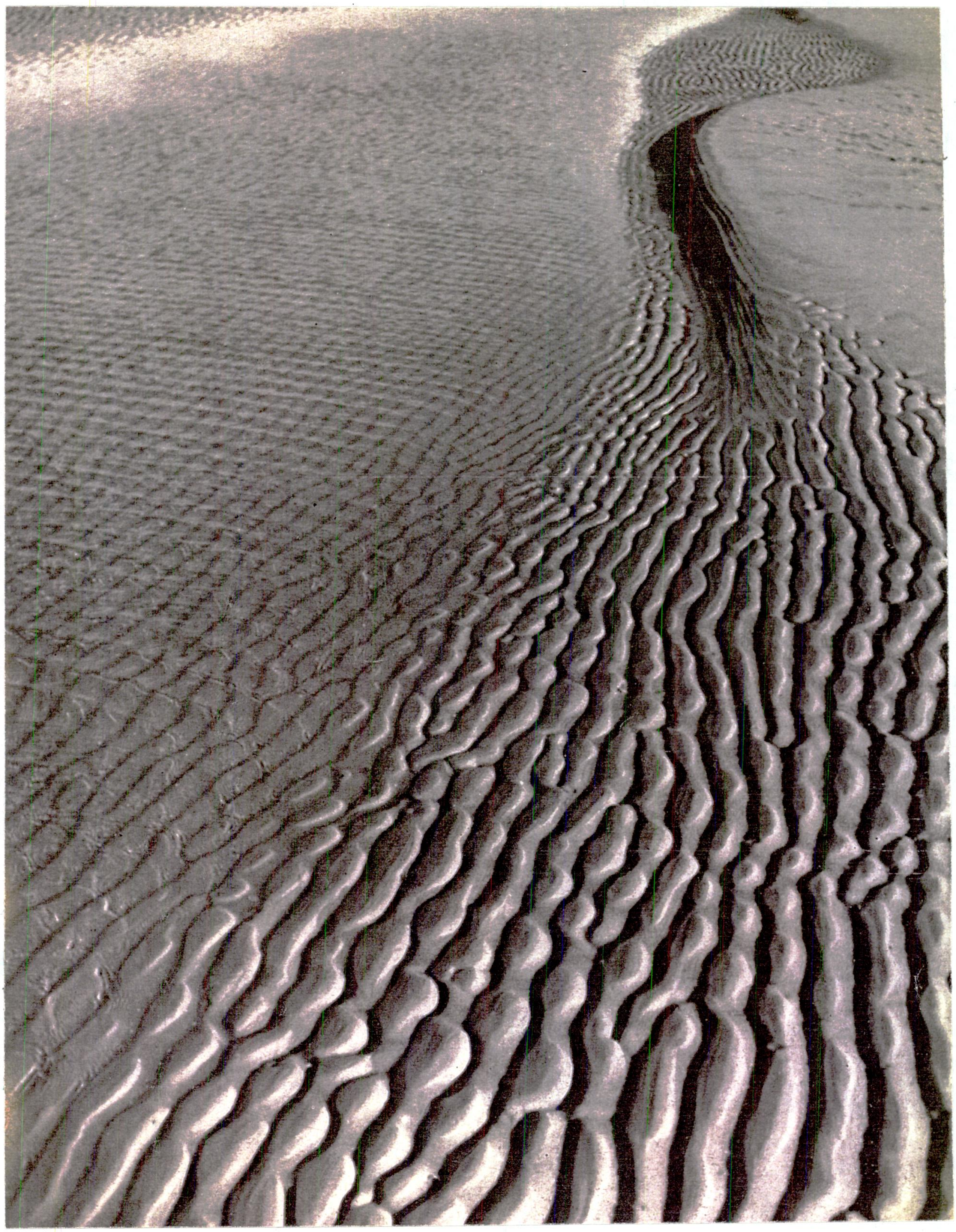


Fig. 3 Ripples left in sand

Ripples left in sand Fig. 3

In 1960 a meteorologist called Edward Lorenz working in the Massachusetts Institute of Technology, with the use of a primitive computer, a Royal McBee, created an artificial weather system. Every minute, the machine marked the passing of a day by printing a row of numbers across a page. Lorenz had always appreciated the patterns that come and go in the atmosphere, always obeying mathematical rules, yet never repeating themselves. He was able to capture the way patterns that seemed regular actually changed over time.

Weather forecasting had been waiting two centuries for a machine that could repeat thousands of calculations over and over again. Lorenz began to see that patterns appeared but they differed slightly in their orderly disorder.

Lorenz developed his rows of numbers into graphs in an early form of computer graphics. A 'strange attractor' is the name given by Lorenz to a graph which illustrates the chaotic process. These graphs represent seemingly random events. Each axis can change independently of the other. To take a dripping tap as an example, on one axis plot the time interval between one drop and the next. On the other axis, plot the time interval between the next two drops then repeat the process over and over. At first one would notice there was no order to the graph whose first points seemed to appear at random. After a while the points will appear to mark out a definite shape (Fig. 5), a "strange attractor".

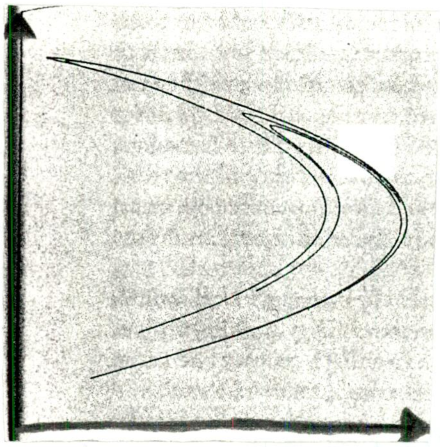
What a 'strange attractor' shows are all possible random events in this particular system. It can also be calculated mathematically for more complex systems. What it also records is the underlying order behind natural events, an orderly disorder.

In 1961 an experiment involving a changing or leaving out the last decimals of a number, had a dramatic difference, creating a completely different graph, as if they were completely different forecasts. How a

small puff of wind represented by the decimal could make a huge difference. This shows how dynamical systems like weather are composed of so many interacting elements, that they are tremendously sensitive to even the tiniest factor; how the air disturbance created by a butterfly's wings can build up into a storm on the other side of the world. This is known as 'sensitive' chaos. It indicates how complicated dynamical systems are determined by their causes. The common analogy for this is the 'Butterfly Effect' which is used to explain the unpredictability of weather, how systems in nature have a "sensitive dependence on initial conditions" (Gleick 1987 p. 23) and the way, in nature, small scales intertwine with larger scales. Dynamical systems imply a holism in which everything influences or potentially influences everything else.

To illustrate systems of greater complexity, Lorenz developed graphs using more complex mathematics. One such graph seen in Fig. 6, resembling an owl's mask or butterfly's wings, became an emblem for the early explorers of chaos. It traced a strangely distinctive shape, a kind of double spiral in 3D. The shape signalled pure disorder, since no point, or pattern of points ever re-occurred, yet it also signalled a new kind of order. Chaos, therefore is the barrier between order and disorder.

This new science was brought about by scientists straying outside the normal bounds of their specialities, relying on mathematics that seemed unconventional and difficult. Thus to chaos researchers, computers became their laboratories full of test-tubes and microscopes. This led to the crossing of scientists into the computer era, realising that they would have the power to collect, organise and manipulate information on a scale that had been unimaginable before. Benoit Mandlebrot, a mathematician, was one such scientist whose interest in the chaos theory and his knowledge of computers led him to discover what he termed "fractal geometry".



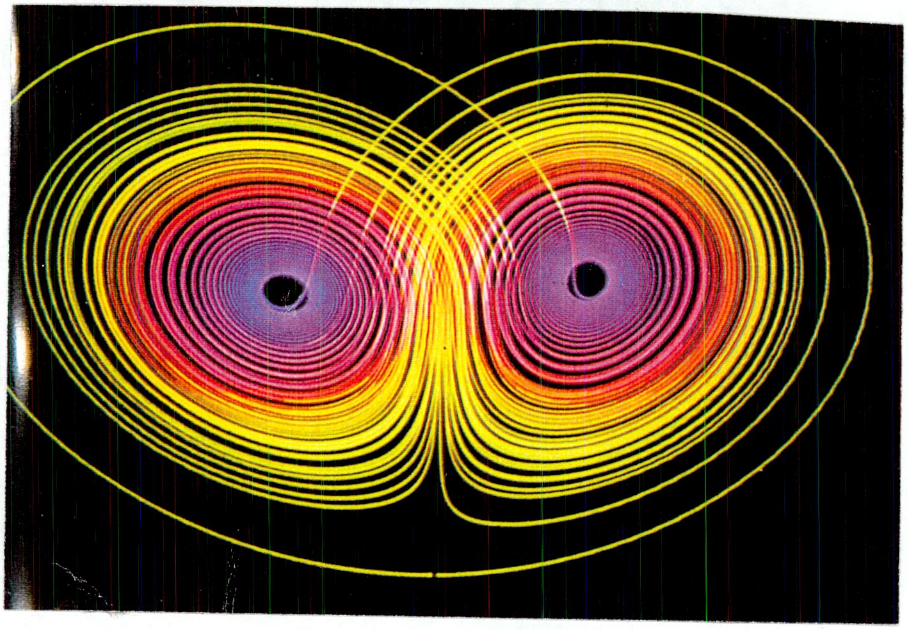


Fig. 5 A Strange Attractor

Fig. 6 The Butterfly Effect

To see the world in a grain of sand.

(William Blake quoted in Gleick 1987 p. 115)

Benoit Mandlebrot, born in Warsaw in 1924, had from an early age shown an ingenious geometrical intuition. Given any mathematical problem, he could almost always think of it in terms of some shape in his mind. Mandlebrot had an advantage over the other mathematicians, who thought about new shapes in geometry: he was a researcher for IBM, recording economic statistics. He had access to the computing resources of IBM computers perfectly suited for their high-speed calculating ability. This advantage led to his discovery of a new geometry and dimensions for which he coined the name 'fractal' from the Latin adjective <u>fractus</u>, to break, in English 'fracture' and 'fraction'.

> Our feeling for beauty is inspired by the harmonious arrangement of order and disorder as it occurs in natural objects, in clouds, trees, mountain ranges or snow crystals, the shapes of all these are dynamical processes jellied into physical forms, and particular combinations of order and disorder are typical for them.
>
> (Mandlebrot 1989 p. 22).

Fractured, fractional geometry focuses on broken, wrinkled and irregular shapes (the roughness of the world) in nature or abstract shapes created by repeating equations over and over into a computer. In nature it describes the marks and patterns left "by the chaotic processes of dynamical activity". (Briggs 1992 p. 22). Fractal, meaning irregular abstract shapes or natural irregular shapes show similarities at different scales. This is also known as 'fractal scaling' nature's 'self-similarity'. Taking Fig. 7 for example, as the camera zooms into a vine-covered wall, each magnification reveals new detail which repeats the same patterns discovered on larger scales. According to fractal geometry, this vine is an object that appears to exist between

Fig. 7 Fractal vines

FIG 7

dimensions (Briggs 1992 p. 22). These patterns illustrate the fact that the system's whole movement takes places continuously at every scale, as a twig reflects the shape of a whole tree, illustrating the chaos idea holism:

> Clouds are not spheres, mountains are not cones, coastlines are not circles and bark is not smooth, nor does lightning travel in a straight line.
>
> (Mandlebrot 1994 p. 2).

Euclidean geometry saw everything as spheres, triangles, squares, cones or lines yet it failed to capture the essence of irregular shapes. Mandlebrot turned to a different idea, the idea of dimensions. In fractal geometry, one finds more and more information the deeper one zooms in. Whereas Euclidean geometry has one dimension of a line, two dimensions of a plane and three dimensional space, fractional objects are neither two dimensional nor three dimensional but some were in between, geometry between dimensions. Mandlebrot claimed that the degree of irregularity (roughness or brokenness) remains evident over different scales. Over and over, the world displays a regular irregularity like the chaos theory of order with disorder.

Fractal images have led to a growing belief that our reality is made up of folded worlds, worlds folded in between different dimensions. This theory is reflected in the work of William Latham whose three dimensional sculptures are suspended within the two dimensional screen of the computer. Latham's work will be discussed in further chapters in more detail.

> We have all evolved inside the same holistic dynamical system called life.
>
> (Briggs 1992 p. 25)

Evolution also works as a classic fractal; Darwin conceived of the evolving forms of nature as an irregularly branching tree or as fish eating smaller fish, drawing attention to the interdependable characteristics of life. Even before the arrival of the new language of fractal geometry, the recognition of structural similarities was already well established. The most widely known example was D'Arcy Thompson's book On Growth and Form (1961) which illustrates the geometrical similarities between all organic forms. D'Arcy Thompson's intuition about the forces that shape life came closer than anything in the mainstream of biology. He thought of life as 'life', always in motion, always responding to "the deep seated rhythms of growth" (Gleick 1987 p. 202) which he believed created universal forms. He was enough of a poet to trust that neither accident nor purpose could explain the striking universality of forms he had assembled in his long years of gazing at nature. If it's true that everything on the planet has evolved through intense interaction with everything else, then these self-similar images of holism we see around us should perhaps not be surprising. The fingers on our hands are 'self-similar' to the wings of a hummingbird and fins of a whale. After all, we all have evolved interactively together in life.

The Mandlebrot set corners the mathematically abstract shapes of fractal geometry which could only be created by a computer. The images owe a lot to the development of computer graphics. It is because of a machine that geometry, which to most people was considered boring, has become an art form, producing aesthetically beautiful images of irregularities and chaos. For example the image in Fig. 8 which Homer Smith of AA Matrix (an independent research group based at Cornell University in Ithaca, New York) calls The Orchid is a part of the Mandlebrot set explored through a mathematical technique used to solve "polynomial equations". (Briggs 1992 p. 81).

Mandlebrot created the set by using a computer to which he applied a simple equation to each point on a plane, the result of which would determine the colour of the point. The equation was then re-applied

Fig. 8 The Orchid

1468 [illegible]

over and over again to the results in a process called 'iteration'. The larger the number of repetitions the more accurate the end result was. Some 'iterations' have up to 30,000 repetitions, a task that would have been beyond any manual capability. The result of this process is the 'Mandlebrot Set' (Fig. 9), one of the most famous images in popular science (Gleick 1987 pp. 215-232). Figs 10, 11, 12 and 13 illustrate how the 'zooming-in' or magnification of the images provides the most interesting shapes, resembling sea-horses. The shape of the black 'bug' near the centre can be found reproduced at different levels of repetition. This is the chaotic region and has the 'self-similarity' characteristics of natural fractals.

The image has also an important property as regards the chaos theory because it is sensitive to any change in numbers, just like Lorenz's artificial atmosphere. Small differences magnify themselves with every repetition.

The creation of these images of worlds within worlds, which only came about because of scientists obsession to control our physical environment, has led to a new awakening of computers for artistic means. In the next chapter the issue of fractals as art will be considered. Fractals are perceived by many people as being beautiful but these shapes were initially developed for the purpose of science, for the purpose of understanding how the world is put together. In other words, the original graphs were not intended to be aesthetically pleasing. Thus being so unavoidably raises many questions, the most important being simply, why? This fact most tells us something about our system of visual perception.

Fig. 9 The Mandlebrot Set

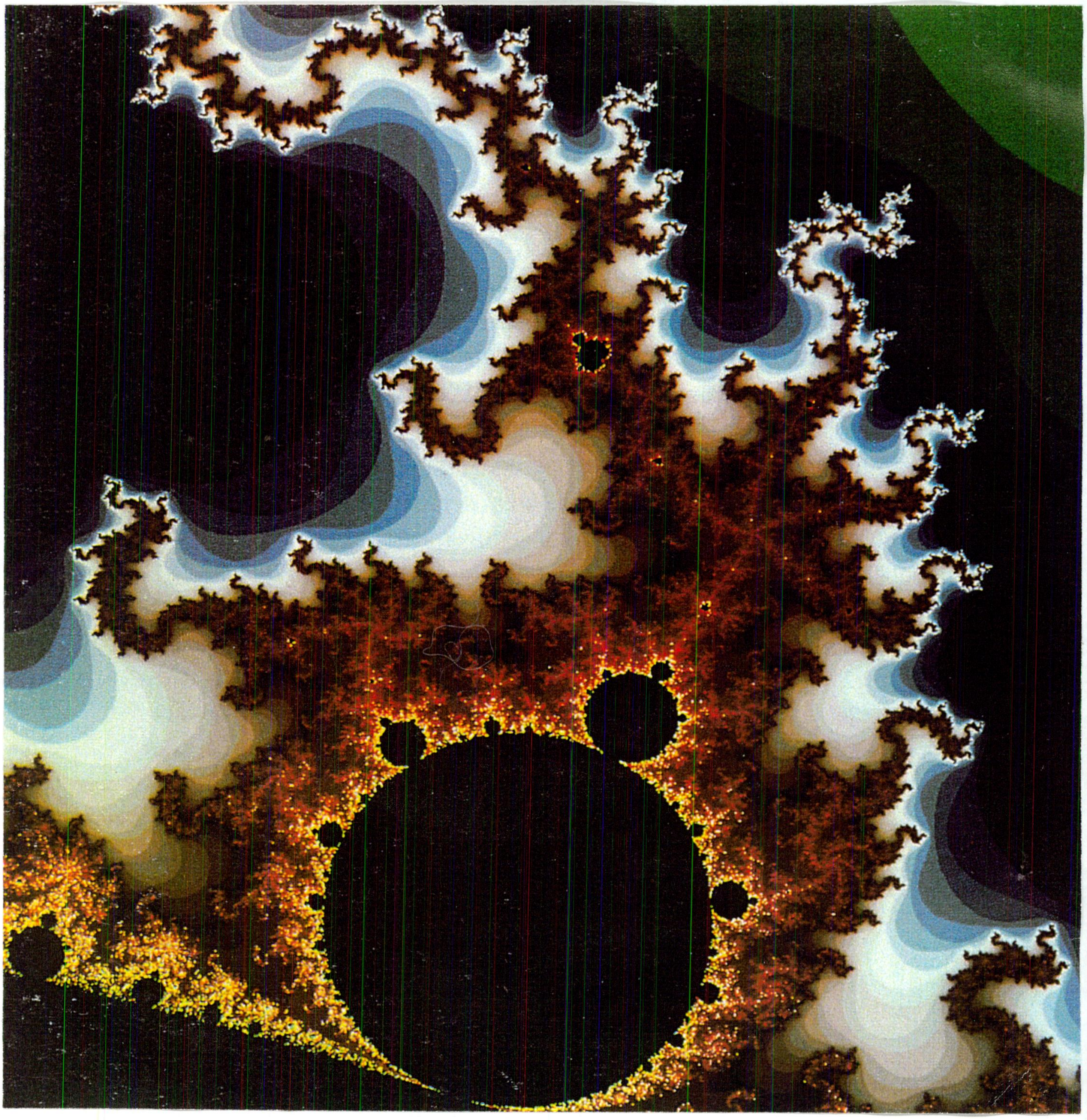
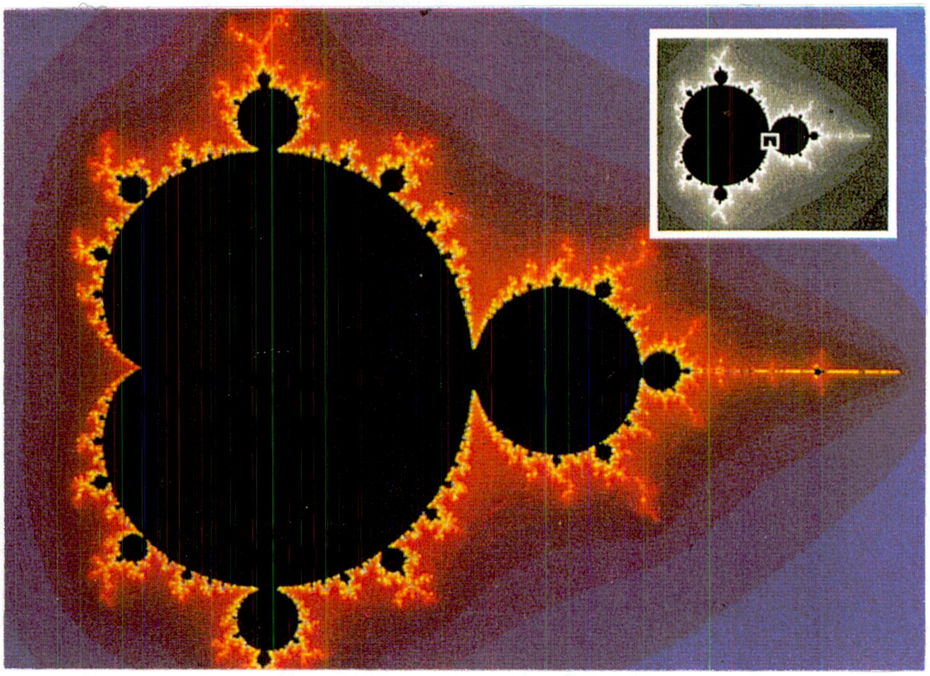


Fig. 10 Magnification of Mandlebrot Set



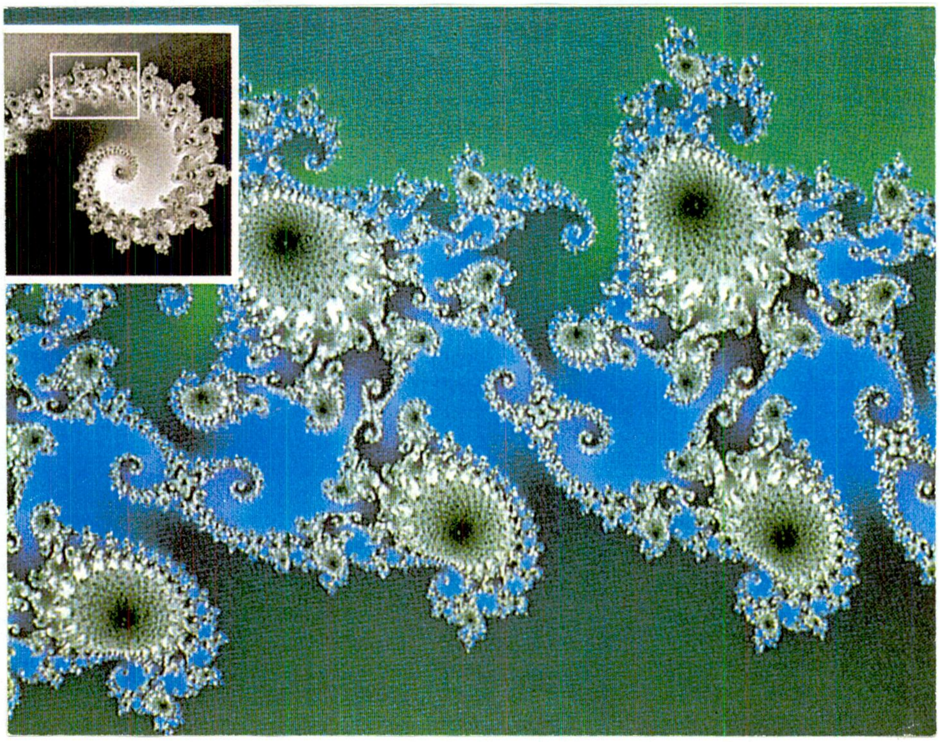


Fig. 11-13 Magnifications of Mandlebrot Set

CHAPTER TWO: CHAOS, FRACTALS AND COMPUTERS IN THE ARTWORLD.

> The most beautiful thing in the universe is the mysterious.
> It is the source of all true art and science.
>
> (Albert Einstein quoted by Richard Wright 1995 p. 395)

Chaos theory and fractal geometry extend science's ability to do what it has always done, find order beneath confusion. With the use of computers, scientists can see chaos, can understand its laws but ultimately can't predict or exert control over it. Artists have always exploited and valued what might be called 'the order that lies in uncertainty'. The English 17th century Romantic poet John Keats admired what he called "Negative Capability", the ability to be "in uncertainties, mysteries, doubts". He claimed that this capacity was key to the artist's creative power. Leonardo da Vinci insisted that "a painter who has no doubts will achieve little". (Briggs 1992 p. 27).

Whatever it is that the artist depicts whether abstract or realistic, the artist's final product implies worlds within worlds. Within art there is always something more there than meets the eye, the mind or the ear. It is because of this very ability that art has always been fractal. Artists know that, like the sensitivity of a chaotic 'dynamical' system, a change in one small part of a painting, poem or a piece of music may destroy or transform the work.

In the brain, evolution has provided us with the ultimate pattern recognition tool: our ability to distinguish pattern has been central to our survival as a species, in short art. It is not the rigid pattern of conventional geometry that attracts us, but irregularity. Compare, for example, a hand-knotted oriental rug with that of a machine-made copy: the pleasure in the first comes from its slight irregularities, the breaking of pattern within a greater pattern, the deliberate error. The machine

version is regular and perfect - 'perfectly boring'. For artists, irregularity has always been important. Even the obsessively rectilinear modern Dutch painter Piet Mondrian left drops and faint wavers in his straight lines to indicate the presence of the human creator behind the abstract mathematical shapes. Michelangelo carved his sculptures by following the grain in the marble. Artists know that the subtle irregularity of a line and its variable thickness embody its energy, its life. Indeed, it might be argued that irregularity is an important feature of art and a part of what makes an artwork beautiful to us.

The artist and the artisan are often hard to tell apart. For example, objects that were meant to be utilitarian, be they folk architecture, religious imagery or drawings and photographs of nature, often end up being regarded as genuine works of art. It may become hard to distinguish them from works in which science was used almost as an excuse for artistic creativity. Thus, art faces us with many possibilities; we are presented with innumerable works of art for the sake of commerce, objects have been commissioned under precise specifications to be useful, to decorate, to educate, to flatter, to entertain, to impress or to persuade. We are also presented with a few works created strictly "as art for art's sake". (Mandlebrot 1989 p. 21).

During the 1970's when Mandlebrot conceived and developed fractal geometry, it lead to a worthy topic for discussion, that this new geometric language has given rise to a new form of art. The majority of fractal art has not been commissioned for any commercial purpose, even though all the early work was done at IBM's Thomas J. Watson Research Centre, New York, USA It appears that fractal geometry has "created a new category of art; next to art for art's sake and art for the sake of commerce, art for the sake of science (mathematics)". (Mandlebrot 1989 p. 21).

Fractal 'art for the sake of science' is indissolubly based on the use of computers. It could not possibly have arisen before the hardware was ready and the software was being developed, that is, before the decade of the seventies. The images created by fractal art have an uncanny resemblance to the designs and colours painted by the 'hippy' generation of the sixties. Maybe they had some subconscious vision of the irregular geometries in nature and the holism of our world. What a curious irony, that this new geometry which everyone seems to describe as 'baroque' and 'organic' should owe its birth to an unexpected new match between mathematics and the computer.

This new form of art redefines the boundary between science and the plastic arts. Since fractal art and computer art are closely bound, then the same arguments can be applied to both. Can pure geometry be perceived by the man in the street as beautiful? To be more specific, can a shape that is defined by a simple equation or a simple "rule of construction" (Mandlebrot 1989 p. 21) be perceived by people other than mathematicians as having aesthetic value, or at least as being decorative or perhaps even as a work of art? Even when fractals are taken raw, they are attractive. They are like painting by numbers, which can be surprisingly effective even in the hands of the amateur. Yet painting by numbers or kaleidoscope images are beautiful and effective but are nothing more than attractive novelties, not works of art. The lack of human intervention raises some questions. Are fractals completely devoid of human input or do they simply lack artistic intervention? They are obviously created by somebody, usually a mathematician. Some might say that fractal images are incomplete art, since they are abstract and not culturally rooted. Since our culture is extensively rooted in technology so fractal / computer images most reflect that aspect of our lives to some degree.

The most successful attempt by scientists working with fractals and chaos theory to give their work wide appeal has been the series of

exhibitions and books produced in the mid-1980's by a group of German mathematicians, principally Heinz-Otto Peitgen and Peter Richter. Their exhibition Frontiers of Chaos organised by the Goethe Institute, Munich (1984) and book The Beauty of Fractals (1986) were daring ventures by scientists to juggle the immediate seductiveness of the imagery of fractals with their importance as scientific artefacts. Indeed, in their book they state that at first they thought the attractiveness of their pictures would be enough to satisfy their audience without the need for any further explanation. There have been other groups of scientists (sometimes artists as well) who have sought to present work derived from scientific experiments in a 'cultural context' (Wright 1995 p. 395). Mostly they restrict the images to an aesthetic frame until they become a kind of mathematical ornament. It sometimes seems as though a scientific graphic image can acquire a cultural status simply by cutting off its scientific function. Typical of this is the group based at the Illinois Institute of Technology, who states that their aim is "to communicate their love of the other complex mathematical beauty of nature". (Wright 1995 p. 397).

Scott Burns, as associate professor of engineering design at the University of Illinois, studies a piece of fractal mathematics he called Newton's method. The method is named after its inventor, Isaac Newton, is a "shortcut for finding the roots of a polynominal equation" (Briggs 1992 p. 149). Burns, who works on Macintosh personal computers, shows some of the work he creates at craft fairs and galleries in America. Burns says his mission is to convey the beauty of mathematics because it's also the beauty of nature. These images represent his personal expression of the hidden beauty that surrounds us. You may question, is it art? In some ways these images (Fig. 14 and Fig. 15) may be thought of as painting by numbers on a grand scale. Burns doesn't believe in taking credit for the many shapes and patterns; he says they "occur naturally in mathematics". (Briggs 1992 p. 150). Yet there is some human intervention because it is Burns who

Fig. 14 Image by Scott Burns

Fig. 15 Image by Scott Burns

makes the choices of the colour palette and when to shut off the iteration (repetition) of the equations, like a photographer who doesn't know the final images until he has processed the film. As Burns says himself, "I can focus the picture but I don't really have control over what it is that's being seen" (Briggs 1992 p. 150). This idea of not knowing the final image until the end result is reached can be applied to most art works. Did Jackson Pollock know the exact image that would come about after his vigorous splashing effects during the Abstract Expressionist movement? Or the English Land artist Richard Long does not have any pre-conceived vision of the piece of sculpture which he would leave behind on a mountain after one of his walks.

Mario Markus, a physicist at the Planck Institute in Dortmund, Germany, is another researcher into fractal imagery. Using his computer screen as electronic graph paper, he plots a series of equations that describe the transition zones from order to chaos. These equations can be used to model real systems which have complicated interactions, such as the turbulence in fast-flowing water. In Figs. 16 and 17 the deep blue background in each describes the dark domain of total chaos. The infinitely intricate shape in the foreground is a fractal creature that breeds and lives in the region of transition. (Briggs 1992 p. 152).

Markus confides that making his plots has brought a new form of art. Surely, one could make the objection that these pictures were produced by the computer program and he just had to press a few buttons. However, as mentioned before, this objection could also be made about photography. It can be said that one only needs to look through the camera and press a button. The reason photography is considered an art is that a good photographer does a lot more than push a button. He chooses an object, an angle, a lens opening and time, a million other possibilities. Furthermore, he can manipulate darkness and contrast in his lab. A photographer thus "has many degrees of freedom with which

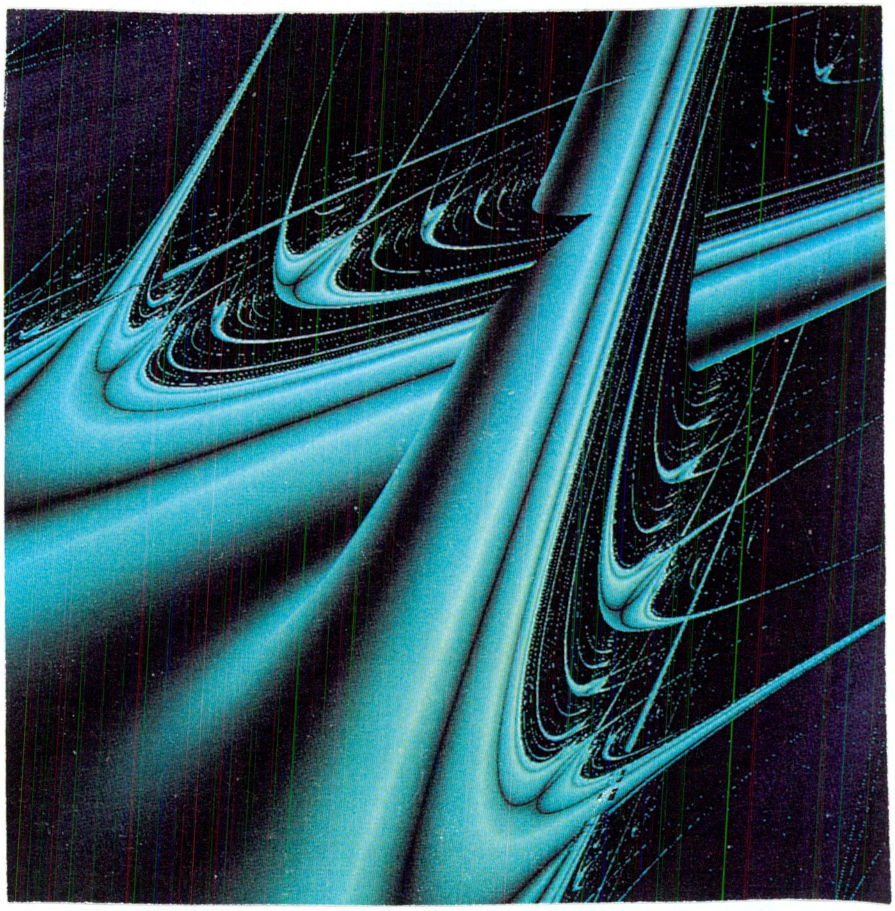


Fig. 16 and Fig. 17 Images by Mario Markus

to express an emotional state within a high-dimensional space of control parameters." (Briggs 1992 p. 152) According to Markus:

> The parameters I control are degrees of zooming, windows, horizontal and vertical scales, colours and sometimes a third dimension according to some intensity level. An even greater diversity is possible when one starts to change and choose the co-efficients of a formula. Truly one can say that equations can be considered here as new types of painting brushes.
>
> (Markus quoted in Briggs 1992 p. 152)

So if photography is considered art, then surely computer generated images are also artistic.

If photographers do not make their film, poets do not build their typewriters and painters do not weave their canvasses, so why should artists working with computers write software? The answer is in a question frequently raised: Is the computer a tool or a medium? In the strictest sense of the word, the computer is neither a tool nor a medium, it is the programs which are the tools and the printers, plotters, sound synthesisers are the media. (Nadin 1989 p. 46).

Artists have always been explorers and one of the primary areas for innovation by contemporary artists has been in developing new connections between media. For example, within the thirty years artists have developed the genres of video and performance art, which are now considered mainstream. Since the 1960's the media have been a primary focus of artists. So what could be more exciting for innovation than the computer? This is one of the reasons why artists should learn to program. If artists are going to work with media as their subject matter, they must expand upon software that already exists. According to Craig Hickman in his article for Leonardo magazine programming

offers artists the flexibility they need to explore new boundaries. (Hickman 1991 p. 50).

Basically, a computer is made to perform a finite number of tasks. A typical task might be to take two numbers, add them together and store them. The computer knows which instructions to perform by reading a list of them and "executing the instructions in proper order". (Hickman 1991 p. 49). This list is called the 'program'. So it is this list of instructions that determines the type of imagery the artist will produce.

One of the major considerations of the digital medium is the instant replication of the notion of the original so that uniqueness and the attraction of ownership will have to undergo reinterpretation and change. Our understanding of the artist's public relation changes as the distinction between artist and public gradually disappears with the advance of interactivity and virtual environment which will be discussed in a later chapter. In the 'electronic medium' everything done by an artist can easily be re-processed by the public. Variations can be produced by a matter of interaction by the public on their own personal computers with the artist's work - by using the same software as the artist. (Nadin 1989 p. 46)

> Thus art does not progress but tries in each generation to connect the unique spirit of a time with a primordial mysterious insight that lies deeper than chaos.
>
> (Briggs 1992 p. 177)

Over the past ten years, digital images and computer technology have come to exist in our daily experiences. From graphic images in bank machines to Hollywood films awash in high-tech special effects, from advanced scientific visualisation to personal computers, the electronic image has changed the way our culture perceives itself and receives its

information. A technology that is used throughout culture as a tool for communication, documentation and creatively has placed itself squarely in the centre of our lives. A pure form of expression from the computer is realised through interactivity or through the artists personal software i.e. programs. If artists don't produce their own software, the images created can't go beyond Markus or Burn's images of fractal art and will be only a kind of scientific ready-made with really very little interest.

Breaking the boundaries of traditional display of form and content, a new generation of artists has begun to explore the potential of the computer, dramatically reshaping and redefining contemporary artistic production. One such artist is William Latham, who has pushed computer-generated images that step further than work of Markus and Burns. His work is concerned with evolving and breeding natural-looking forms and his techniques resemble many characteristics of fractals. With the combination of computer graphics, the chaos revolution and fractal geometry Latham has generated new kinds of visual images.

CHAPTER THREE: WILLIAM LATHAM'S EVOLUTIONARY CREATURES

William Latham designs evolutionary and organic forms which are evolved by a computer program called 'mutator', an artistic system based on natural geometry. He draws his inspiration from natural shapes and creates his unique works by applying a selective mutation process to literally breed aesthetically pleasing forms. He pushes the static images created by the computer from the world of novelty to a world where sculptures breed, mutate, and evolve. A parallel can be found between the ideas of chaos and fractals and those of Latham's animated forms. He has opened doors into new dimensions which offer artists the chance to turn the imagined into the visualised in a way which is impossible using paper or traditional methods.

Latham was first inspired by natural systems, while still a student in 1984 and how they often relied on the repetition of very simple steps, such as crystal growth or the creation of stalagmites by water dripping in underground caverns. Even biological processes are related to the simple geometries articulated by D'Arcy Thompson (1961) as discussed in chapter one, and both D'Arcy Thompson and Latham recognised the fact that repeated small changes in mutation and natural selection give rise to a huge variation of interesting biological forms.

Latham felt that these natural systems have a huge potential for creating artistic forms. He wanted to explore these to go beyond art systems such as the Russians' Constructivism and create a new system for producing synthetic organic forms. He had already observed that he was using some kind of system when applying techniques such as lithography to gradually change an image as he repeatedly printed it, and so he became interested in producing his own experimental system for making art. (Latham / Todd 1992 p. 2).

While studying at the Royal College of Art as a fine art student in 1984 he was intrigued by the idea of an "evolutionary tree of sculptures" (Latham / Todd 1992 p. 2) whereby an image is gradually changed by applying a series of operations or rules to a set of simple forms. In Latham's case, the rules were called by him beak, bulge, scoop, union, stretch and twist and the forms upon which they were performed were a cone, a sphere, a cube, a torus and a cylinder. Eventually in 1984 Latham produced a large drawing called <u>The Evolution of Form</u> (Fig. 18) and detail Fig. 17. At the top of the drawing are a number of primitive geometric shapes - a cone, a cube etc., which gradually evolve into more complex forms as they near the bottom of the drawing. These sets of rules named by Latham "FormSynth" were specifically developed to explore evolution and artificial life. This system he began using for creating his forms was brought about long before he used computer graphics and reveals the principle behind all his work. (Latham 1988-89 p. 13).

<u>The Evolution of Form</u> drawing shows a massive number of forms, each carefully drawn, each slightly evolved from the last or a combination of a few. Latham could choose which forms to evolve, usually the ones that he considered to be the most aesthetically pleasing. The drawing resembles an evolutionary family tree where any form could be traced back to its ancient relatives, regardless of how complex it had become. Latham, thus takes on the role of a creator 'God' and gives preference to more beautiful forms; but instead of the survival of the fittest, the survival of the most aesthetic applies.

Latham's 'tree' of irregular forms resembles fractals in the way the forms don't have any definite end, just the limitation of the paper or the patience of the artist; thus the number of mutations is vast. In 1985, the creation of "FormSynth" system led to a major shift in Latham's way of thinking as an artist. His attention shifted from the creation of a single sculpture to the idea of producing millions of sculptures. To Latham a work of art now became the whole evolutionary tree of sculptures, like the holistic idea of sensitive chaos (chapter one).

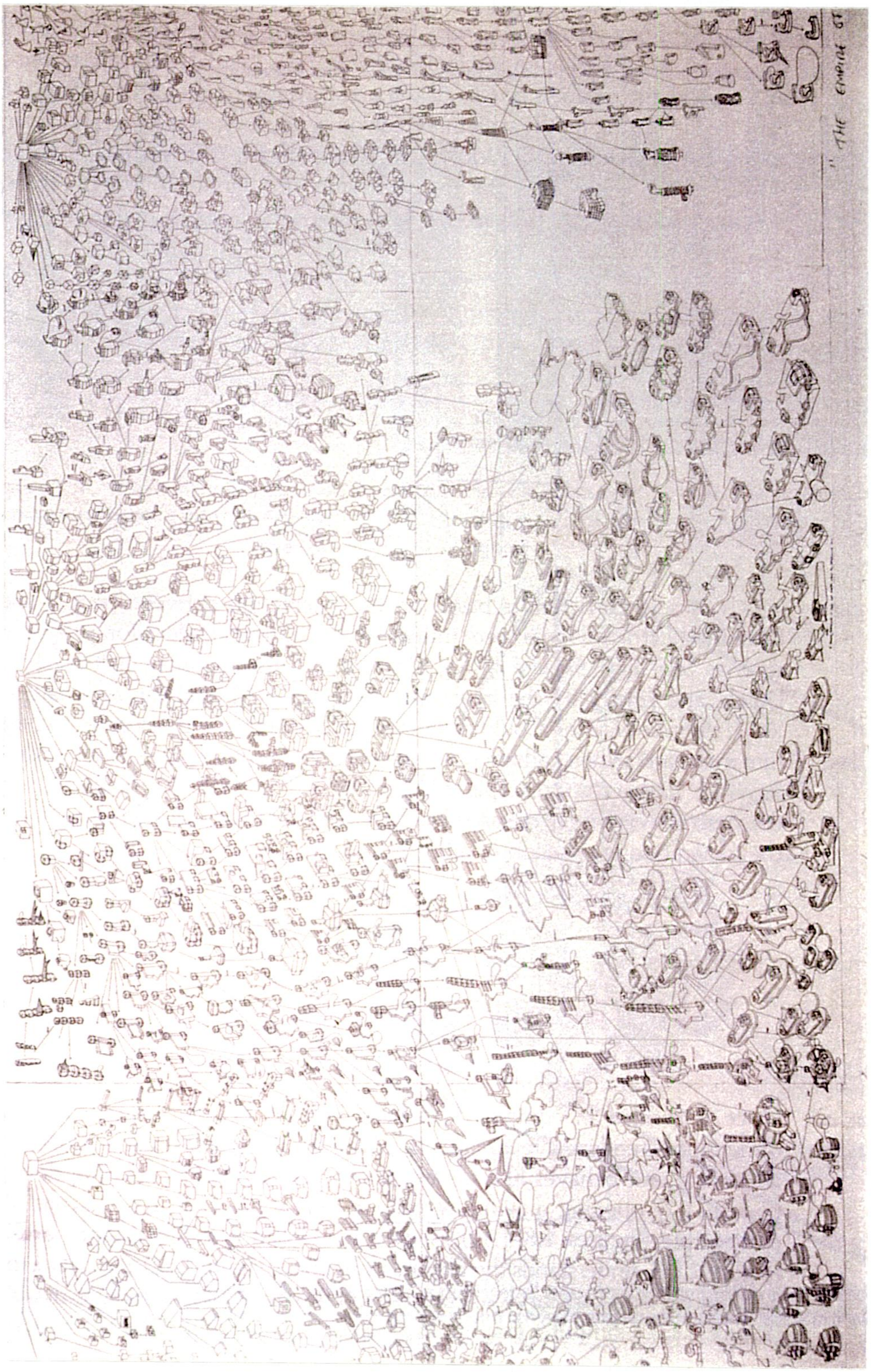
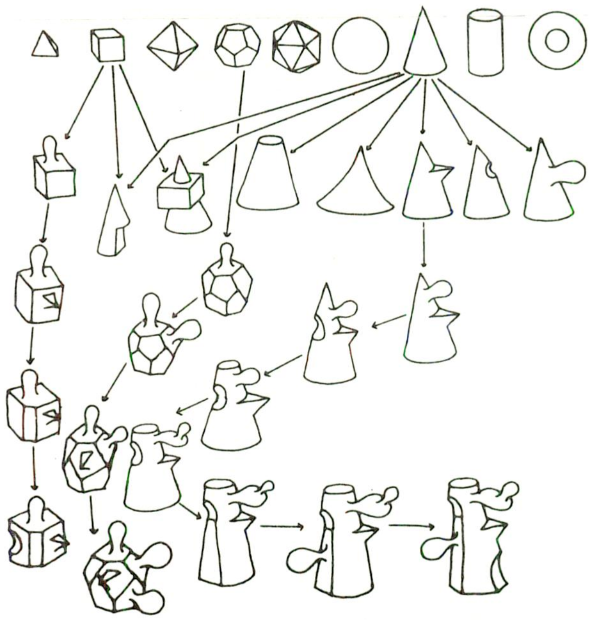


Fig. 18 The Evolution of Form



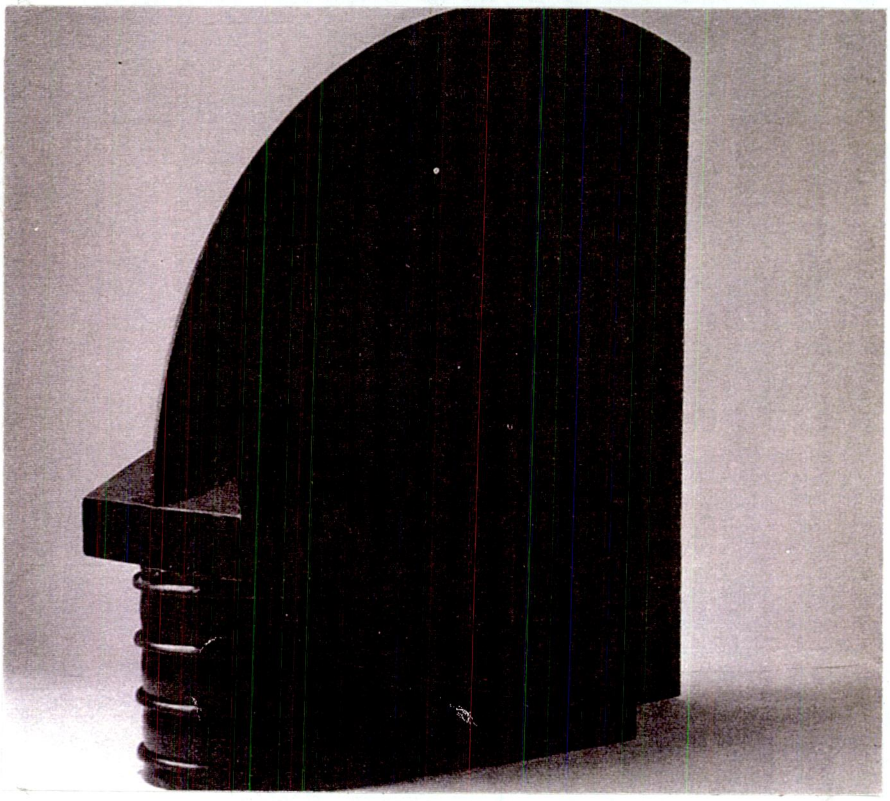


Fig. 19 Detail of the Evolution of Form

Fig. 20 FormSynth Sculpture

In 1985, Latham created several physical sculptures by selecting forms from the 'Tree' drawing and then making them out of plastic and wood; one of these can be seen in Fig. 20. He found using traditional media i.e. wood, very time-consuming and creatively restricting. What really interested Latham was the searching for the different shapes, the 'FormSynth' system. He found that it was in the drawing that he could create complex forms. It was because of this complexity that he could not reasonably build every single form. He found that many of his forms were physically impossible to build. He says that the few forms he did build had to have a wide enough base, which meant that in the end they were not the most aesthetically pleasing. (Latham 1988-89 p. 16).

Although drawing seemed to have advantages over sculpture, it still had disadvantages of its own. Latham's forms were representative of three dimensional shapes, yet were flat two dimensional images on paper that didn't involve the interaction whereby the viewer sees the whole of the form. i.e. viewing the shapes from different angles. Latham wanted "to continue working on the drawing instead of carrying out the mechanical execution of the sculptures". (Latham 1988-89 p. 16). Since we are surrounded by a world that is constantly pushing and pulling at itself, one would say, Latham's 'FormSynth' reflects this beautifully. It also questions the static nature of an individual sculpture and to arrive at a finished piece, there have been many interacting elements i.e. making mould, material etc. Latham started looking for more efficient ways of rendering his evolving forms, as manual methods were too restricting:

> I think the computer screen is like a gateway into another domain, in some ways people have realised that we can't go very far into space but we can explore computer space. What's even more fascinating is that this is a world that you invent then explore.
>
> (Latham 1995 p. 1)

Latham found the computer to have many of the capabilities he needed to create his forms. It is because of the computer's efficiency at producing work quickly and also its ability to handle any shape without having to consider physical constraints, such as gravity, material etc., that led him to not only render his forms but eventually use animation to evolve them. Latham was also fascinated by the interaction between man and machine, as seen in computer games and science fiction. His ideas were influenced by films and television programs such as Star Trek, Stepford Wives, Dr Who and the half man, half machine Dalek and, finally, by the interaction between Hal and the astronaut in the motion picture 2001: A Space Odyssey made in the seventies directed by Stanley Kubrick. (Latham / Todd 1992 p. 6).

Could machines really interact with an artist to help him or her create art? According to Latham, computers can help artists produce work that lies beyond their imagination. He uses the computer to help him produce sculptures which only exist within that twilight space between the human mind and the machine, reflecting the ideas of fractal images, as discussed in chapter one and two, of worlds suspended between dimensions. Latham's ideas of biomorphic evolutionary forms captured in artistic systems and embodies in computer software make the computer into a potentially highly trained assistant. He thinks of the computer as a creative partner, almost a shadow of himself. In 1986 Latham began to experiment with a wide variety of programs and machines without any real creative success. The progress was slow at first due to having to learn about computing but gradually it became clearer how computers could be used to help his purposes. With the aid of Mike King of the City of London Polytechnic and King's program 'Sculptor', Latham began to be able to create any sculpture that he had evolved through 'FormSynth' but these would have to occupy a virtual, as opposed to a physical space. (Latham 1988-89 p. 16). Latham describes his works as the "ghosts" of physical forms, in which the computer is like "Alice through the looking glass - a view of another world". (Latham quoted by Stallabrass 1994 p. 15)

In 1987, Latham was given the opportunity to explore computer imagery further when he was awarded a Research Fellowship at IBM's Scientific Centre in Winchester, England. Most of the programs which he still uses were developed for the study of scientific data and are therefore different from programs often used in computer art. It was at IBM where Latham teamed up with Stephen Todd, a mathematician and specialist in database, computer code theory and graphics. Latham and Todd worked as a team to put to life Latham's forms.

All the images he has published since 1987 have been prepared using systems written in the Extensible Solid Model Editor (ESME) - a high level interactive language of graphics and geometry features, also using the Winsom render which controls lighting, colour and texture to give a realistic but surreal representation of the sculptures. It is because of the Winsom render, which allows for accurate rendering of light, shade, reflection and so on that the computer images are often indistinguishable from photographs.

It is because of three systems (programs): Form Grow which generates lifelike forms using geometric rules, Mutator which is based on evolution and natural selection and life cycle which animates Latham's forms by rules of birth, growth and death, that the term 'Artificial Life' can be applied to his work. His animations of organic-looking 'creatures' that display many of the characteristics of life - birth (Fig. 21 and Fig. 22) called Breeding Forms on the Infinite Plane (1991) which shows a form giving birth at the same time as it is being born, death (Fig. 23), showing the death of a form using the Life Cycle system and many others, such as reproduction and ageing.

Latham constructs his forms from various pre-defined drawings. Fig. 24 is an example of a hand-drawn sketch of a lobster-like form drawn when working out the concepts for his film Mutations (1992). These are then modified by the program called "Mutator", which stimulates evolution.

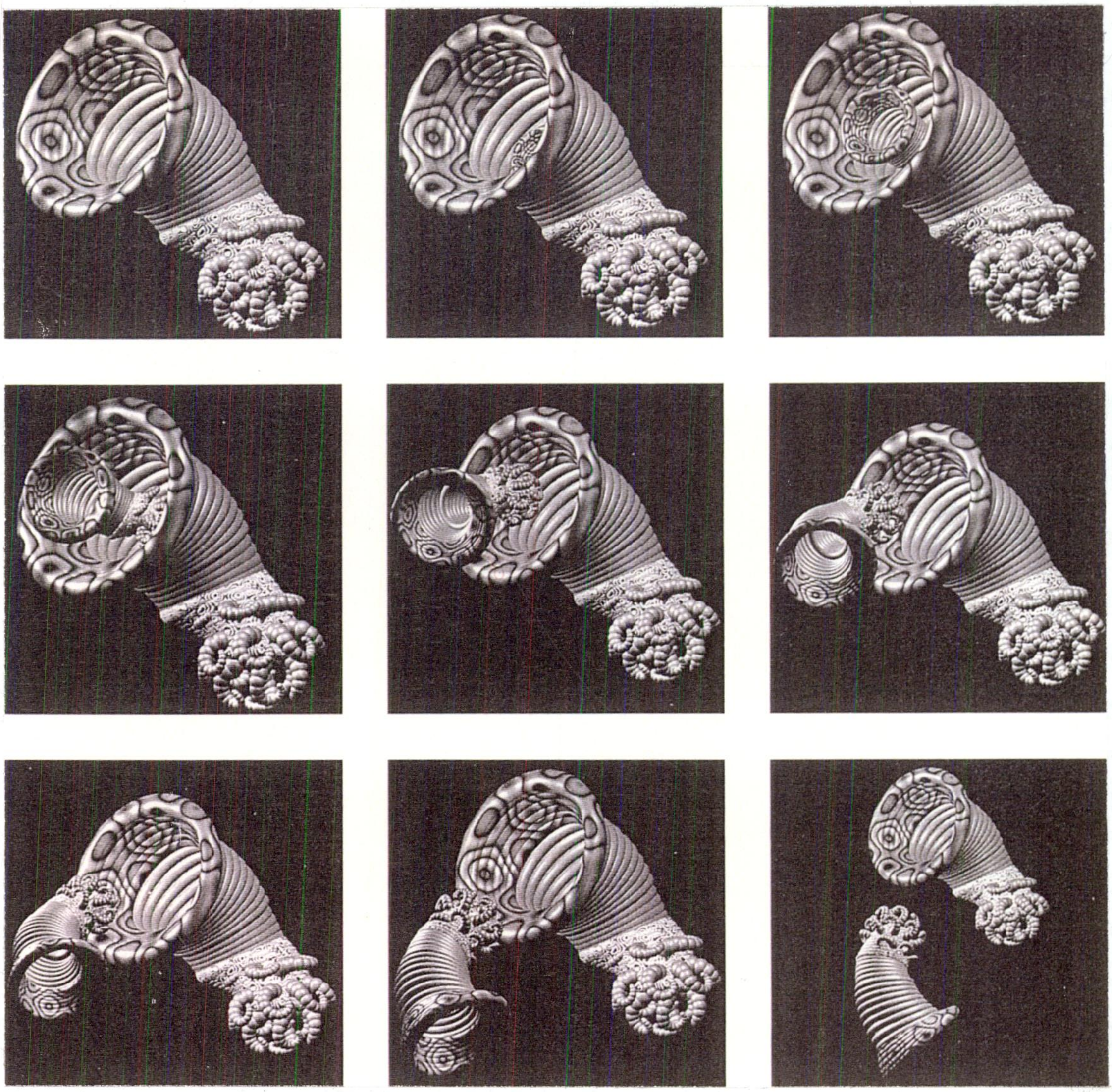


Fig. 21 Form Giving Birth

Fig. 22 Breeding Forms on the Infinite Plane

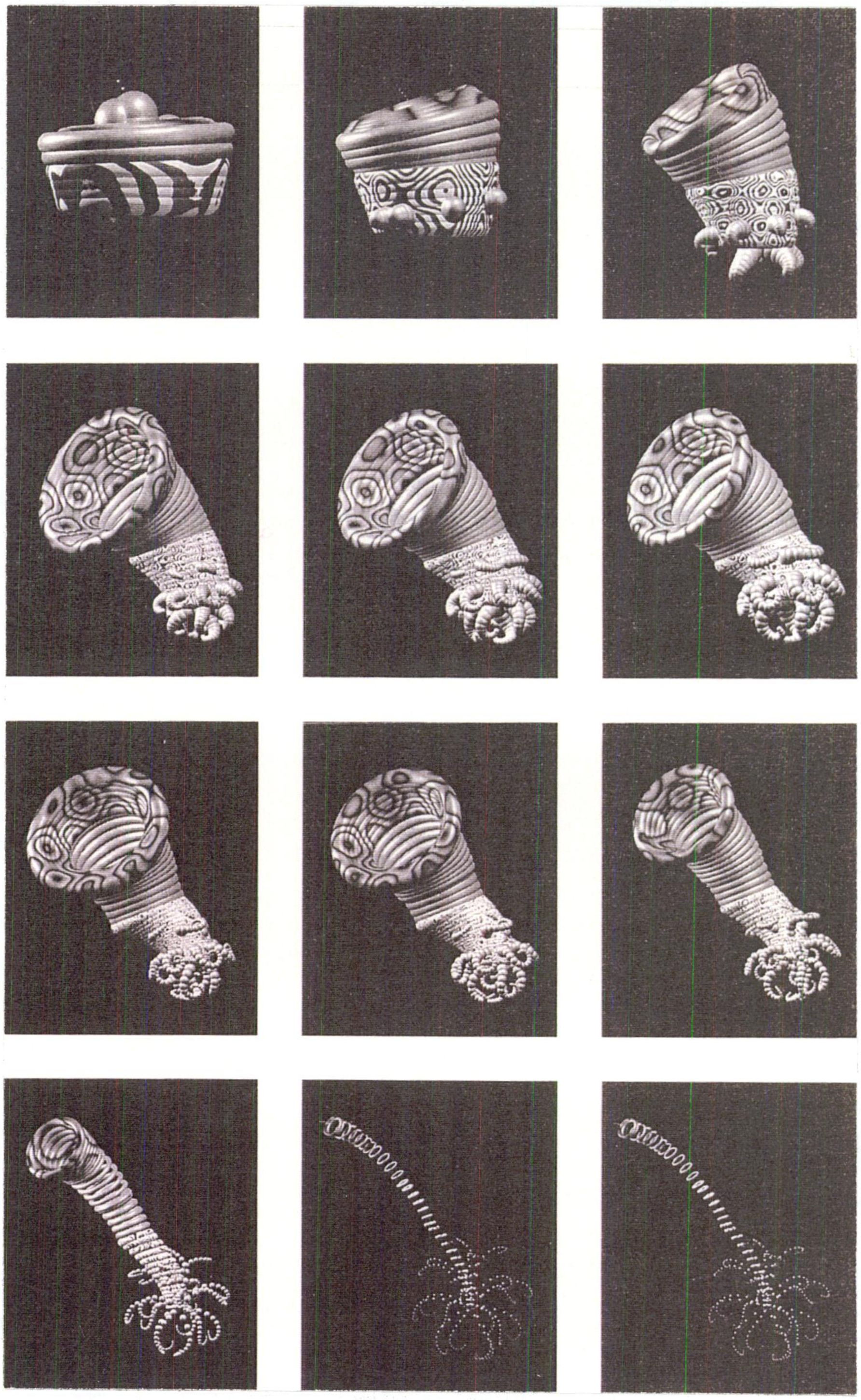


Fig. 23 Death of a Form

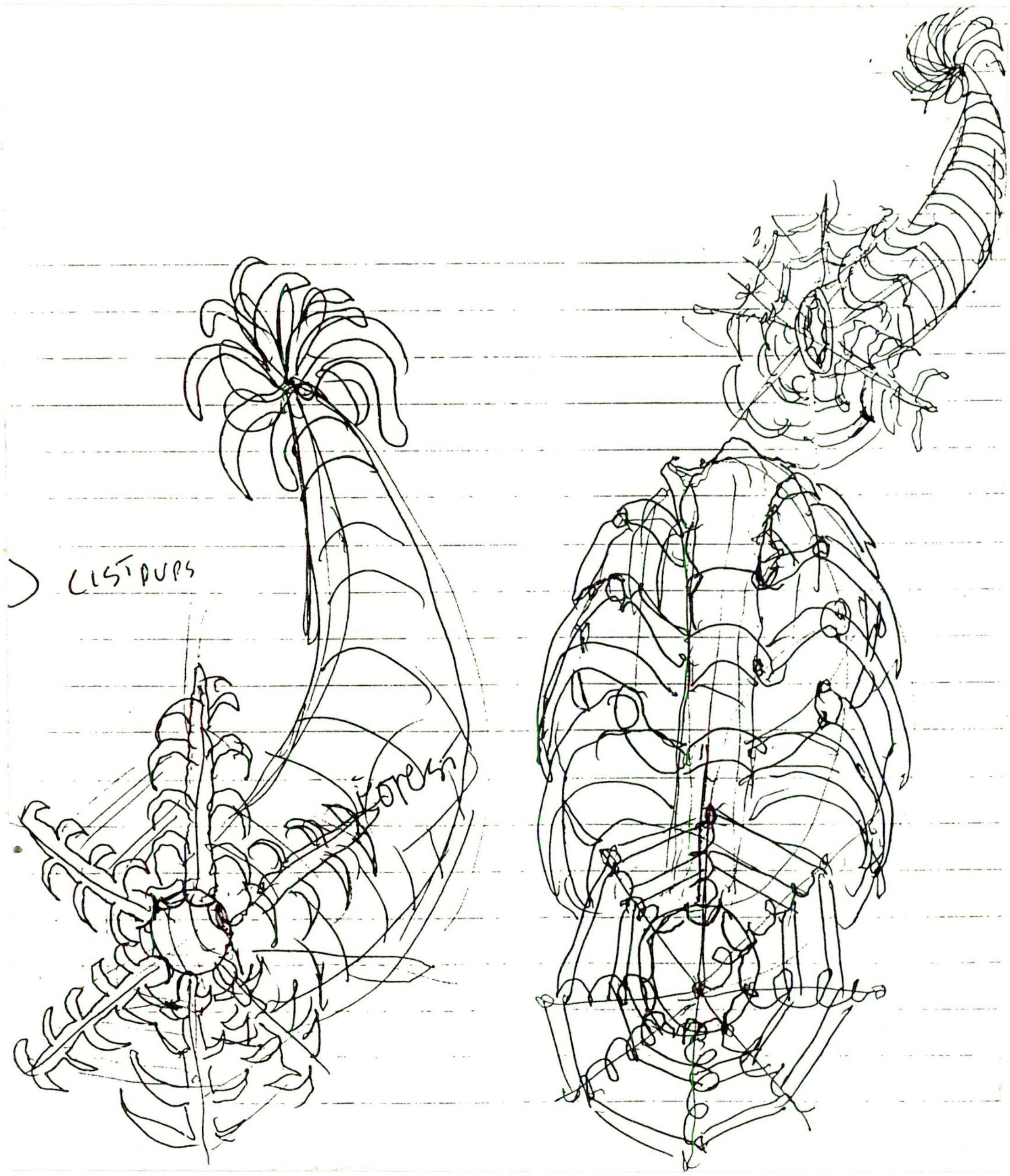


Fig. 24 **Hand-drawn sketch by Latham while working out concepts for the film <u>Mutations</u>**

Sets of numbers take on the role of genes, while the higher level programs determine structures into which these genes are fitted. The computer presents Latham with a set of nine forms generated from a starting image (Fig. 25); he then picks the one he likes best on purely aesthetic grounds (Fig. 26). The final pictures are merely the fruits of what Latham calls an "evolutionary tree" (Latham quoted by Stallabrass 1994 p. 15). In his art, it is the survival of the prettiest. Latham is the creator of these creatures and without his direction, they wouldn't exist. These forms which Latham refers to as "actors" are comparable to puppets, brought to life for as long as the puppeteer controls them. He assumes the role of choreographer and the movements of his pieces are filmed.

Latham is attracted by the idea of creative human / computer interaction and exploits the potential of this artistic medium and was finally led by the power of three-dimensional computer graphics into an artificial virtual world (Latham and virtual reality will be discussed in more detail in the final chapter). According to Latham, the artistic process takes place in two stages, creation and gardening. Latham first creates the programs of the virtual world, applying whichever physical and biological rules he chooses - light, colour, growth, evolution and other rules / programs of his invention. He then sees himself as a gardener in this virtual world he has created in which he selects and breeds sculptural forms as a botanist breeds flowers and he records the evolutionary process in animations which show skeletal forms unfolding and surreal lobster creatures breeding.

The art created by using Latham's systems has a distinctive philosophy and generates unique results with a distinct artistic style which Latham has called "evolutionism" (Latham / Todd 1992 p. 12). It makes no difference if a final image is animated but the system through which the forms are created is clearly based on biological theories of life and evolution. It reaches beyond the imagination of traditional sculpture to

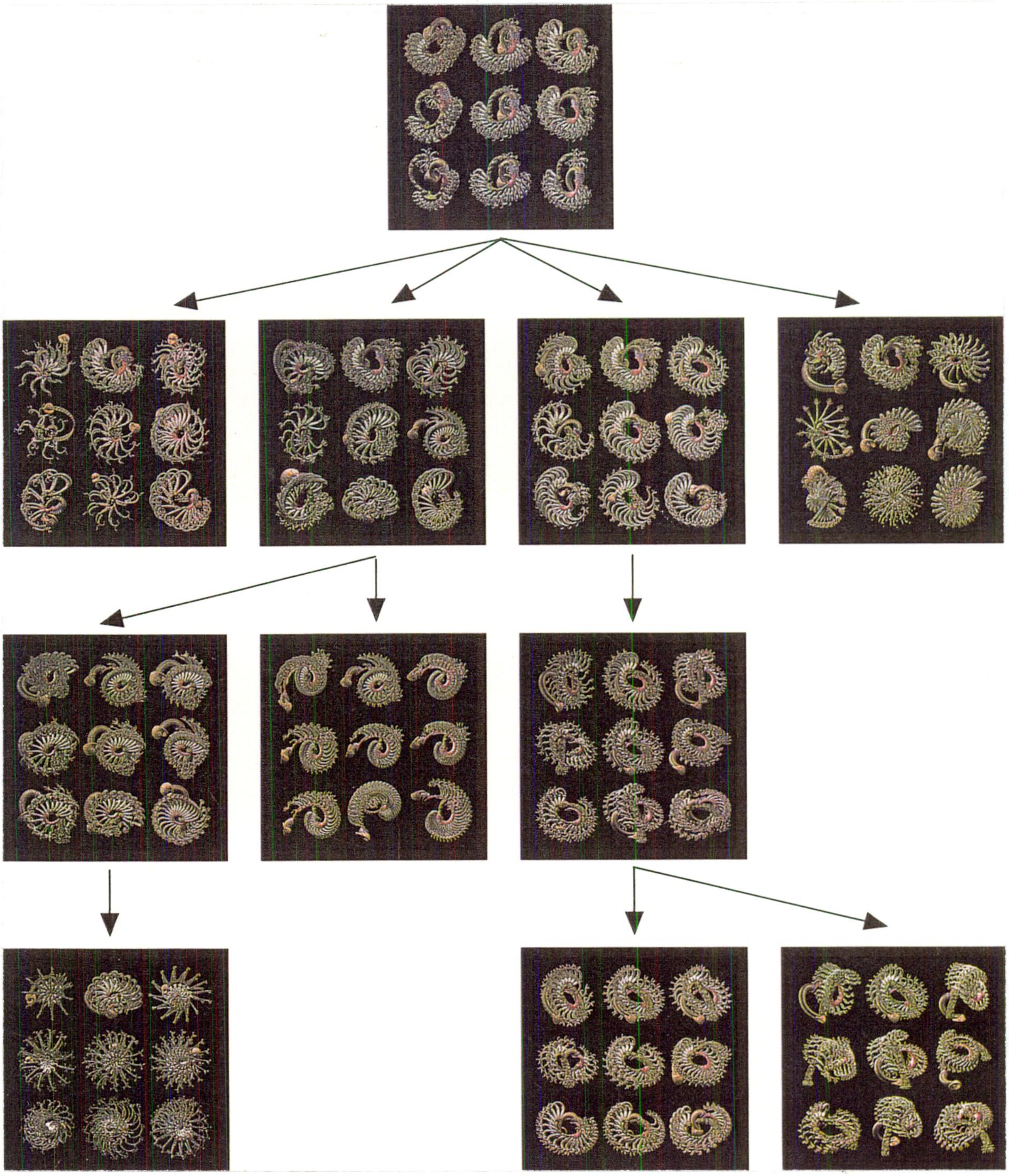


Fig. 25   Large Mutator Evolution Tree

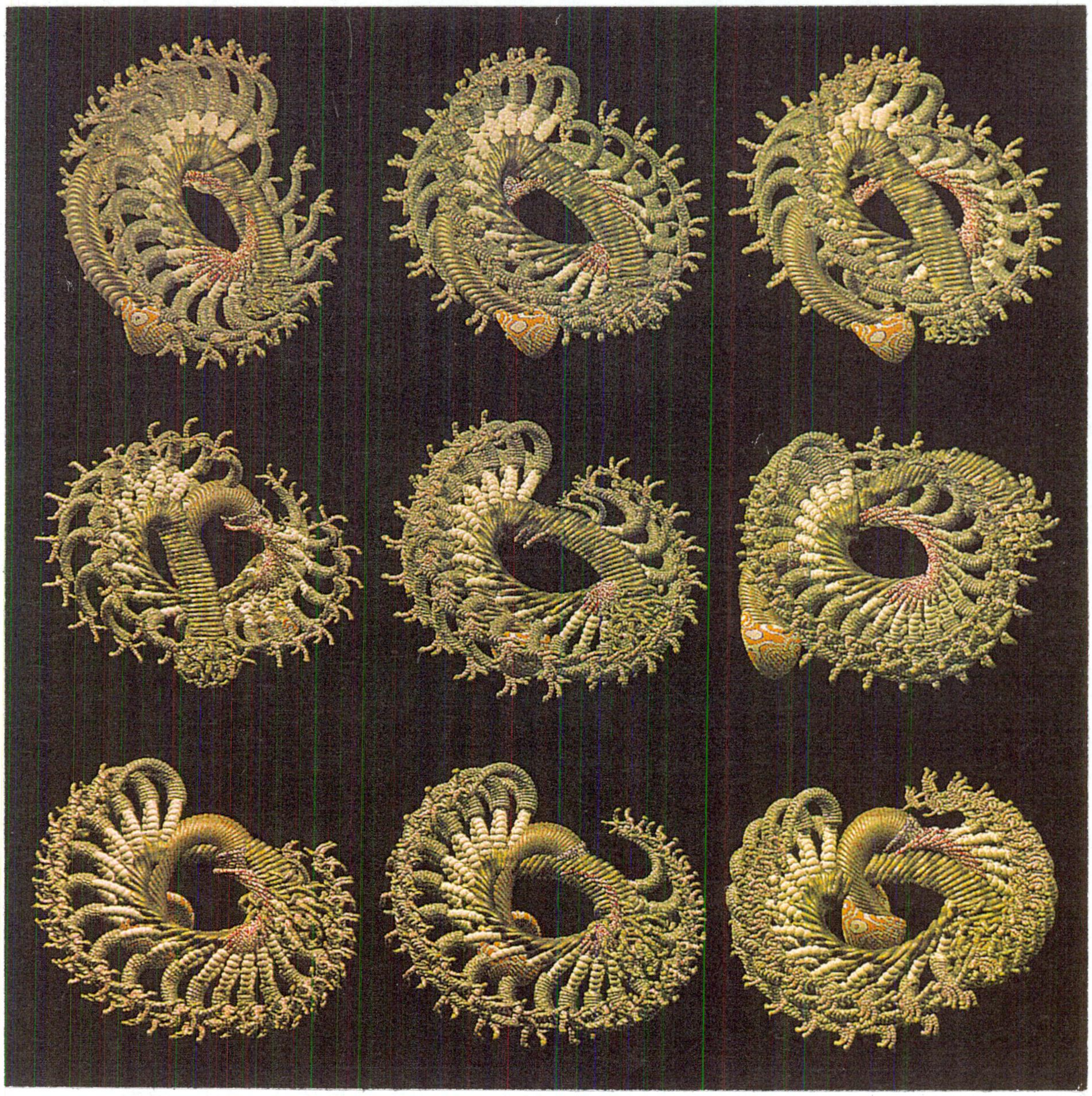


Fig. 26 Nine Mutations

invent a new style. Since all organic forms have developed by evolution, it should not be surprising that the results are so hauntingly familiar. Latham's use of synthetic colours and metallic surfaces intensifies the sense of magical strangeness; these are structures which seem natural but which appear to proclaim their artificiality. They are suspended weightlessly, like "ghost of physical sculptures in that they only exist in the form of data, not in physical form". (Latham quoted by Martin 1989 p. 122)

There is a suggestion of a powerful metaphor for life and growth as the program codes operate like DNA in a cell, to generate various forms. The images convey a hypnotic feeling, as if man had stumbled on the 'generative' secrets of the universe. His works could be interpreted as an artistic approach to genetic engineering:

> I am making a direct reference to genetic engineering and the way we are messing with nature. I too am using genetics and inbreeding to come up with my work. And like the scientist you can't help but be fascinated by it. It's addictive, you can't but explore but some of the results are very extreme.
>
> (Latham 1995 p. 2)

In the real world genetic engineering for the sake of art would be ethically questioned but because of Latham's virtual computer space, all is possible. He plays God and picks the forms he likes best and evolves these until the process at artistic selection yields something he's happy with. Of course one of the most fruitful sources of evolutionary mutation in nature is sex, and Latham's program has an equivalent to this. He can combine forms he likes in order to generate aesthetically interesting offspring. However, he isn't limited to heterosexual couplings. He can set up polygamous, incestuous liaisons between one form, its grandparent and second cousin, all in

the name of pushing back the boundaries of art: "With a mixture of human creativity and evolutionary things, things that are beyond the human imagination, there comes a point when you cross the boundaries of what is familiar." (Latham 1994 p. 2). It is because of new technology that Latham's work has developed into our cyber-culture of today and can make visual the unimaginable. This development will be discussed in more detail in the final chapter.

In order for us to experience the atmosphere and imagery Latham creates, it is important to discuss in more detail, works from two different forms in which he exhibits his works: First, from a gallery exhibition from 1988-89 and secondly, an animation from 1993 which shows how he has developed for the mass-media and television.

Latham's exhibition viewed from 1988-89 in the Arnolfini Gallery in Bristol (Fig. 27) revealed to the public his style 'evolutionism' and organic, yet surreal imagery. This exhibition of his work, and more advanced work, was also shown in Dublin in 1991 (Fig. 28) at the City Arts Centre. The exhibition consisted of several large Cibrochrome prints of forms at different angles accompanied by a short animated film called <u>Conquest of Form</u> (1993). The images portrayed resembled organic shapes such as the brain, intestine, muscles, shells and also molecules. The most obvious imagery used was often curiously marine-like forms, which were suspended weightlessly and the movement in the sculpture had a strange water like fluidity. The work seemed to bloom like sea-anemones in some sort of aquatic void. In Fig. 29, which Latham aptly named <u>Shell 2</u> one can see the shell-like structure, which contains a lot of similarities to a physical shell, with its shape, texture and fluidity. Yet Latham's shell reveals its artificiality in the way it floats in computer space with none of the physical elements, such as erosion, that overshadows natural growth.

Fig. 27 <u>Conquest of Form</u> Exhibition, Bristol.

Fig. 28 <u>Conquest of Form</u> Exhibition, Dublin.

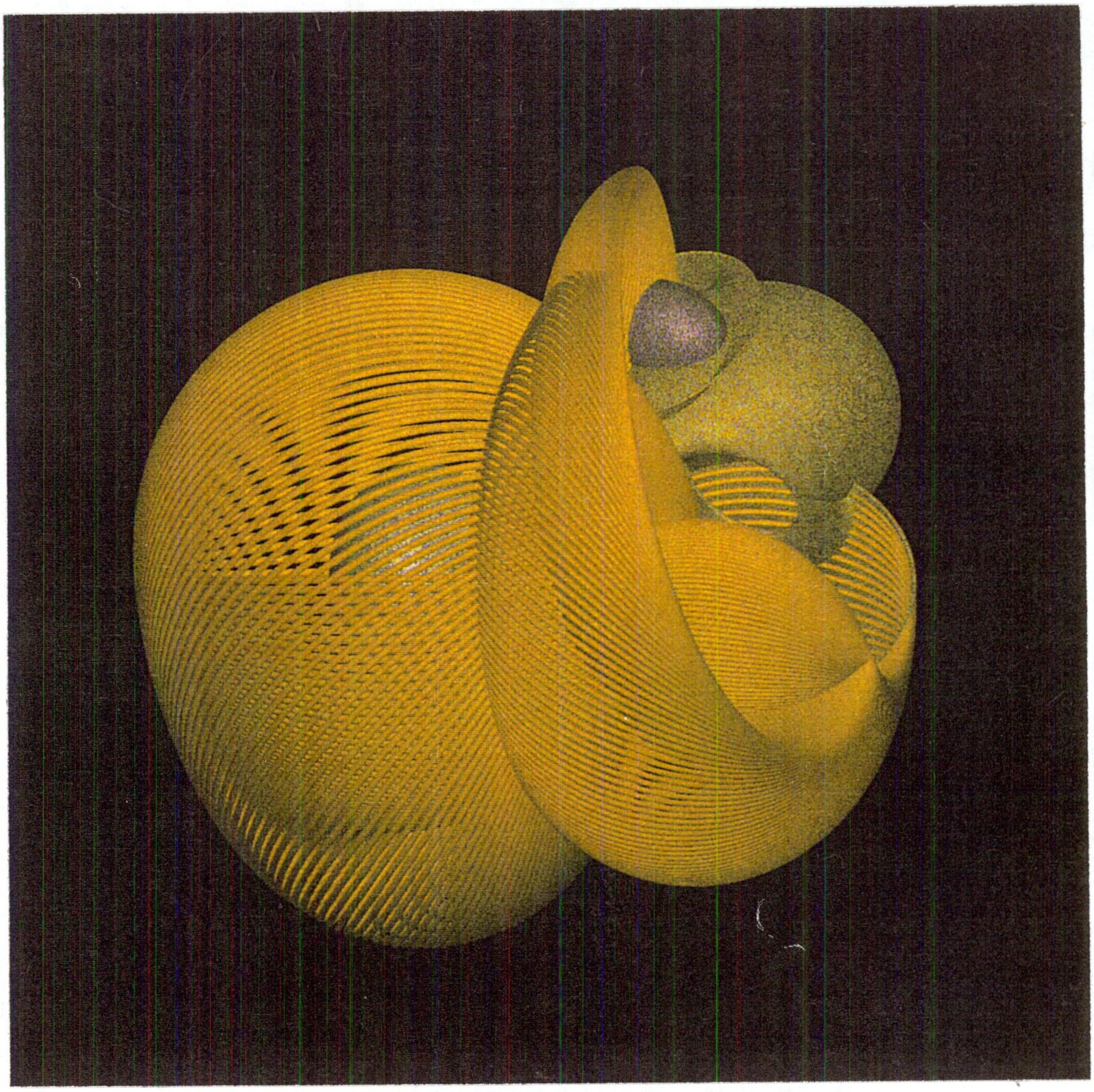


Fig. 29 Shell 2

Fig. 30 also reveals that Latham's images not only resemble organic marine creatures but can appear to contain design qualities associated with Celtic interlace. The intricacy of the twisting and coiling forms could easily be mistaken for a celtic brooch or necklace. It can be interpreted in this way because the use of colour seems very metallic. This metallic feel to the surface enhances the fact that these sculptures are artificial forms and are not true representation of physical forms. The shiny surfaces of some of the forms are camouflaged by a kind of coloured marbling, which is extremely artificial and so the most successful images end up being the most monochromatic.

The lack of tactile qualities in the prints seems to question the fact that these forms are considered as sculptures by Latham. The fact is that in the Cibrochrome prints, only a view from one angle can be seen and the viewer can't walk around the piece. Thus in Latham's use of his short animated film The Conquest of Form (1993), which accompanied the prints in the exhibition at Bristol, the involvement of the viewer is achieved with more success. The purpose of the film was to emphasise that the objects were genuine, three-dimensional forms, also to give the viewer a chance to comprehend them. In this earlier animation we move around the object as if walking around a sculpture in a gallery. The form is displayed in a void with no background reference which makes it impossible to distinguish between the viewer walking around a stationary piece and a stationary viewer looking at a rotating form; this also gives the form its weightless, marine-like quality. There the relationship between the viewer and the object becomes more like traditional sculpture. One of the many advantages that the computer view has is that there are no constraints to the angle of the viewer, who can view the work from the top or even from the inside looking out as shown in Fig. 31, a still from Latham's animation The Conquest of Form.

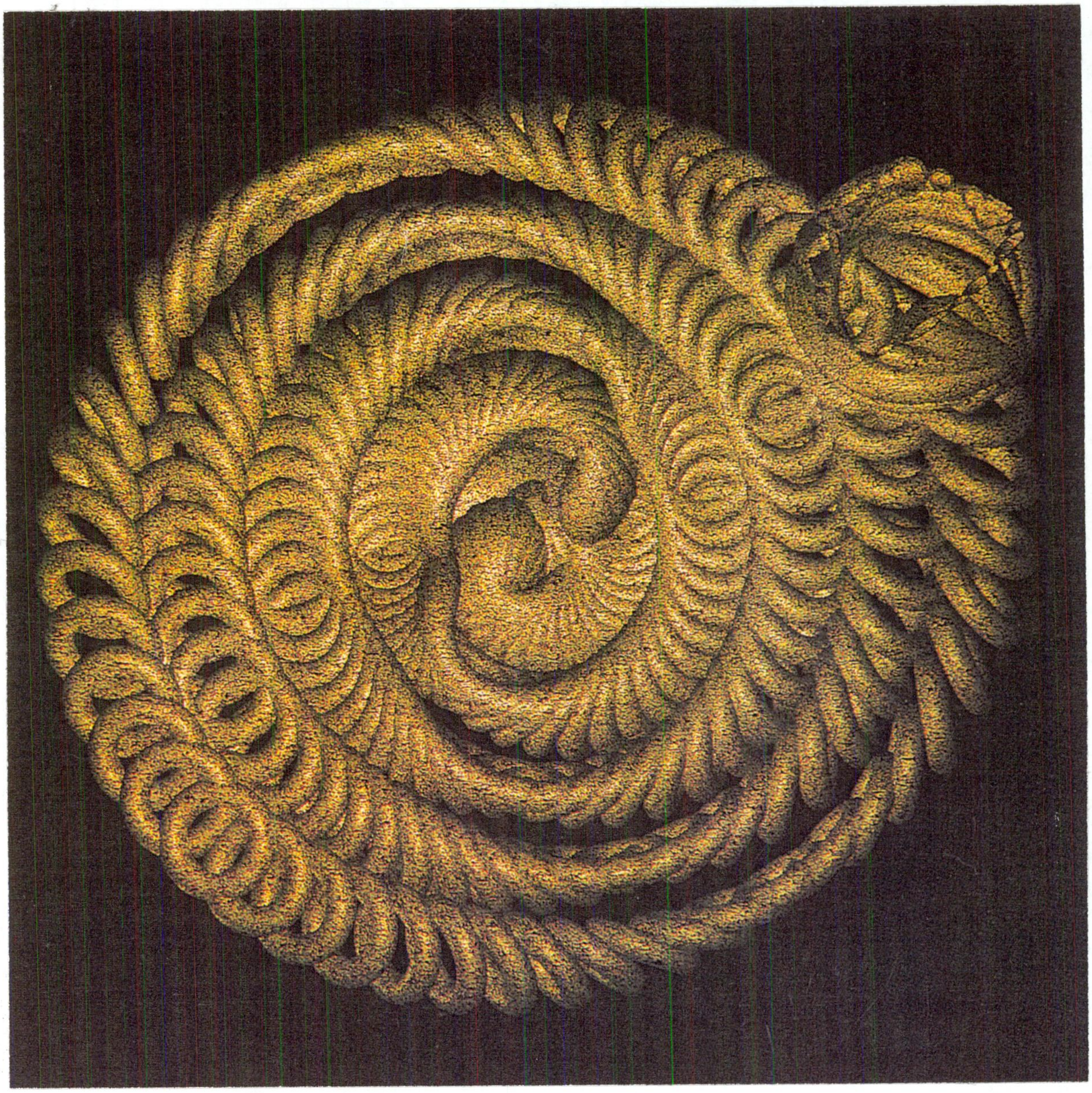


Fig. 30 Twist 4

Fig. 31 Inside the Form 1. (Still from Conquest of Form)

The type of work shown at the Conquest of Form exhibition in Bristol didn't contain the full evolutionary process and ideas of genetic engineering that Latham wanted to explore. The forms he created remained static, only the computer's 'eye' moved, so he began to investigate new ways of breathing life into his creations.

By the early 1990's Latham had developed his computer systems further to allow the piece he created to function as lifeforms. With the use of his Mutator program to evolve his creatures, his animations could actually show his forms giving birth, growing, mutating, ageing and dying. In Latham's short film Biogensis: Artificial Life in Computer Space; broadcasted on Channel Four in 1993, it is hard to believe that these creatures are not living. It is especially evident in this film that the forms we are presented with seem to float weightlessly in space in a very natural manner.

Unlike The Conquest of Form, they are extremely reminiscent of sea-anemones in their motion. Latham himself considers his work to grow as though on coral reefs, as seen in the coral-like structure mutating beneath the surface of the ocean in Fig. 32.

'Biogensis' refers to the concept that all life is created from living organisms. Here we have lifeforms that behave very naturally, yet Latham purposely shows their artificiality. It seems that Latham is questioning the idea of what life is truly about. The movements of the lifeforms are so natural that one becomes unaware of some of the more unnatural events in the video. It seems to hypnotise the viewer with a surreal sense of familiarity, like something one has seen before. To maintain the fluidity of the forms, when one part of form collides with another, Latham allows it to pass straight through as though there were no obstacles in its path. Of course, this would be impossible in the physical world but Latham sees no reason to restrict the beauty of his creations through mere physical laws.

Fig. 32 Evolving Mutations beneath the Surface.

There is also a portrayal of the characteristics of metamorphosis in the way the 'skin' of an egg-like form is constantly moving in opposite directions from the form; this gives the feeling of something growing inside, thus, representing a 'cocooning' stage in Latham's creatures development. What emerges is a similar lifeform which opens out like a butterfly. The atmosphere presented is like watching an aquarium or a zoo, observing how living organisms evolve and grow in the constraints of computer space. According to Latham, he is attempting to stylise the characteristics of living organisms in his work. There is also an aspect of irony in the way he presents non-living creatures that appear to be alive. The DNA in real living organisms is replaced by codes in a computer program. The resulting illusion questions the common perception of life and reality. He says he wants to go beyond nature, to create something that is more "savage than nature". (Latham 1995 p. 3).

Latham has developed the scientific images of fractal 'math' art from Burns and Markus to another dimension. He has gone beyond novelty and painting by numbers to produce creatures that seem to possess life. It is his knowledge of programming with the help of his team, that has allowed his work to enter into the world of galleries and the art establishment. His sculptural forms interact, evolve, possess infinity and are created by a list of numbers just like the fractal images first visualised by Mandlebrot (see chapter one). It presents questions about the role of traditional sculpture in today's society and its limitations. Latham makes use of the sensitive chaos ideas of holism (as discussed in chapter one) in the way everything interacts, evolves and breathes together to form life.

The next chapter will consider how Latham's work can advance into the future world of cyberspace and techno-culture and how the relationship of his work with the public can become more personal with the development of interactive art and CD-ROM. What better place then virtual reality space for Latham's exploration of artificial life.

CHAPTER FOUR: WILLIAM LATHAM'S WORK IN A WORLD OF INTERACTIVE ART AND VIRTUAL REALITY.

Artificial intelligence, artificial life, virtual reality, virtual libraries, cyberspace, interactive television, multimedia, the Internet, the list is growing. The language of culture is adapting to the language of technology. The past two decades have experienced transformations unimaginable even by the science fiction writers of the 1950's. The convergence of science, communication, entertainment, the space industry, computing, engineering, video and the arts represent the ideas of holism and the universality of our world. The interactive ideas of sensitive chaos (discussed in chapter one) can be seen in today's society with the advance of mass-media and the world wide web of information, the Internet.

Simms, ROM, CD-I, VR, CPU, to name a few are the mantras of our new cyber religion. With the development of the world wide web, information is readily available at the touch of a button, and communication with someone on the other side of the world has become instant.

The most commonly used word in art and technology of today is 'interactivity'. Artists have always been intrigued with the interaction of their work and the viewer. We can see this, early in the century with the Futurists and the Dadaists and in the late fifties and sixties with Fluxus and Actionism where artists performance and events involved the reactions of the audience. For example, the essence of a Futurist event on the streets or in a theatre in Milan or Turin was when the audience was pushed, even taunted into responding to a performance or a poetry reading, aimed at shocking or insulting. Success for the artists of these times was measured by the reactions of the audience. Today, the work of Marina Abramonc shows how she involves the audience on a more personal level through her performances: on one

occasion the audience was even asked to assault her body using a variety of implements laid out by the artist.

The reaction or relationship between the interaction of the audience and art is very evident in today's new technologies, e.g. computer games and CD-ROMS for personal computers. The relationship has advanced in the way that the expectations of the audience are to be fully immersed and to be able to make choices in the making of the artwork. It is because of computer and hi-tech developments that are now used throughout our culture as tools for communication, documentation and creativity, that the public has higher expectations of involvement when viewing art. They want the images to become more of an interactive experience because of advances in cyber-culture. The word 'cyber' comes from a Greek word meaning to steer or navigate, and so is aptly used in referring to computer space and how this is controlled by the user or artist.

If we look at what our children learn and the advancement of technology in their environment, it is not surprising that they have now higher technical expectations when visiting a cinema, a gallery or even watching television. The most obvious interaction between man and machine is computer games, which the average Western child is exposed to frequently in their lives. Far from being a hindrance to a child's development, computers and computer games can greatly enhance the level of opportunities for a variety of learning situations, particularly within the classroom environment, i.e. gathering information on the Internet and e-mailing students in another continent (Webster 1996 p. 76). Interactive games are like reading and playing chess, as they involve similar thought processes. Alternative worlds and scenarios can be created by children, enabling them to make their own stories and games. (Webster 1996 p. 76). The sophistication of children's awareness of television and film techniques may give some indication of how such technologies are incorporated into the fabric of

society. Our childhood experience of television futures in the form of Doctor Who (1965) and the terrifying Daleks only brings about laughter from today's youth, brought up on Star Wars (1977) and Terminator (1984). They expect more from artificial life and intelligence. So, when these spectators visit a gallery or museum, they anticipate a fuller interaction with art than previous generation could have had.

It is because the computer seems to be an indispensable tool in many areas of today's society that there now exist many new developments for William Latham's work to explore, such as, the relationship between man and machine, artificial life. In 1994, he began to look deeper into the exploration and development of mass-media, which he refers to as "junk culture" (Latham 1995 p. 3). The idea of junk culture implies that there is no finite end; information can be changed, evolved by the user of multimedia software and passed on from computer to computer. In Latham's case, it is the system (the experience of the process) that he finds the most fascinating. No single form is precious; if it were, it would never change or evolve. It is the evolution and breeding of the form which is important to Latham.

Recently, in 1994, Latham ended his relationship with IBM, in Winchester, and set up his own company, called Computer Artworks Ltd. The aim of the company is to fuse computer art and science, to create innovative technologies and unique imagery across a wide range of media, e.g. pop videos, multimedia packages (CD-ROMS), computer games and Internet information. The majority of the computer imagery it develops is to be used on personal computers by way of multimedia CD-ROMS and computer games for Sony Playstation. Latham has moved his work into today's society of interactivity and universality.

In 1994, Computer Artworks Ltd. created The Garden of Unearthly Delights, a CD-ROM for IBM, Britain. It is a multimedia software

package which integrates sound, graphics and video into one interactive unit, and is stored on CD-ROM to be used on a personal computer. The key word in this is 'interactive'. Latham creates the forms, evolves them creatively, but hands the role of gardener over to the user of this software. This product can be described as many things - as a game, as an experience. It seems as though Latham is providing us with a question about the characteristics of similar interactive products, e.g., computer games. Computer games can only exist in a limitless area of cyberspace but often the worlds created are ironically limited with pre-defined goals and a rigid set of rules and restrictions. With Latham's Garden of Unearthly Delights, the user can create his or her own directions and path without any pre-determined ending. This CD-ROM is not a game but contains the atmosphere of a journey into the unknown. It keeps the mediative feeling of his earlier animated films. The viewer explores the forms as they appear, as in a botanical garden. The fact that the user can now decide how to view the work interactively given the sculptures a more tactile and personal element.

In 1995, Computer Artworks Ltd. produced Organic Art another CR ROM for personal computers. This multimedia software package contains forms Latham has created, revealing how his inspiration of fusing natural history with science fiction is still evident. This CD-ROM contains numerous scenes, continually creating new mutations for the user to discover. Organic Art is fully interactive, letting the user design his or her own virtual scenes with a unique 'Evolutionary Generator' (Computer Artworks Ltd. 1997). There are over 400 million combinations to explore. The CD-ROM presents the viewer with a menu with a variety of options which can then be selected and controlled using pre-set organic scenes. This multimedia production by Latham allows the layman to interact with the computer, to create art for themselves and build, very quickly, complex organic structures, impossible in previous software developments.

Latham clearly reveals the priority of mass-media culture over the traditional 'high' arts. This is also a central issue for Postmodernism. During the late twentieth century we have seen the very notion of what art is and is not being questioned by the advent of the Postmodernist movement. Postmodernism is a term used to describe many aspects of contemporary cultural production from architecture to music. Its characteristics include the borrowing from earlier styles to produce witty new combinations (Webster, 1996 p. 77). Postmoderism offers us ideas of how we are integrated and the sensitive chaos idea of holism. It comments on how we are all one and not separate units. So it is not surprising that it coincides with the ideas of the mass culture of today's world. By using multimedia technology and downloading information from the Internet, Latham is clearly commenting on our world and on how man and machine are evolving together.

Virtual reality is a computer system whereby the operator, or perhaps it would be truer to say, the experiencer is in direct communication with the computer via a head set. 3D graphic images are viewed through a visor at the front of the helmet, while stereo sound is experienced via built-in headphones. As users turns their heads to the left or right, the computer can trace the headset's spatial relationship to the computer via sensors in the helmet. It then processes this information and returns modified images to the visor that give the impression that the wearer of the headset has turned their head within the 3D cyberworld. Other spatial information can be collected through the use of data gloves. (Webster, 1996 p. 82).

With the development of virtual reality, Latham can now allow viewers to immerse themselves completely in the world that they choose to use, deepening the experience of the viewer in the work and suspending them in an illusionary world between dimensions. Latham has currently been experimenting with the possibilities of virtual reality. This project is known as SAFARI and will be an artificial world containing Latham's

creations. He envisions a world where several people can enter his computer space at any one time, each with their own aesthetic opinions and how each person will make choices on the forms presented. This idea of group artistic interaction is pushing the boundaries of multimedia is presently still being explored and developed (Computer Artworks Ltd. 1997).

It is through the development of new technologies that the full potential of Latham's ideas of 'evolutionism' and artificial life can be experienced. The whole holistic experience of life growing, evolving interdependently is evident in our cyber-culture, linking us even more closely to the future.

CONCLUSION

Art is a mode of inquiry much like science in that the artist or scientist are both committed to a particular path of controlled activity and the work produced remains as evidence. Visualising higher dimensions has been a well-documented path in both art and science. Scientific simulations are further evidence of this continuing effort to make visible the complex yet invisible structures of the universe. Computers are helping to connect the talents of the artist and scientist. Artists inherently possess talents and interests that will become even more important as the future requires them to develop their understanding and imaginations through technological tools.

Supercomputers, graphics and creative human beings have the power to bring about the visual enlightenment with regard to the universe that was formerly only explored by mathematicians.

In chapter one, I examined the holistic ideas of the chaos theory and the idea of worlds suspended between dimensions of fractal geometry. I have found that it is the whole system and process that is important in our physical environment, that nothing remains static, everything pushes and pulls at each other to create interchangeable and interdependable life. In chapter two, I recorded the fact that the discoveries by scientists in the 1960'a led them to break out into the art world and produce aesthetically seductive images. The daring ventures by scientists led them to juggle the immediate attractiveness of the imagery artefacts. The images of fractals are questioned by the art establishment as being just a novelty but, to artists/scientists such as Burns and Markus, these images represent personal expressions of the hidden beauty that surrounds us.

Since Mandlebrot first proposed the fractal geometry of nature, computers have helped us accept the possibility that the beauty of

nature lies in the genes (computer codes) of the beholder. Artists are beginning to explore this new part of science; not separating us from nature but exploring our integration in it. In place of self-consciously rational Modernism, we are now seeing artists advancing into the interactive culture of man and machine in the Postmodern society of the mass-media. In the mass-media productions of today's environment, e.g. multimedia, CD-ROM, the Internet, the system and the process are more important than the separate unit or the individual. The fact that the world as an interdependent whole is a crucial part of our society and reflects the sensitive chaos idea of holism. Everything in our world is linked and evolves together to produce our world of cyber-culture. We are learning how to navigate and control our virtual worlds, in order to in some way question man's relationship with the physical world. Are we losing contact with our physical environment because we feel it is safer to explore illusionary worlds in cyberspace? If this is so, it doesn't say a lot about our society. It will be up to human intelligence to decide whether or not to let technology empower us or enslave us. Hopefully we will make the right ethical decisions.

In chapter three, I have explored William Latham's work and feel that he is a very good example of an artist whose work portrays the ideas of dynamic systems evolving and mutating together to produce a whole. To Latham, it is the process that is of main importance in his breeding of sculptural forms or creatures. He has surpassed, in my opinion, the static images of scientific visualisation from the world of novelty to a world where sculptures possess life itself. His haunting forms reflect the fractal ideals of worlds suspended between dimensions. His forms are three-dimensional creatures that exist on the two-dimensional computer screen. They evolve and breathe weightlessly in some sort of higher dimension. This can provoke questions about the advance of virtual worlds; are we eventually going to suspend ourselves completely between physical dimensions and virtual dimensions? Are we eventually going to lose sight of what is reality? This is already

apparent in digital imagery, as discussed in chapter two, where the original image can be changed and distorted by the user on a personal computer. A knowledge of programming will empower artists to contribute to the imaginative use of the computer. We are only just beginning to feel the full impact of the computer on our world.

I believe that Latham's work is evolutionary in the true sense, proceeding under pressures of (un) natural selection, as the artist accepts or rejects forms as they develop on the screen. These forms exist only in the purely conceptual world and are definitely the product of contemporary ideas and tastes. Latham's development of multimedia software, re-enforce his fascination with the interaction between man and machine, immersing the viewer completely in his work, so that the user can make choices of what path to take and use his or her own aesthetic judgement.

For the moment, Latham's creatures are untouched by human hands but with his exploration into the world of virtual reality, this statement might, shortly be refuted. The fact that Latham's forms contain the underlying order so perfectly illustrated by the theories of chaos and fractal geometry, reflects the natural harmony these theories can have for us, and for the artist. This is an art which is responsive to the real world, but separate from it, half-way between independent life and animation, in a world between dimensions, highlighting the awesome potential and unspeakable strangeness of the new cyber-culture.

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