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National College of Art and Design

Faculty of Design
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"Reality Bytes"

a study of the emergence and progression of computer generated imagery within the motion picture industry

by

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Submitted to

The Faculty of History of Art and Design and Complementary Studies in Candidacy for the Degree of Bachelor of Design in Industrial Design

1995

Acknowledgments :

Many thanks to my tutor Dr. Paul O'Brien for his guidance, encouragement and assistance throughout this project.

I wish also to thank the following for their co-operation in providing and sourcing much of the research that helped to form the background of this thesis:

Gemma Bradley, Assistance Librarian, N.C.A.D.

The Staff of O'Sullivan Associates, Dublin

Mark Brophy, Industrial Design, N.C.A.D

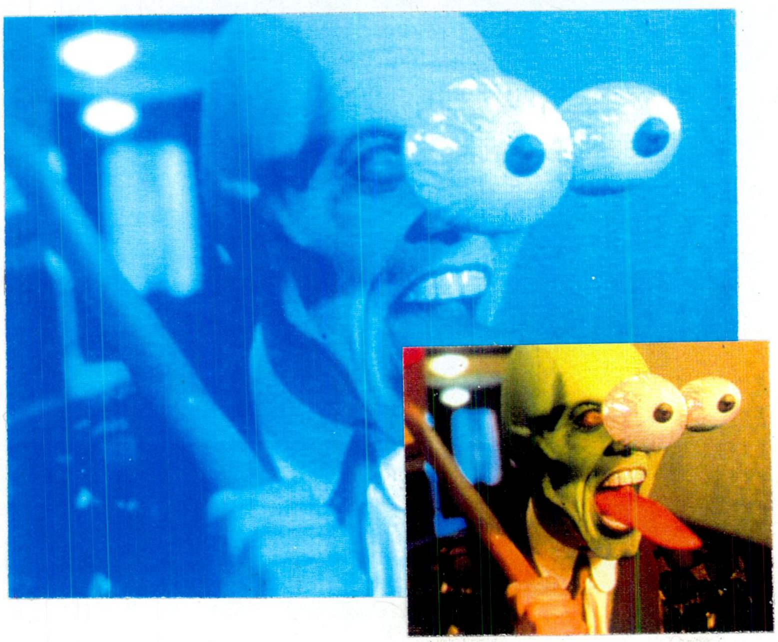
Jennifer Parkin, Film Studies, U.C.D.

Philip Phelan, Goldstar Ltd, Dublin

Peter Sheehan, Design Partners, Bray

The Staff of the Irish Film Centre, Dublin

“Reality Bytes”



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Introduction

Due to the phenomenal advances in computer aided film techniques, is there a possibility of the motion picture industry being reduced to the manipulation of computer animated actors and mise-en-scene by a series of individual P.C. operators?

The very nature of the film industry as a manufacturer of images for public entertainment requires the producer to employ whatever advantages technology can offer in order to create a product more sophisticated, spectacular and awe-inspiring than what has gone before.

The developments in computer graphics software and hardware in recent years are allowing production teams to explore almost infinite possibilities for visual display. Within the last five years we have begun to see the result of what can be achieved when the creative minds of Hollywood are armed with the technology which allows them to express their imagination freely.

But what has brought about this most recent revolution in visual technology and what are its implications for the conventional film industry and the traditional cinematic experience?

This study is divided into four main sections to chart the development and implications of computer-driven visual display.

The first section outlines the emergence of digital effects and the barriers which prevented the rapid development we see today. The experimentation with short sequences of visual effects and the branching of computerization into almost every aspect of the industry is addressed with reference to some Hollywood productions of the seventies and early eighties, as well as to innovative "short films", produced to market the emergence of digital technology.

An explanation of how digital effects are created is outlined in the second chapter. Each process which enables the animator to create the desired image is dealt with in brief but explanatory detail. This section gives an understanding of up-to-date visual techniques and how technology has been developed to transform the film industry.

The third chapter discusses the emergence and progression of computer animation for the purpose of special effects and stunt sequences, with particular attention paid to the move towards creating a seamless production utilizing computer images, i.e.. the production of Films in which advanced visual effects are employed to create a whole story rather than as a tool to enhance a production. Reference is made to recent production namely, Terminator II and

Jurassic Park. There are also references to Forest Gump and The Mask in discussing the infinitely variable but equally effective applications of visual effects and how hidden computer detailing can often be as intriguing as blatant digital display.

The final section looks towards the future applications of computer technology within the motion picture industry and discusses the implications not only for the production industry but for the whole cinematic experience. Will the popularity of video games push the film industry into creating a new kind of environment catering for spectator interaction and what are the implications for the movie star? Can computers ever compensate for the personality of real actors? These are some of the questions addressed in the concluding chapter.

CHAPTER ONE

1.0 More of a Bloom than a Boom :

The visual effects which get more sophisticated and exciting each time we visit the movie theatre, are not exactly the result of a crash, boom, bang revolution taking place in the field of visual technology, but rather the product of a steadily evolving industry which has (in true "show biz" fashion) aimed to top what has gone before.

1.1. No New Thing : It has been the objective of many film makers over the past century to strive to capture on film, the bounds of human imagination, to entertain the viewers with exotic or totally imaginary scenes, to thrill audiences with visions of supernatural creatures and unearthly worlds.

From the earliest days of the film industry visual effects of one kind or another have been adopted to create unreal images. Directors such as Alfred Hitchcock, Cecil B. DeMille and Orson Welles are among the more famous early experts of visual effects and in their day the films produced brought thrills and excitement to their audiences as the creations of Spielberg and Russell do today.

The effect methods of these early days seem crude and unimaginative when viewed in the light of modern developments. This is because the industry behind the creation of visual effects has been continually transformed by technological advancement and parallel to this we the viewers have become visually educated.

> This is largely due to television . Rgular exposure to this medium has made viewers visually sophisticated and acutely perceptive. (T G Smith, 1986, P. 199).

The challenge to the film-maker is to keep one step ahead by utilizing systems at the forefront of technological advancement to create impressively realistic and awe-inspiring images. As we move into the 21st century computer technology is the key which is enabling the industry to meet the challenge put forward by the ever-hungry spectators.

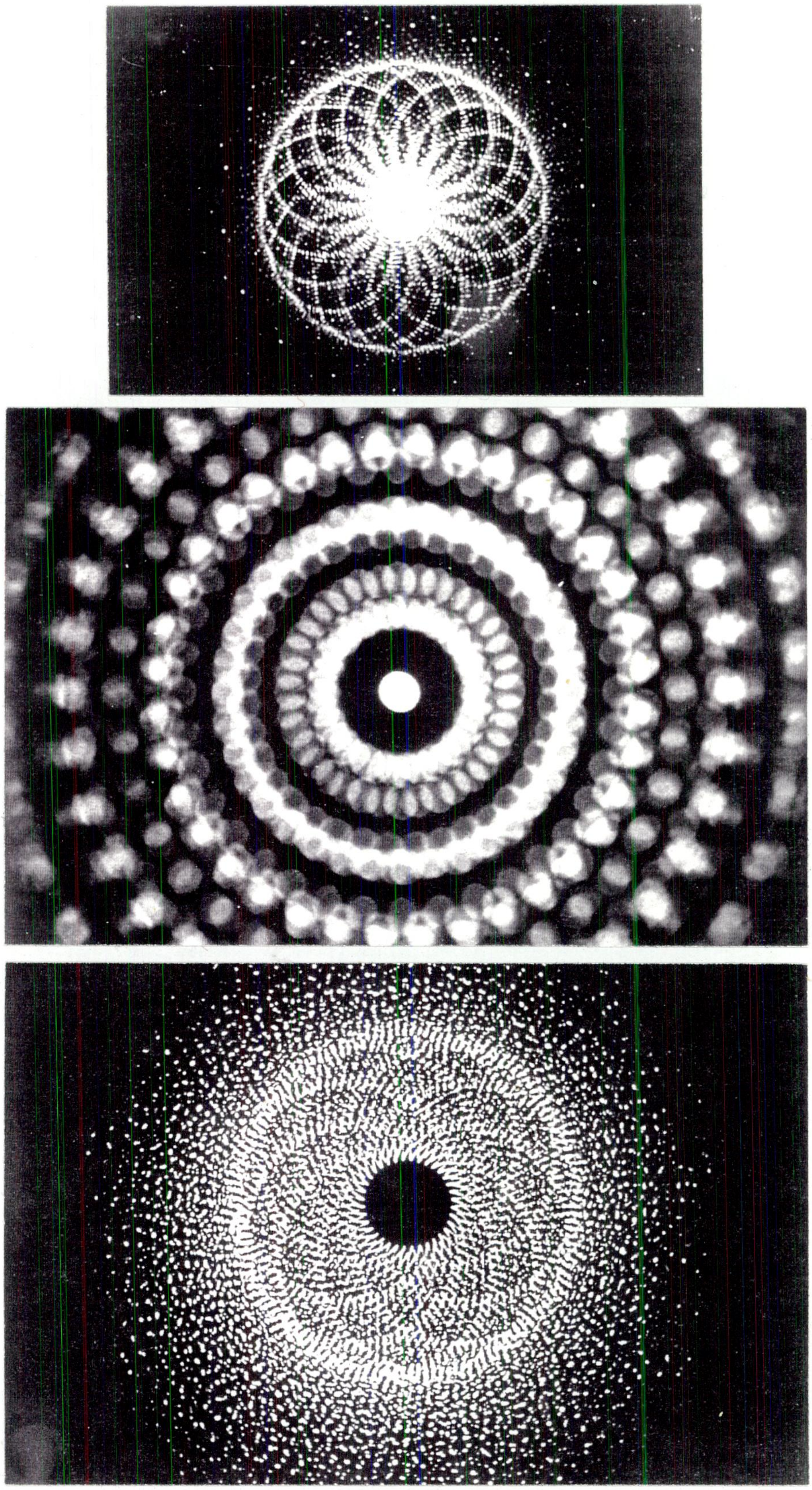
1.2 **Sowing the Seeds** : The use of computer technology as a tool to enhance film production emerged in the late fifties with the invention of the analogue computer. The simplistic images created at that time were for scientific, military and industrial purposes, such as radar and anti-aircraft displays. It would take the mergence of both scientific and artistic creative minds before images would be created by computer purely for artistic display.

It is no surprise then that the first film utilizing computer imaging was the combined work of brothers John and James Whitney, scientist and film maker respectively. The film in question was Lapis and was completed in 1960.

> Working with the equipment developed by his brother John, James Whitney made the film by computerizing tiny particles of light using a development of the 1957 analogue computer. He had worked on similar films before without a computer. These films required thousands of pin-pricked cards to give the light source, needing incredible physical accuracy.
> (R. Noake, 1988, P. 125).

The images were of swirling spinning patterns of light similar to what can be seen through a kaleidascope. Computerizing the dots meant Whitney could manipulate the arrangement more freely and continually film the movement instead of the jerky frame-by-frame recording of his previous creations.

1.3 Slow Steady Growth : Lapis was undoubtedly an important breakthrough but it would be almost fifteen years later before the computer would be capable of creating more complex and variable images, and it wasn't until the making of the first Star Wars film in 1976 that the computer would slowly begin to take hold as an integral part of the film industry.



Illus. 1 Lapis was one of the first films using computers to make a general impact. Working with the equipment developed by his brother John, James Whitney made the film by computerizing tiny particles of light. (1960).

This delay was due to two major problems. Firstly, there was the cost of building and running a mainframe computer large enough to cope with such complex imagery. Throughout the sixties a computer with the capability to handle a minute of animation would need a memory bank the size of a warehouse. Financial input allocated to visual effects was directed towards the development of conventional methods of optical and model-based illusion.

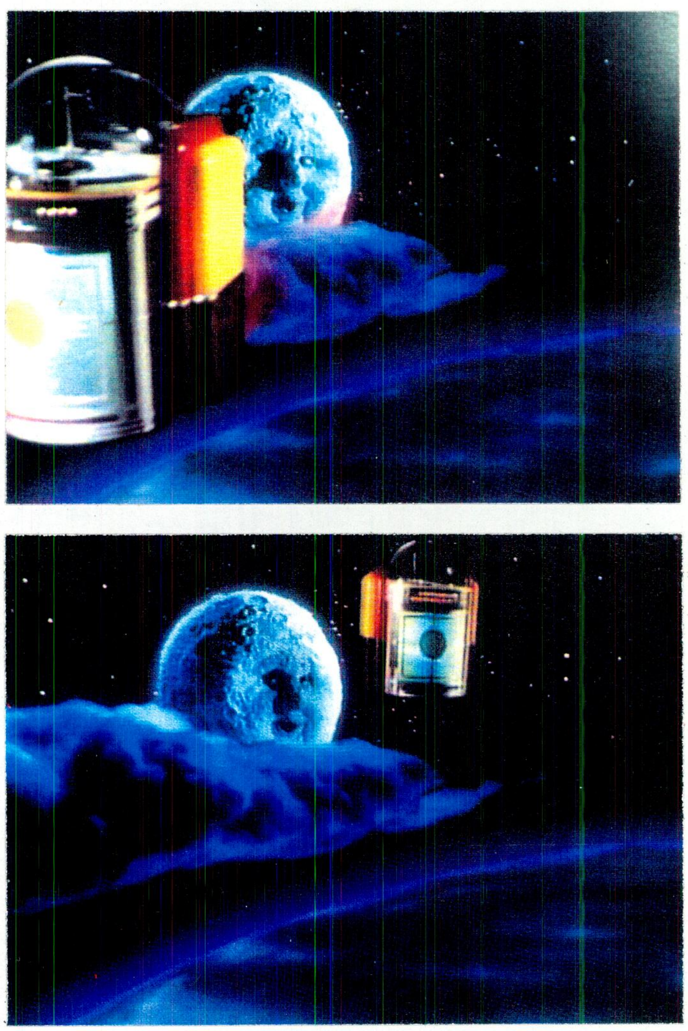
Secondly, computer technology was not being developed in conjunction with film. If the motion picture industry was going to use computers to enhance cinematic creations it would have to borrow the technology from other industry applications. "The problem lay in the divide between the disciplines of art and science" (R. Noake, 1988, P. 124). New programmes were needed which would allow the animator or film maker to use his/her imagination to manufacture a desired image, but the people who had the imagination for artistic visual display lacked the knowledge to write the. programmes and vice versa.

With the development of the microchip in the early seventies the size and cost of computers began to decrease dramatically. This made the technology more accessible to film-makers for experimentation. Initially the computer scientists worked alongside the visual effects

people to adapt the advantages of computerization to conventional filming methods.

1.4 **Computerization Lends a Controlled Hand** : Zoron Presnic, visual effects adviser to Stanley Kubricks 2001 : A Space Odyssey in 1968, developed a method of using filters, backdrops, models and live action to create composited images. He used computer technology to create mattes with almost perfect accuracy allowing the film crew to shoot each aspect of the composite separately and jigsaw them together later with precision. The quality of the end result however depended on the accuracy of the camera shots. Each shot had to be repeated several times depending on how many composites it took to make up the image. It was painstaking work which would be avoided in the future with the introduction of computerized motion control.

1.5 **Motion Control** : By 1976 the people at Lucasfilm division of Industrial Light and Magic (ILM) had borrowed computer technology from other fields of industry in order to control the camera and shutter movement for the filming of Star Wars. This allowed the camera to sweep across the same shot several times with one hundred percent accuracy. In these early days of computer-controlled filming a



Illus. 2 Example of a composited image using mattes created by computer technology. The jukebox, moon and space background are shot seperately and composited together later.

composited picture could be identified by a slight blue, gray hairline sometimes visible around the components.

The practice of composting images using mattes and computer-controlled cameras is still common procedure today and has become such a subtle art with time that the viewers may not realise that what they are watching is in fact an unreal image or rather a delicate combination of a number of real images at once.

> Your basic ILM shot. Placing an image of Luke Skywalker inside a model spaceship, along with Darth Vader and perhaps a dozen technicians in the background or under a bridge, and also a few hundred stars and a spiral galaxy out giant windows. We might also want to put animated laser swords in Luke's and Darth's hands, and maybe the ghost of Obi-Wan Kenobi peering down from above, while on distantly seen television screens we surely will insert a few choice computer graphics and an approaching starship - with, of course, more inserted stars around it. (T. G. Smith, 1986, P. 206).

1.6 **Computer Creation** : Computerization was to have a profound effect on practically every aspect of the movie industry from techniques and equipment to management and control, making conventional filming a more sophisticated and precise art with far greater possibilities.

But the harnessing of computers to manipulate existing processes was merely a labour saving and time-cutting exercise. With the potential computers offered it was only a matter of time and the tedious development of software before they would be used to generate images which exist only in digitized memory.

The next major step came in the early eighties when software was developed which allowed the computer to manipulate images on screen and paint them directly onto film. This technology permitted the film-maker to create any image required around an object by varying the viewing point using a 'joystick' type control.

According to Roger Noake this was an advanced development of mid seventies aviation technology used in flight simulators, (R. Noake, 1988, P. 128). The software was developed by video game companies in the U.S. and Japan. The advantages it offered the film-maker were enormous. Models could be built quickly an inexpensively on screen. The computer could display the model from any angle with perfect perspective. Lighting could be simulated so that reflections and shading were appropriate to its position.

The first displays of computer generated images in the visual media were crude, simplistic graphics for television. Because of the low definition of the television screen these images lacked sophistication and detail. The software hadn't been developed to the extent that images which would be acceptable on movie screens could be created.

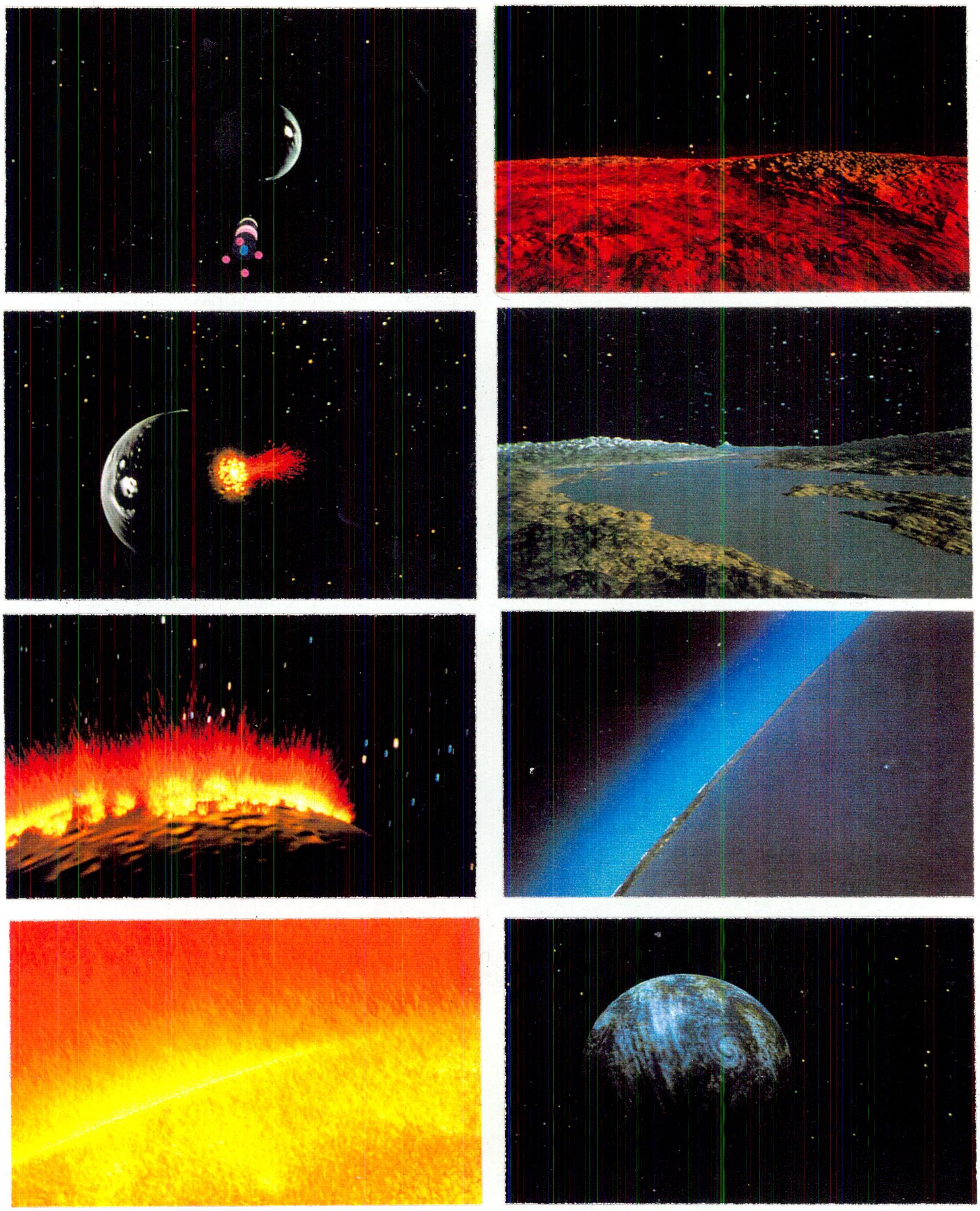
The images were scanned from computer screens which are made up of thousands of tiny dots (pixels), so that the result was grainy and lacked the sharpness of conventionally filmed material. This sort of image was perfectly acceptable for television, but audiences could not be expected to pay into film theaters to see crude visual displays of a lower standard than what they were used to, no matter how advanced the technology used to create these images.

There were also major problems in storing and processing computer imagery. It took drastically longer to produce one minute of computer animation as opposed to conventional filming. Although the advantages computers offered were boundless, the financial input from the film industry was not great enough to support full scale production development. This meant that computers' ability to create images would initially be used to generate fragments of a finished work, such as visual effects or animated sequences.

The first interesting demonstration of computer-generated images for a successful commercial film came with the creation of the "Genesis Sequence" for the film Star Trek II : The Wrath of Kahn by the LucasFilm computer division headed by Ed Catmall.

In this scene we see a barren moon-like planet transformed before our eyes into a beautiful, lush, earthy place with mountains, trees, rivers and oceans ; after it is struck by a missile from the starship Enterprise. The scene gives the viewer the effect of approaching the planet, orbiting it and watching the surface explode and erupt into life, evolving into a magnificent display. The entire scene is less than five minutes in duration yet took longer than the rest of the two hour production to complete.

The result however was astonishing and the visual effects were incredibly sharp. The whole scene was created, processed and manipulated using computer equipment. This was the breakthrough in image technology which scientists and film-makers alike has striven to achieve since the first experiments of the Whitney bothers twenty years earlier. It was this sequence that sparked enough interest in film audiences and producers alike to signal the blossoming of the computer

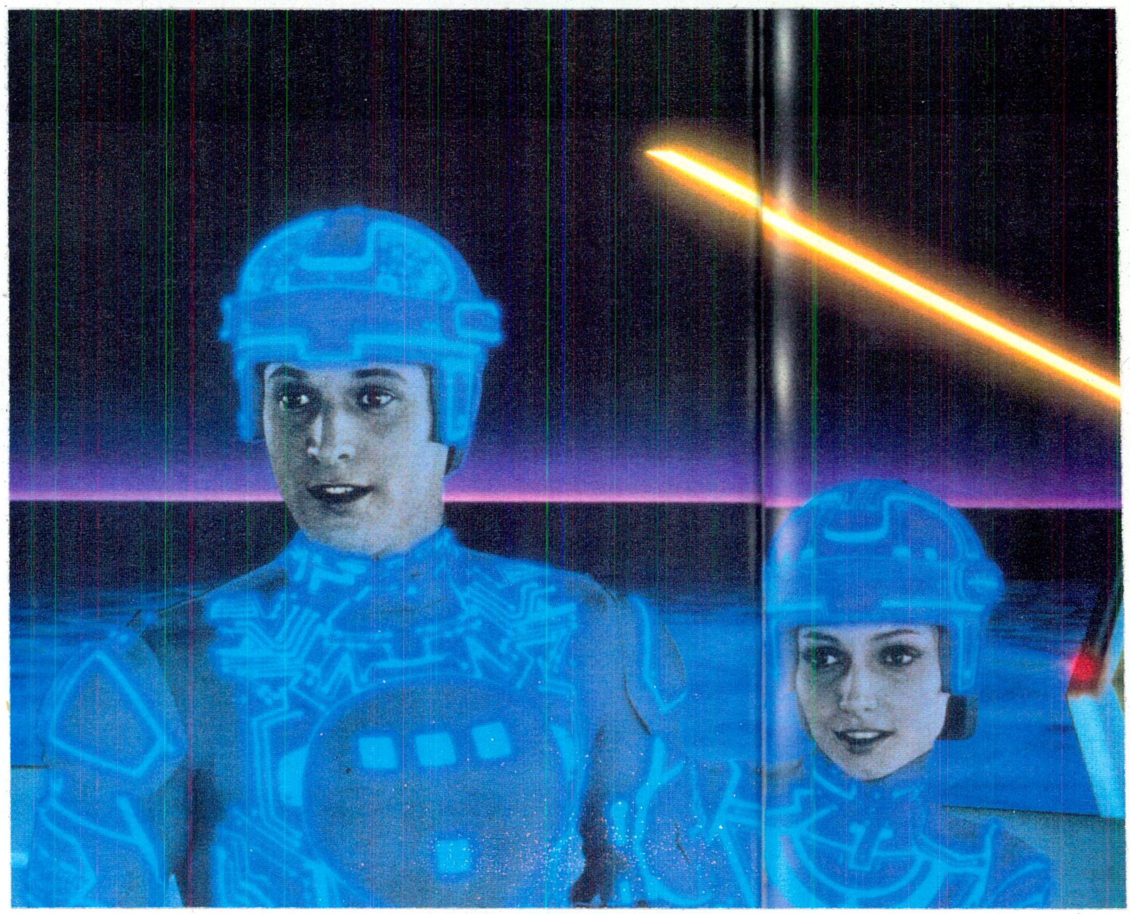


Illus. 3 Stills from the Genesis Sequence from Star Trek II : The Wrath of Kahn. This scene was completely computer generated.

visual industry within the field of film production. Appropriate that it should be titled the "Genesis Sequence".

1.7 **Extending the Productions** : When Steven Spielberg saw this sequence he contacted Lucasfilm about the possibility of producing an entire film on computer. The director of effects Warren Franklin cautioned him that to produce the short display for Star Trek II took a great number of computer hours and that the technology wasn't advanced enough to allow for the presentation of anything longer than a few minutes without huge expenses occurring. The quality of the end result could be very sophisticated but with the addition of fine detailing the costs skyrocketed and the idea was put on hold until further developments could be made.

Meanwhile the directors of Disney set themselves the goal to produce the first fully computer-generated motion picture. After much expectation and media 'hype' Tron was released in 1983. More than eighty percent of the movie was the creation of computer imaging. The story revolves around computer technician, Jeff Bridges, who is digitized and transported electronically into the circutory of a mainframe computer. The environment within the computer is displayed as a wireframe landscape with geometric forms providing



<u>Illus. 4</u> High-tech environment portrayed in this film failed to capture the "Pacman" generation at which it was aimed.

buildings, transport networks and horizons. Everything in view except the actors, is generated by computer. The landscapes, architecture, interiors and vehicles are highly geometric. There is nothing organic and it is obvious that the story was written around the technology which was used to create the film. It is often difficult to define depth of field and the perspective is sometimes off-putting. The lighting on all objects in view produces reflections and shade which are too regular and unnatural. The images are stereo-typic of high-tech and the viewer doesn't feel comfortable with the obviously artificial environment portrayed. Tron was a box office failure. Although it was an incredible feat to produce a film of this duration on computer the images created lacked subtlety and realism. This, coupled with a weak storyline, was the film's stumbling block to success.

Time needed to be spent perfecting the images, making them as real as possible so that the viewers could relate easily to them.

1.8 From Little Acorns...... : From here most of the major film companies directed their computer departments towards the development of short productions concentrating on visual realism and image detailing. All the while conventional film-makers were using the technology to generate increasingly spectacular special effects to enhance their

productions. This continued to be the developmental pattern throughout the eighties and into the early nineties.

During this time American computer company Pixar was at the forefront of visual experimentation and the resulting short film productions were astounding. "Pixar concentrated on simplistic storylines with short sequences" (B. Robertson, 1994, P 27). Attention was focused on detailing. Realism was enhanced by improving the light source. In earlier computer images all the light came from one side or point, giving reflections and shading which was too even and unnatural. Pixar realised that light should come from one or more sources of varying sizes and that reflective surfaces within the images should bounce light. These subtle alterations made a phenomenal difference. The two-dimensional images on screen relied an effective lighting to give them the appearance of being three-dimensional objects. It is appropriate then that following the breakthrough in lighting development the starring roles in Pixars first short film to display the techniques should go to a pair of anglepoise lamps.

The film was called Luxo Jr. and was released in 1986. "John Lasseter, an ex-classical animator for Disney, made this film about the child-parent relationship of the lamps" (R. Noake, 1988, P. 126). The images

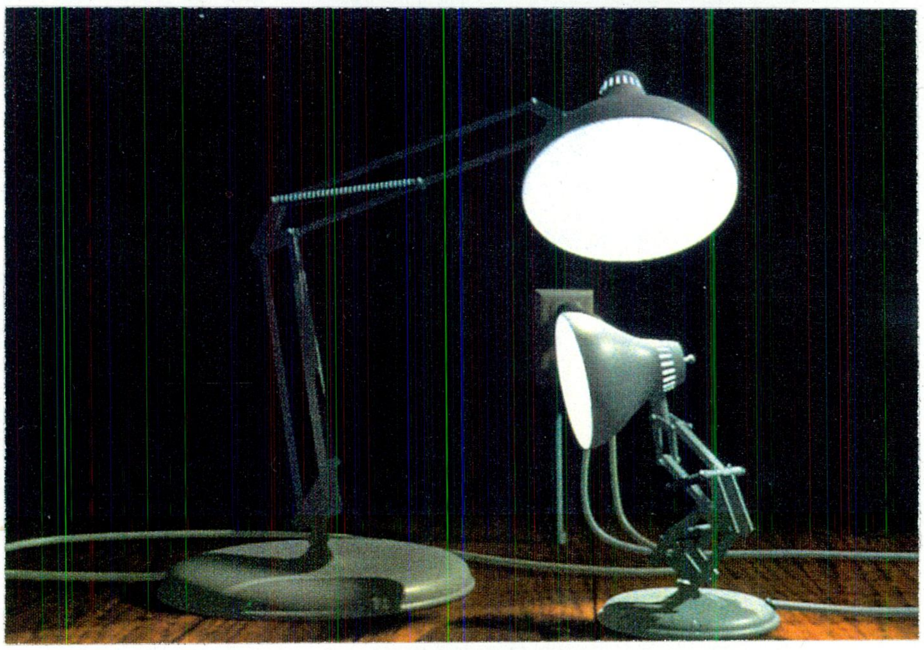
were startlingly real. The quality of the animation and the characterization of the objects were comparable to anything ever produced by classical animation. Perhaps it was the combination of Lasseters extensive experience and the cutting-edge technology which made this simple story such a visual triumph. Science and art married together in harmony and provided a firm basis on which the visual technology we see today could begin to grow steadily.

> It took two of the largest computers in the world, the Cray XMP - 2 and XMP - 4 along with fourteen high speed vax machines to process data for several months in order to create Luxo Jr (T. G. Smith, 1986, P. 205).

The cost was high but when the end result was seen film-makers began to realise the potential computer animation had.

Parallel to this the billion dollar computer games industry was beginning to snowball. Software developments were occurring daily and graphic displays were steadily improving in quality and sophistication.

With the success of shorts like Luxo Jr. and The Adventures of Andre and Wally B (another Pixor production) the film industry began to look towards tailoring computer systems for its own needs. Up to this point the technology had been borrowed from other fields of industry and the



Illus. 5 In Luxo Jr. the quality of computer animation and characterisation are comparable even to the classic tradition. (1986).

graphics equipment used for television wasn't sharp enough for the fine detailing required in cinematic productions.

Most film companies were still skeptical about the place for computer-generated imagery within the industry. Many saw the high cost and extensive processing hours as prohibitive. John Lasseter, creator of Luxo Jr, is quoted in 1986 - "For the time being when used merely to supplement optical printers, the computer is a rich kids toy" (T. G. Smith, 1986, P. 213).

It was the computer firms, particularly those focused on the visual media, be it television, film or video games, that pressed ahead to develop better machines providing better graphics at a lower cost and in shorter time. The evolution continued steadily and began to pick up speed.

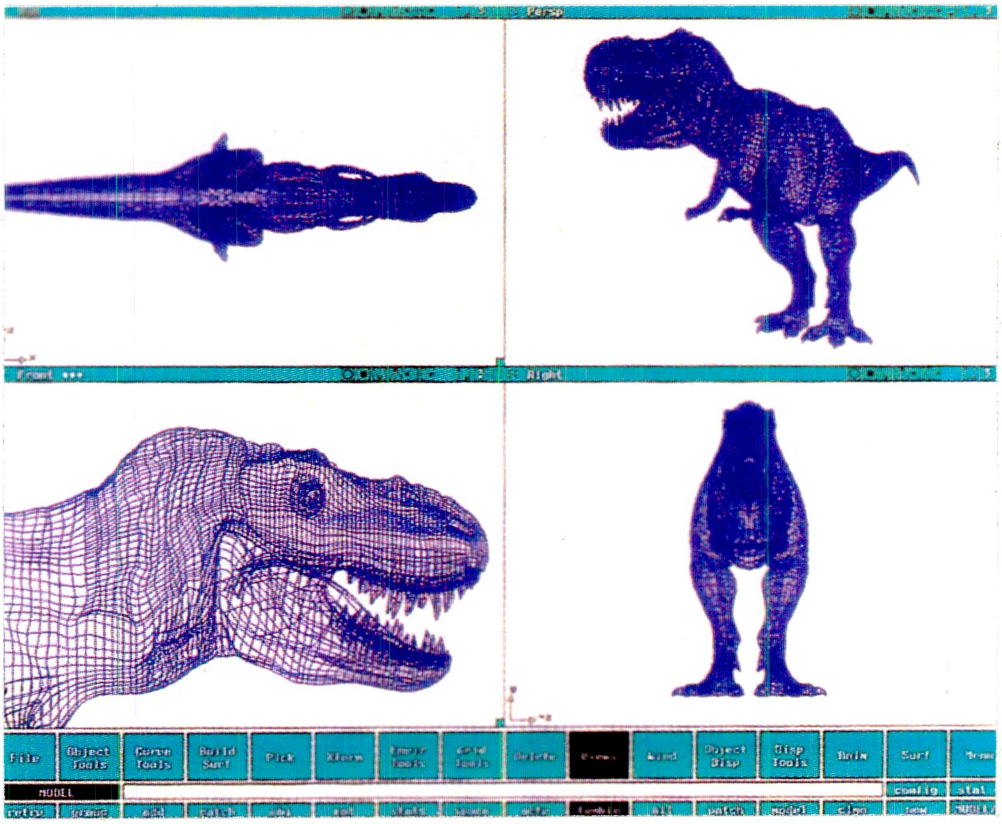
CHAPTER TWO

2.0 How are the Images Generated?

The initial image is built up from a wireframe model constructed on screen. This model can be compared to a skeleton. The accuracy is dependent greatly on how detailed the structural model is and designers spend most of the production time perfecting this basis.

2.1. **Draw** : The model can be created using three different methods. The first and most common is to draw in the detail using lightpen or mouse. The image is constructed in two dimensional plans and elevations and the computer interprets these drawings to define the three-dimensional object. With this data the computer can manipulate the lines of the wireframe, turning them within a 3D-field or distorting them as required.

2.2. **Geometry** : The second method of construction is to break up the image into its simplest geometric forms, from which it is made up i.e. spheres, cones, cylinders, cubes etc. These can be cut and spliced together and the computer can record the data as a series of formulas. This is a laborious method but gives the computer a more detailed foundation on which to build.



Illus. 6 Hard models were used to input this wireframe construction of Jurassic Park's T-Rex. (1993).

2.3 **Hard Models** : The third method is to construct a physical model using conventional modelmaking materials. This model can be scanned and digitized. Hundreds of co-ordinates can be inputted depending on the complexity of the model. Once the computer has registered the points a replica model can be generated on screen. This model can now be manipulated easily, animated, distorted, etc and designers can zoom in on the tiniest of details for enhancement.

According to Peter Sheehan this is often the preferred method of designers because it heightens their perception and gives them a greater feel for what they are attempting to create (Loughnane, 1994).

The physical models often bear little resemblance to the finished image on screen but their construction is invaluable to the designer in enabling him/her to visualise the creation - "bird in the hand scenario".

In the not-too-distant future devices for inputting three-dimensional information directly into the computer will come on line. These are 3D mice, and a number of computer manufacturers are in the process of developing such products, Logitech and Apple have both looked towards Ireland for the development of 3D input devices. Oliver Hood design and Design Partners, two major industrial design consultancies in

Illus. 7 Example of Digitising equipment used extensively within the film industry for inputting hard models directly into the computer system.

Dublin are central to research and design. Launching of the Logitech 3D mouse is set for the Summer of 1995.

> One of the obvious drawbacks of the 3D mice about to hit the market is the fact that the accuracy of the cursor movement on screen depends too much on the steadiness of the users hand. Because the mouse has to be held in mid air to give 3D co-ordinates in relation to two receivers the user hasn't anything to guide his hand (Loughnane 1994).

At the present design consultants throughout the world (Hoods and Design Partners included) are striving to come up with a design solution which will allow for controlled 3D input with the accuracy of the 2D mouse.

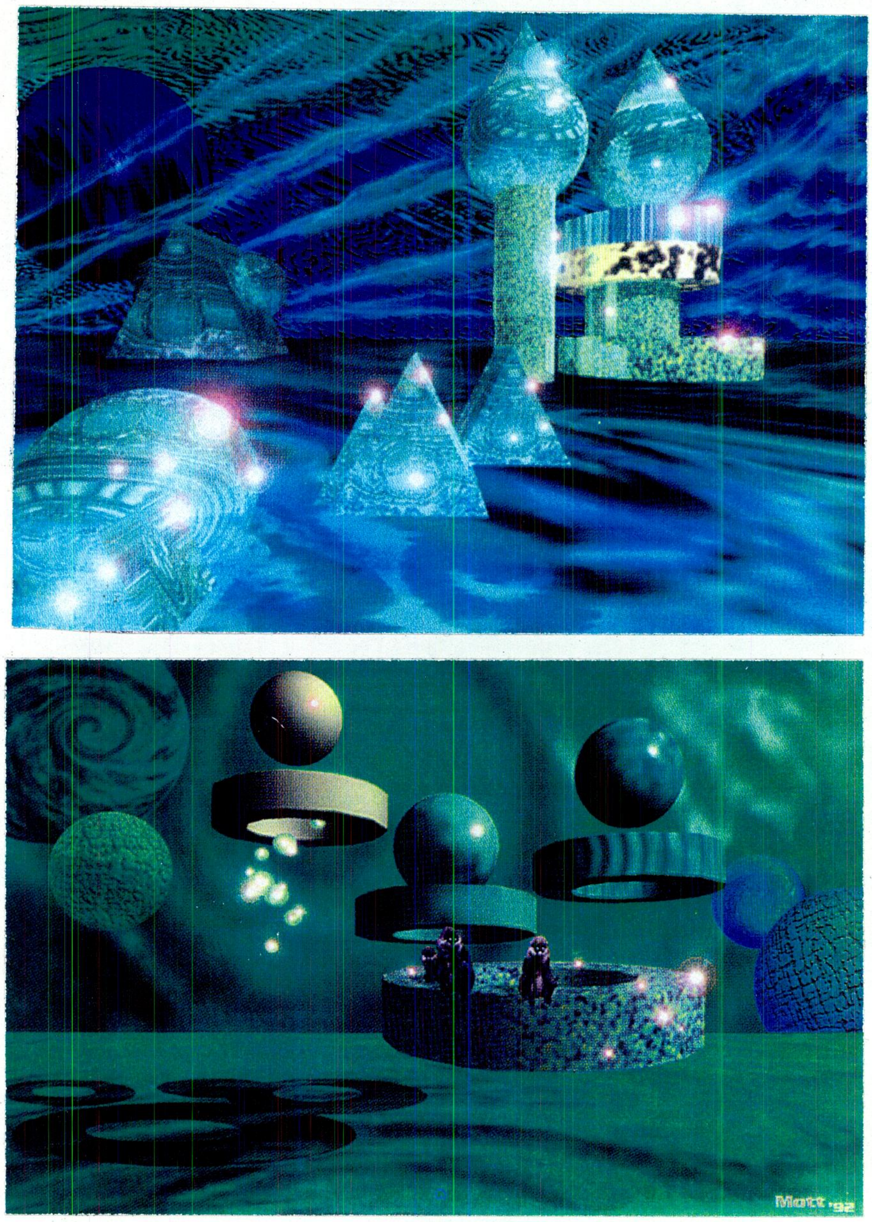
2.4 **Clothing the Model** : No matter what method is employed to input the data to construct the skeletal model, what results is a 3D visual displaying an image constructed of hundreds of polygons all linked together to describe the surface form. Now the skeleton has to be clothed in order to appear solid. It is important to remember that no matter what the image on screen, it must be possible to break it down into geometric forms. The computer can only deal with numbers and formulae so even the most organic forms, (such as liquid flowing), must be reduced to a simple numeric pattern.

> In computer imaging as in the real world around us almost every surface has a different texture, be it rough, cracked, grained or reflective etc. Textures cannot easily

be described geometrically so alternative methods of
inputting the information have been developed.
(T. G. Smith 1986, P, 208).

2.5 **Texture Mapping** : This is the simplest method. Programmes are written into the computer describing a range of textures, leather, wood, sand, bark etc. in 3D detail. These patches of texture can be painted onto the required surface and multiplied to cover an area. Each texture can then be altered in a limited way be adding details, i.e. knots in wood or stains on carpets etc. Flat, even textures often look out of place and unreal so with great attention to subtle details almost perfect realism can be achieved. The texture patches used in this process can be linked, stretched, flexed and manipulated in any way to cover highly complex surfaces.

2.6 **Photo Scanning** : "A more realistic method of texturing is to introduce a photograph of a real surface into a computer". (T. G. Smith, 1986, P. 209). It can be scanned, altered in a minor way and manipulated to cover almost any surface. The initial photo must be close to what is required however, because the computer hasn't the same ability to transform scanned images. This method is ideal for stills and is widely used in the production of flat work, ie. graphic advertising posters for new film releases.

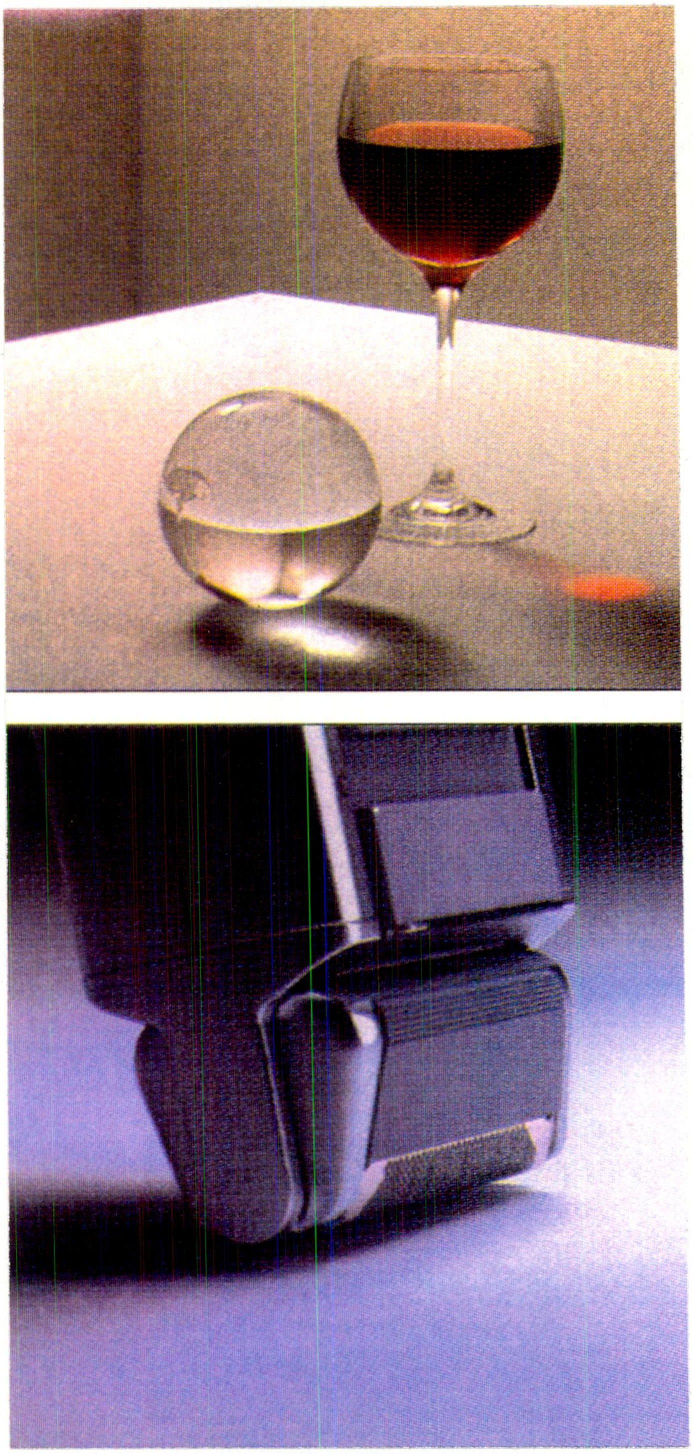


<u>Illus. 8</u> <u>Dawn over Tolandizue (Top)</u> and <u>Primates of Alderbaran,</u> examples of the textural and visible capabilities of High Resolution Apple Mac equipment.

2.7 **Bump Mapping** : The most effective texture application is achieved using highly sophisticated technology invented by J. F. Blinn at the Jet Propulsion Laboratory in Pasadena. Its called "Bump Mapping" and doesn't actually store any textures. Instead it analyses how light bounces off various natural textures and generates a simulated impression of that texture by copying the same pattern of light reflection and absorption.

This kind of texture can be moved and rotated but requires powerful computers and an extensive processing duration. The most up-to-date development of this process is called "Ray Tracing" and produces images which are photographically perfect. It accomplishes this by tracing every ray of light from the source until it bounces off a surface, back and forth until it has dissolved completely. By charting the patterns of millions of light rays individually a flawless image is generated making such effects as transparency, refraction and mirroring possible.

2.8 **Texturing the Unmeasurable** : The methods outlined already are ideal for constructing images of objects with defined shapes and surfaces but cause severe problems when aiming to generate completely organic and natural landscapes. To break down a mountain range into its geometric



<u>Illus. 9</u> To produce 3D scenes such as these, Blue Sky Production's ray-tracing - based rendering software uses physical laws to determine how light is scattered from the surface of objects.

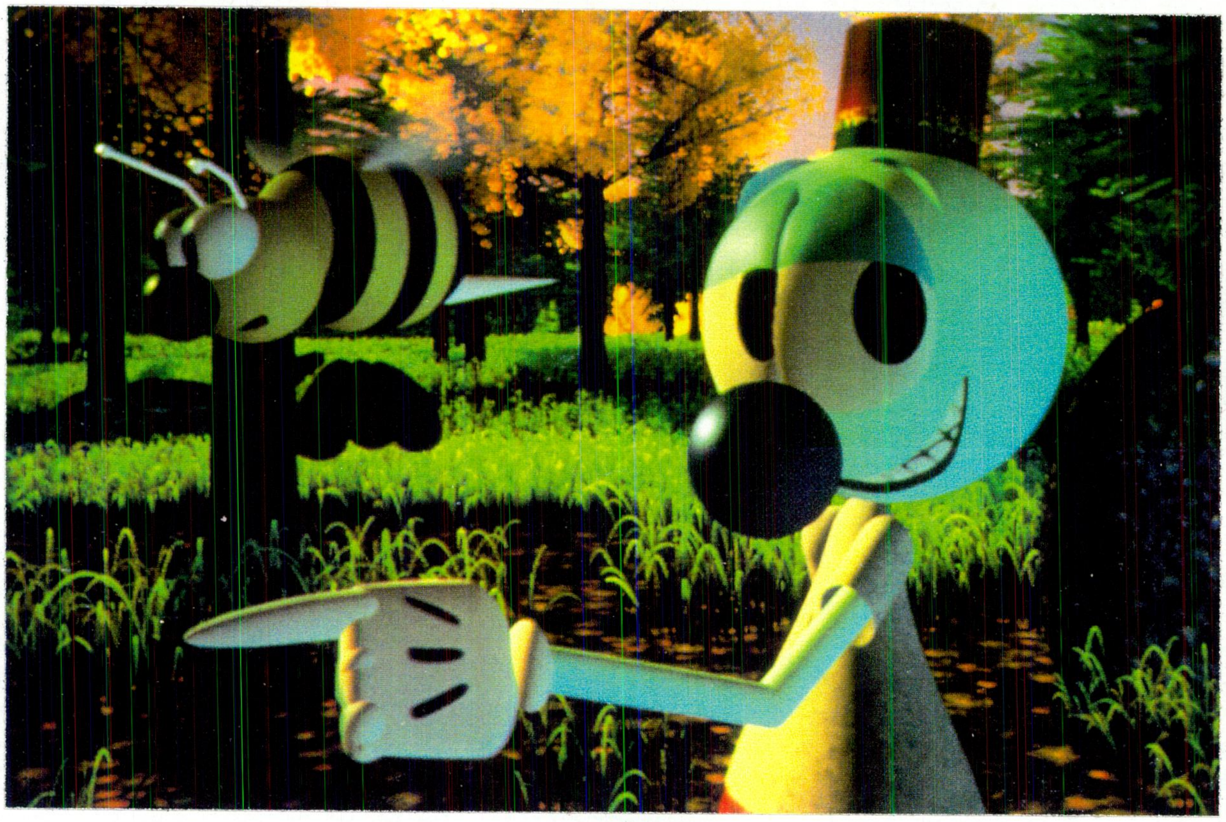
configuration so that we can zoom in on the tiny surface details is a mammoth and completely impractical task.It took a complete re-evaluation of geometry itself to provide a solution to this problem. The result was the brain-child of IBM's Benoit Mandlebrot : Factual Geometry.

> It is based on the observation that some natural shapes simply cannot be accurately measured ; that the measurements we come up with depend on how finely divided our measuring sticks are and how close we are to the object we are measuring. (T G. Smith, 1986, P. 209).

The object is grown, it is developed organically rather than constructed. The method works by recognising that any object may be made up from a number of larger or smaller objects with similar characteristics.

> Some surfaces such as the shape of a mountain repeat themselves the closer we get to them ; boulders and soil along a mountain ridge are mountain shaped and so are the pits and valleys in the surface of the boulders. Likewise the branches and leaves of many trees are miniature trees in themselves. (T. G. Smith, 1986, P. 210).

Once the computer is programmed to acknowledge this information views of mountains, forests, grassy plains and oceans can be made from any direction moving ever closer and sweeping in any pattern the animator requires.

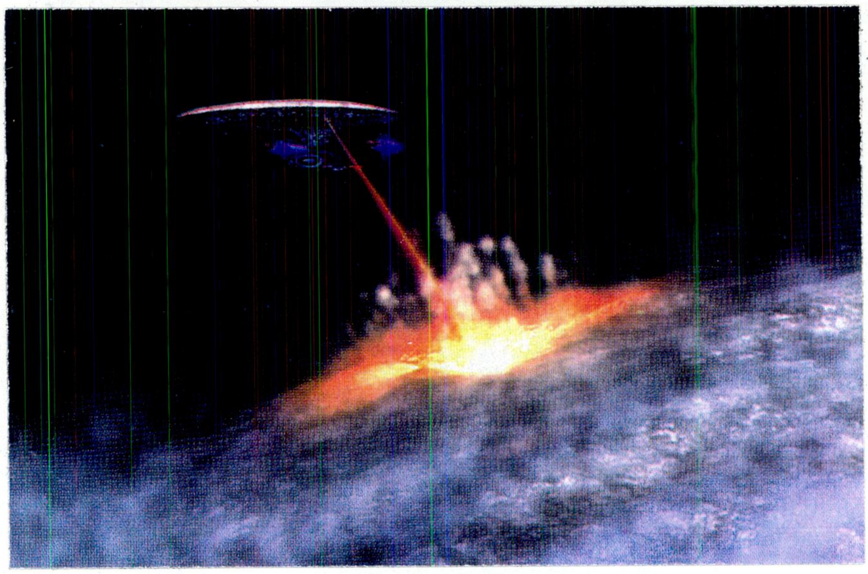


Illus. 10 Fractal Geometry was employed to create the natural background in this still from Pixar's Andre and Wally B. (1984).

2.9 **Particle Systems** : Finally, surfaces can be modeled by particle systems.This method creates many different effects by generating minute dots. The dots are recorded as blurs on film, opening up the possibilities of 3D models for objects such as smoke and fire where other computer modeling methods would give a hard defined surface. A myriad of displays are now possible using particle systems developed by Pixar and Softimage in Montreal..

> With 3D particle animation, says Warefront's president, Larry Barels, 'you can blow a character away like smoke or make him ooze onto the floor into a puddle', Barels adds, optimistically, that the effects created with particle systems will be the next fad in computer graphics animation, replacing Morphing in popularity".
> (B. Roberson, 1993, P. 40).

2.10 **Recording the Images** : The images created were initially transferred onto film by conventionally recording the pictures directly from the screen using standard optical equipment. But because of the pixel arrangement which makes up the image the end result wasn't satisfactory. Equipment was developed to laser scan each frame onto film with perfect resolution. This technology has now been advanced to disk recording. Entire movie productions are recorded onto laser disks, similar to large compact music disks. This cuts down on processing time dramatically.



Illus. 11 For an episode of Star Trek : The Next Generation, animators at Santa Barbara Studios used particle-systems software to simulate the effects of gasses escaping from the melting surface of an alien comet. (1994).

These are the basic procedures for the production of computer-generated images within the film industry. There are however regular hardware and software developments adding to and improving on what has gone before. “By the end of the eighties Hollywood had enough faith in digital tools to make their use in future films more of a rule than an exception”. (G. L. Graves, 1994, P.17).

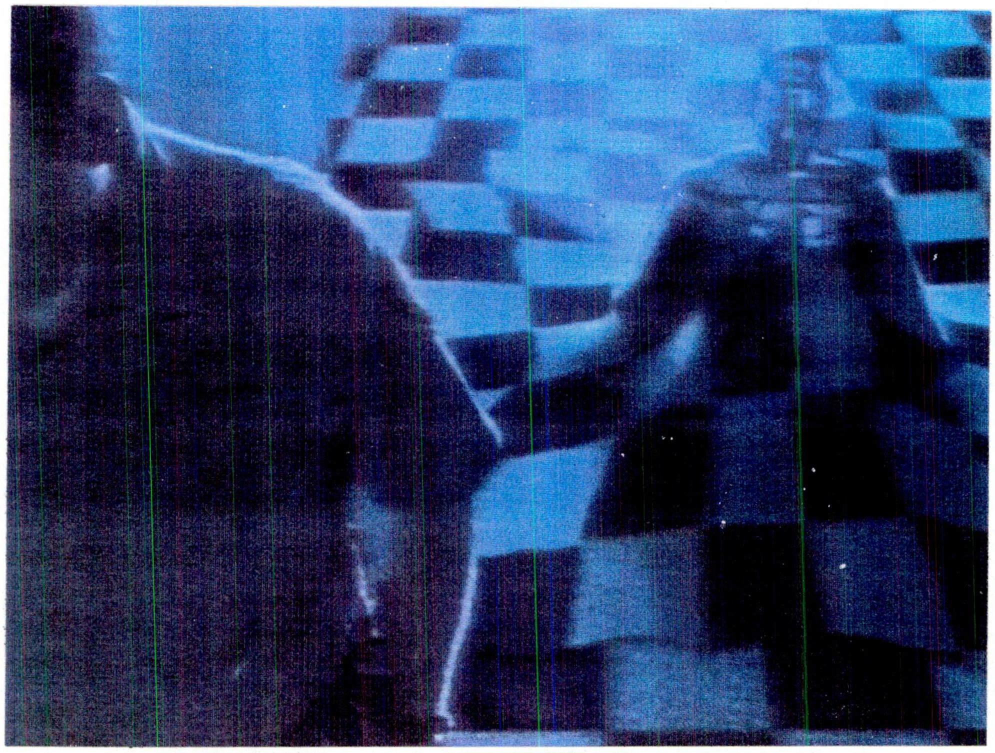
CHAPTER THREE

3.0 Stories Enhanced by Digital Wizardry

As computer technology was becoming more and more advanced it was also becoming more user-friendly. This served to make the possibility of using such equipment to generate images a more accessible and attractive alternative to visual effects people, whose talents lay in traditional methods.

Visual effects began to play bigger roles in overall productions. Instead of using the technology to create short but spectacular sequences, whole stories began to revolve around the images that could be created. But unlike ten years earlier with the making of Tron, the effects were not so obviously computer-generated. The images were very realistic and movement was natural. Digitized objects blended in perfectly with their backgrounds and lifeforms moved in a most convincing manner.

3.1. Cyborgs and Dinosaurs : When James Cameron's, Terminator II was released in 1991 the audiences were viewing something totally new, images they had never seen in a movie theatre before. This sequel was a much bigger box-office earner than its predecessor, and this can be attributed, in no small way, to the stunning effects which at the time



Illus. 12 Cybernetic Soldier is transformed from it's hiding place in Terminator II.

made it the most expensive movie ever made. No corners were cut or expenses spared in creating the most realistic and awe-inspiring visuals possible. Using morphing techniques, which has previously been used on music videos and in advertising, the main character was given the ability to take any form imaginable, melting into liquid or extending dagger-like weapons from his limbs. The Terminator (a cybernetic soldier) could transform his appearance instantly and in a fluid nature which was completely comprehensible to the viewer. The character's movements were perfectly coordinated, eliminating the jerky machine-type motion which had become synonymous with robotic or cybernetic figures in the past. This creature moved and behaved physically in a human manner but had fantastic powers of transformation and distruction.

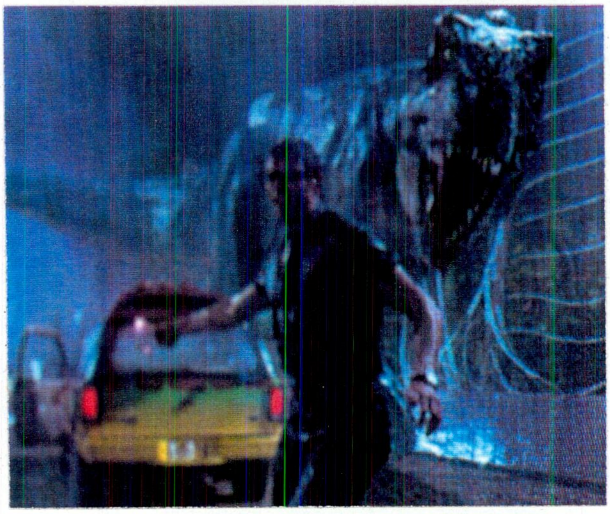
Although it was difficult for the spectator to understand how such effects could be possible, the application of the advanced computer technology was so convincing and the animation so subtle that the movie gained immediate world-wide acceptance. The spectators could relate easily and naturally to what was happening on the screen. Instead of immersing the viewer in computer images which are difficult and uncomfortable to comprehend (at least to those of us without a 'Nintendo' background) the film makers were making a conscious decision to create images which related directly to human nature and

the world around us. Instead of placing the Terminator in an imagery environment with other exotic and unnatural creatures the film was set in a modern American city with human characters. The spectator could easily relate to the environment and follow the linear pattern of the story without having to concentrate on the whole scene. The overall effect of real actors alongside animated images set in a familiar environment was obviously a success.

Spielberg took it one step further with the production of Jurassic Park in 1993. The creatures which were reborn in this movie, thanks to the developments of digital imaging, were animals which are familiar to all of us even though extinct for millions of years.

Although no one has ever seen a dinosaur we are all well aware of their past existence and through literature, T.V. and film we understand what they looked like and how they lived. Animating model dinosaurs was something which had been done several times in the past, but Spielberg and his digital effects team made the giant reptiles truly come to life.

> The creation of the Jurassic Park dinosaurs required industrial light and magic to extend the previous boundaries of modeling and animation complexity. We continued to use alias as our primary modeling tool - it's the most advanced commercial technology



Illus. 13 Larger than life T-Rex in Spielberg's Jurassic Park. (1993).

> for this type of work. Pixar andRenderman*(1) is a pivotal element in the digital revolution which is rocking Hollywood. (T. Williams, 1993, P. 133).

The dinosaurs were inputted into the ILM machines by digitizing 3D models which had been constructed and animated in a limited way using robotics. The graphics department made the images move naturally and completely realistically. But it wasn't just the movement and behaviour of the creatures which made them so stunning, the attention to textural detailing had a profound effect. The scaly skin of the animals glistened with moisture and saliva dripped from their teeth. Particle animated vapor was exhaled with their breath and most convincing of all were their gleaming eyes which stared menacingly at potential victims.

Both Terminator II and Jurassic Park were experimental showcases for the digital animation industry and they proved beyond doubt that computer software paved the road ahead for the Hollywood blockbuster.

3.2. Now You See It, Now You Don't : Hollywood film-makers began to use the digital techniques to enhance productions which in the past may not have utilized any effects sequence at all. The story behind the film

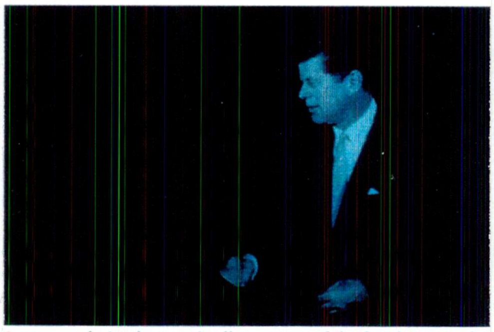
1. Renderman is a software package developed by Pixar for the purpose of creating surface textures

didn't have to be based in science fiction or prehistory to take advantage of the developments in computer animation. The technology wasn't monopolised by the creators of fantastic scenes and unearthly beings. It could be used just as effectively to enhance a story set in the real world around us with characters who had no supernatural abilities. The people who paid to see Jurassic Park and Terminator II were paying to see the effects. The films relied on and succeeded by displaying astounding effects sequences. The film was the effect in both instances.

But digital effects could be used just as successfully in more subtle ways. Details could be added to or removed from any shot.

> Digital editing has taken movies forward into a new medium. Regular movies that you didn't think of in terms of effects now use them because they are so transparent. A film crew will find a house that they want to shoot but there is something next door to it that gets in the way. Before, they would have to look elsewhere. But now they can just take the things they don't want out of the scene. People are a little looser now about where the shoot. If they are making a period piece they know they can come to us and we can remove all the poles, wires and street lights. Directors are considering things they would never have done before. (R. Marie, 1994, quoted by B. Swain 1994, P. 11).

1. To achieve the amazing special effects scenes in Gump, first stock footage of Kennedy grippin' and grinnin' in the White House is dug out of the archives . . .



2. Kennedy is electronically cut out of the background while a new background is filmed with actors . . .

3. Tom Hanks does his stuff in front of a "Blue Screen", with bits of tape used as guidelines . . .

4. The three elements are slapped together by computer. But — hey! — they're all out of alignment . . .

5. *Et Voila!* Nothing a bit of digital jiggery-pokery can't cure . . .

Illus. 14 Digital techniques allow Tom Hanks to greet JFK with a handshake in 1994's Forest Gump.

Robert Zemek used animation techniques to create effects for Forrest Gump in 1994 which were so subtle the spectator may not have been aware of anything extraordinary occurring on screen. From the opening scene where the camera captures the image of a feather floating on the breeze and follows this digital creation as it flies over houses, streets and gardens to finally come to rest at the feet of Forrest Gump (Tom Hanks), the production is permeated with digital enhancements. Some are obvious (Gump meeting John F. Kennedy) but more often the techniques are used for subtle detailing i.e. a Vietnam vet's legs were digitally removed from the knees down for half the production.

Whatever the storyline behind the film, be it a science fiction combat scenario or a simple romantic comedy, computers are being used extensively for the creative and enhancing techniques they offer.

3.3. **Anythings' Possible** : Up until now computer generated imagery has been used to create or twist reality, whether it has been digitally erasing rigs and wires used in stunt sequences, or creating something unreal but believable, such as dinosaurs in Jurassic Park or bodily contortions in Death Becomes Her. Each film marked an advancement in computer animation technology. "The as-of-yet-unrealised promise of digital

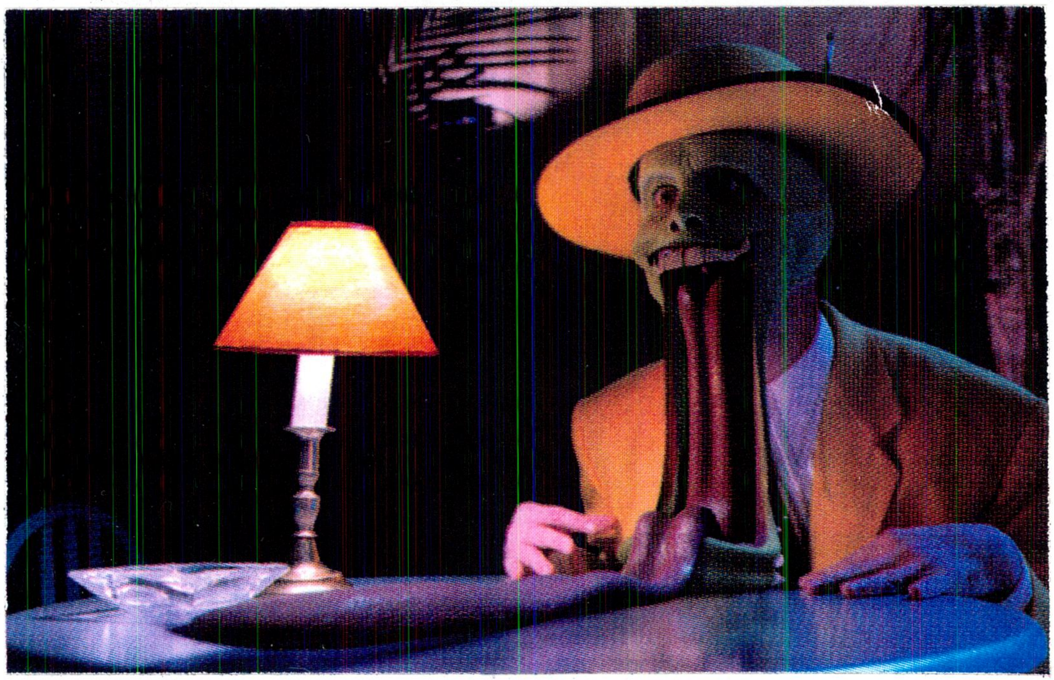
Illus. 15,16 Bodily contortions controlled by SoftImage software for Death Becomes Her (1992) and Natural Born Killers (1994).

effects was that of allowing directors to bring to life whatever can be imagined". (G. Murray, 1994, P. 22).

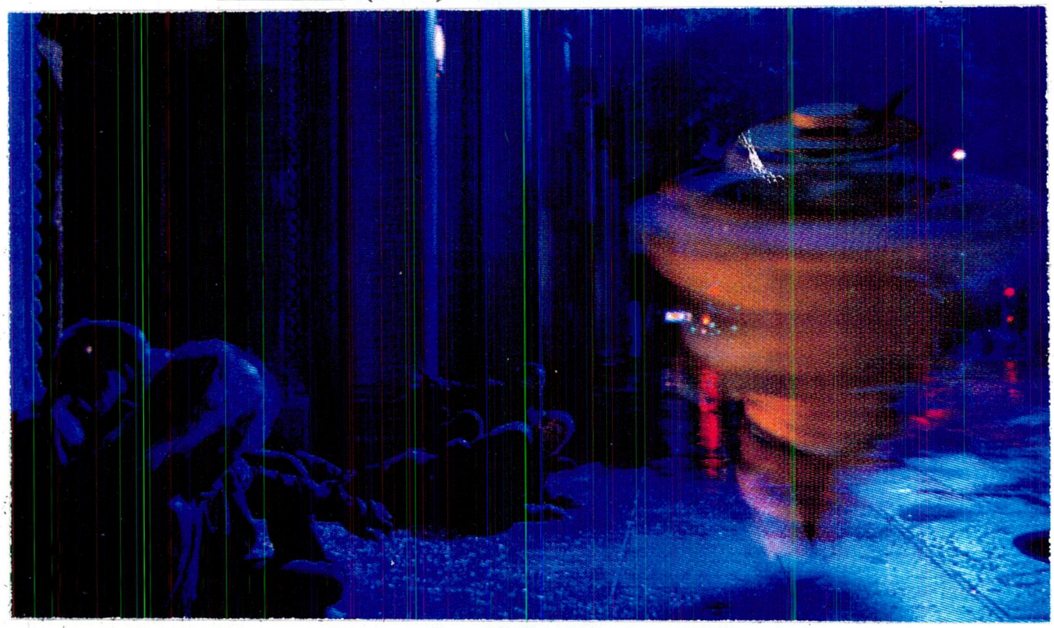
The breakthrough came in 1994 with Charles Russell's The Mask. The film stars Jim Carrey as a mild-mannered bank clerk whose life is transformed when he discovers a mask. When he puts it on he's instantly takes the appearance of a comic strip superhero. "With his innermost desires and whims manifested". (G. Murray, 1994, P. 22). When he puts on the mask his face is distorted to that of a cartoon character and he is sent whirling in a frenzy. "An artful transformation of reality into fantasy never seen before on the screen". (G. Murray, 1994, P. 22). This historical milestone for computer animation was yet again achieved by ILM using SOFTIMAGE'S software 'Creative Environment'.

The film represents two big advances for digital animation. Firstly, a graphics department was used to develop a main character throughout the entire film and the animators were let loose to use whatever type of animation was necessary to create images of their own desires. The script wasn't completely adhered to, allowing the animators the freedom to express their imaginative talents to their full extent.

> Whereas the constraints of reality required for past films have kept ILM animators on a pretty tight



Illus. 17 Turning an actor into a Tex Avery - style cartoon character for The Mask. (1994).



> leash, The Mask relied on their cartoon-sensibilities gone wild, expressing their 'Tex Avery/Chuck Jones' aesthetics" (G. Murray, 1994, P. 22).

Because of the loose direction the animators were allowed to put their creative personalities into the project. The team was supplied with the software which allowed them complete freedom. Many of the animators had backgrounds in classical stop-frame animation but found the leap to digital technology a short one because of the interactive capabilities provided by softimage. "You can get in there and play with it like clay, pushing it, moulding it and it will respond. It welcomes the creative angle". (T.Bertino, 1994, Quoted by G. Murray, 1994, P. 22).

3.4. **Some of the More Difficult Shots** : When the character first tries on the mask it grabs at his face and tentacles extend from it around the back of Jim Carreys' head. Lightning flashes from the mask and around his face and the shape of the mask begins to contort. The animation had to synchronize with Carrey's head movements. This caused great difficulties because the actor was twisting and moving around so much. The software allowed the animator to start with key frames and it would automatically fill in between, with additional details added later to reduce the fluid nature of the animation which can appear unreal if left to the computer. "If you just let the tools do the work you get a

floating, smooth, clean motion lacking in character". (P. Tippett, 1994, quoted by B. Robertson, 1994, P. 24).

Every time Carrey tries on the mask he is whipped into a frenzy, whirling around the scene like a miniature tornado. To create it the ILM programmers wrote a tailored programme that would spin a solid object shaped like a top, picking up colours and textures from his clothes. The colours had to match perfectly and the character's hat and head had to appear in the correct position. Objects in close vicinity would fly off shelves or newspaper pages would be caught up in the whirlwind created by the characters action.

Several standard cartoon clichés were adopted to enhance the character: eye popping, jaw dropping and bodily contortions were all part of the effect.

> The Mask is a step forward and a side step. It doesn't step forward in believable reality but it goes forward in terms of unbelievable reality. (T. Bertino, 1994, quoted by B. Robertson, 1994, P, 54).

Illus. 18 Computer animators employed various classical animation cliches to create The Mask character. (1994).

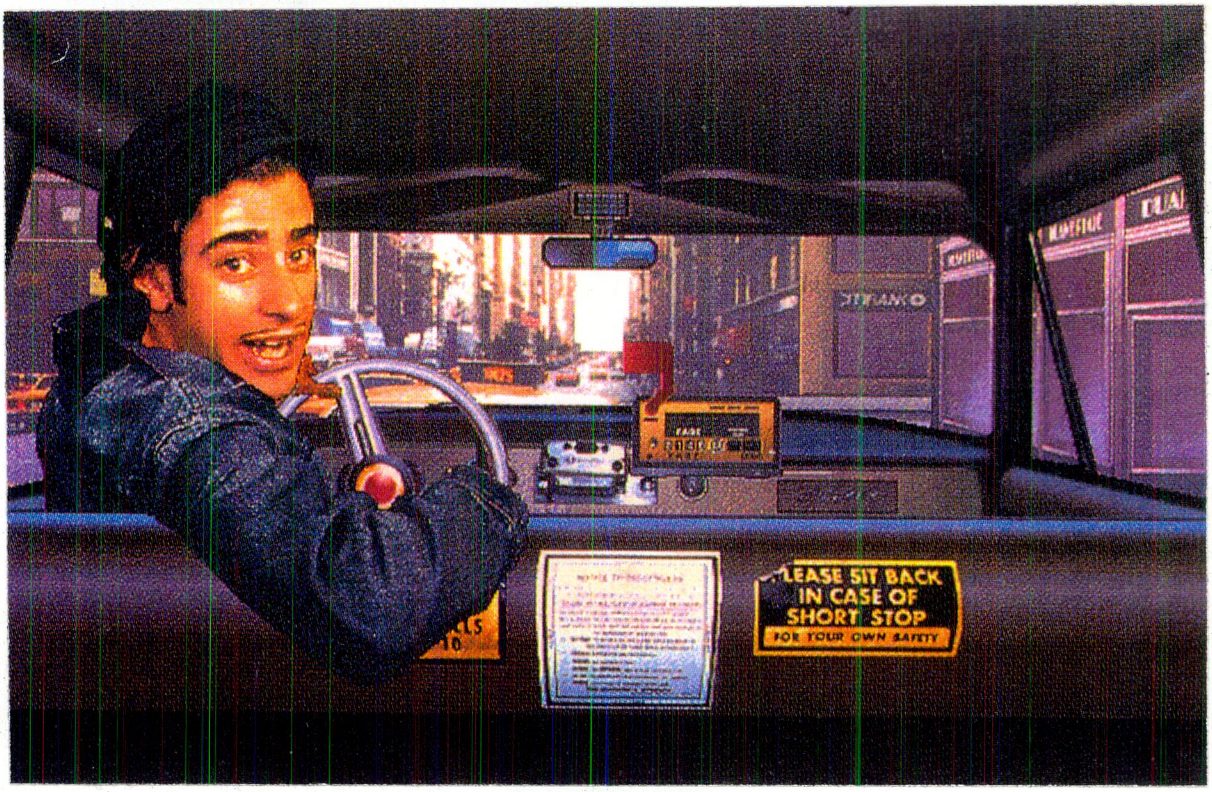
CHAPTER FOUR : CONCLUSION

4.0 Applications and Implications of Visual Technology in the Foreseeable Future :

Visual technology is developing now at an increasingly rapid rate. Even the smallest film studios are employing computer-literate animators, or adapting their own traditional skills to take advantage of the facilities on offer. "What we're seeing this year is just the tip of the iceberg to what we're going to see in about two years". (J. Segal, 1994, quoted by G.L. Graves, 1994, P, 18).

More aspects of the film production process are being computerized, not only for the quality and control offered but also for attractive economic reasons. The number of personnel required to complete a feature length production has greatly diminished. This is especially true in the production of animated films. In the recent past animation companies like Bluth and Disney relied on third world animators to provide a lot of the labour-intensive cell painting. Today most of the work is completed by a handful of computer operators, in European or American bases.

> We're at a stage similar to a few decades ago when the electric amplifier and electric guitars and such where first coming out. They allowed a new kind of ensemble, the rock and roll band. It didn't exist before that because the technology wasn't there for



<u>Illus. 19</u> Real actors were "Motion Captured" to create the characters for this CD-Rom based video game titled <u>Hell Cab.</u>

> four people to create that kind of noise. The same thing is happening today, the computer technology is finally here where four people in real time can create images which used to take days and lots of people. (P. Schere, 1994).

Computer graphics companies are competing against one another for the projects on offer from Hollywood. The cost of hiring digital equipment and operational staff has never been lower, so instead of minimising their profit margins by selling their services the graphics companies such as Biovision (Menlo Pork, California) or Rocket Science (San Francisco) are looking towards producing complete projects for direct sale, mostly for games companies of television stations.

Not only are these companies offering cutting edge visuals and graphic innovations but also after-sale advantages. The 'street fighters' or 'ninja warriors' visualised for major game companies also come with accurately digitized modeling schematics, which allow for the production of 3D toy models of the characters, cashing in on the games popularity, i.e. Power Rangers and Mario Brothers.

Because of the rate of development of graphics technology it is a valid assumption that in less than five years it will be possible for a single

P.C. operator to produce the digital effects similar to those displayed in the movie theaters over the past year ie. The Mask, Stargateand The Crow.

If this is so, and it seems certain that it will, the cost of producing the average Hollywood blockbuster is likely to drop by millions. However, it is equally likely that the effects we see today will rapidly become outdated. So there will always be demand for cutting-edge technology which will enable the film producer to top what has gone before. Technology at the forefront of development will be required by those who are willing to pay for the most spectacular show, ie. the film producer and eventually the spectator.

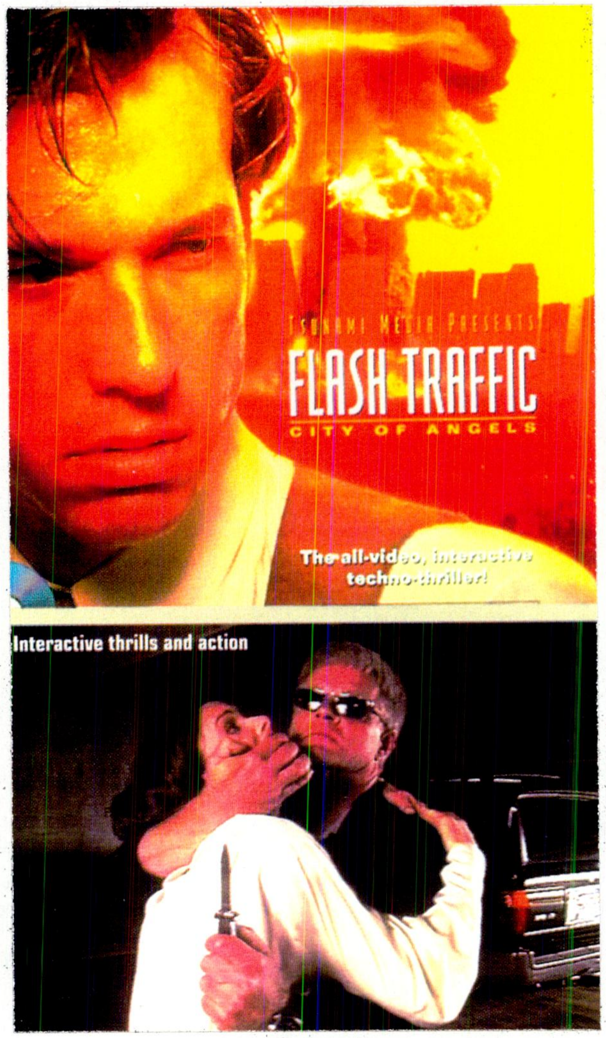
Although the number of people required to create the images is most likely to decrease, the cost to the producer will only be reduced as the technology becomes outdated.

4.1 **Spectator Interaction** : In recent years a number of major American film companies have been trying to cash in on the popularity of the multi-billion dollar video games industry by releasing productions which are directly related to games scenarios. Real actors are cast to play the characters popularised by the success of the games. Up to now film

productions which are based on video game characters and storylines have been box-office failures. Just as Tron failed to capture the intended "Pacman" playing audience in the early eighties, more recent productions like Super Mario Brothers (Disney) and Last Action Hero (Warner) failed to straddle the parallel worlds of computer game and cinema screen.

Cinema as it exists today cannot provide the excitement offered to the player of an interactive game. The video game player has the ability to change the image on screen through his/her own decision and action. The spectators at the cinema have no control over the scenario being unraveled on screen. This is the fundamental difference which is bringing both film and video games industries together to develop an environment which will allow the spectators in a movie theatre to alter the direction of a story displayed on screen.

> The computer game seems perfectly cast in the role of cinema's cuckoo in the nest ; the ugly duckling kid whose facility with the latest technology unlocks a wholly different way of relating to moving images - one based less on identification with a character and more on direct interaction with the screen. (S. Bode, 1993, P. 27).



Illus. 20 Interactive movies such as <u>Flash Traffic</u> allow the viewers control over the unfolding storyline.

The technological development which aims to bring the experience and excitement of video games to theatre film viewers is referred to as Interactive Cinema.The interactive movie usually has eight parallel storylines which viewers can vote to pursue by pressing a joystick attached to their cinema seat. The decision of which storyline to follow is taken on a vote basis from the spectators.

Interactive cinema is an experimental idea with a lot of problems still to be addressed. How will the viewer feel at being out-voted on which plot to follow? Will they lose interest if the film is out of their control? The impact on production budgets is also a concern. Interfilm's experimental interactive film I'm Your Man lacks sophistication and detailing because eight storylines had to be produced on a budget equivalent to a conventional movie. In order to make an interactive movie appear as good as present Hollywood productions, will the production cost be eight times higher?

Interactive cinema is an intriguing concept and if the aforementioned questions can be answered by technological input then it is certain to attract an audience whose enjoyment is based on being in control of the branching scenarios of a game.

As for the present, however, movies and video games remain distinctly separated.

> It is easy to look at some similarities between Hollywood and the video games business. Its also easy to find some differences. A movie or television show is a story. A story has exposition, conflict and resolution and the emotional power for the viewer is in that arc. A video game is a different experience. Games are about competition and mastery, and its about winning and losing. What drives a player to a video game isn't a story (although the environment of a story can make it more interesting) it's the desire to master the game, and win.
>
> So the real question I think for the video games business is how can we avail ourselves of the technological benefits that Hollywood has to offer, without losing sight of the fact that people play video games, they don't play stories.
> (S. Zelnick, 1994).

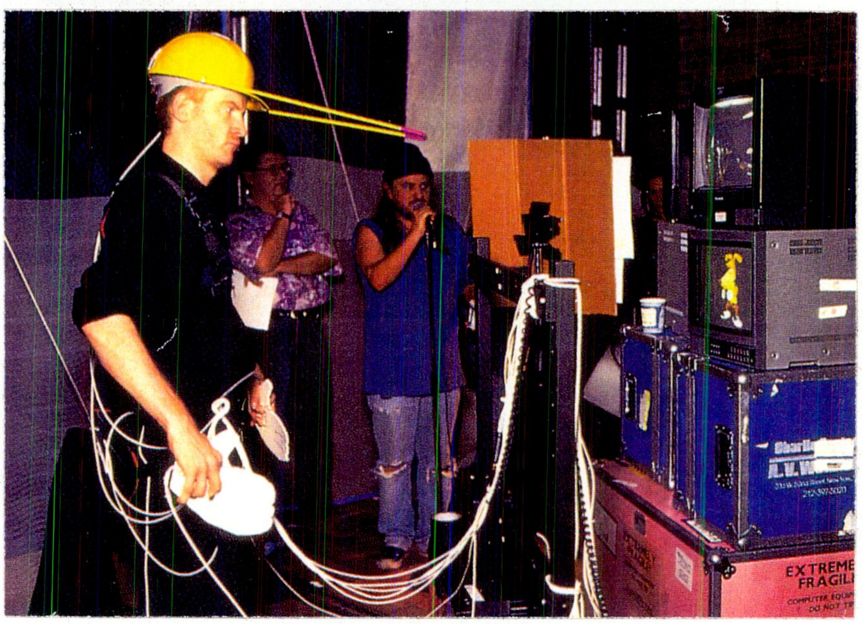
4.2. **Implications of Digital Developments for the Actor** : One of the biggest financial outlays for any feature film is the "moviestar". The greater the name the bigger the price tag. The success and failure of many a production pivots on who is cast in the leading roles. The cost of employing a superstar can often exceed the entire financial expenditure for the rest of the production. But even the actors are not safe from technological developments ; or are they?

At present computer technology can't completely simulate the persona of a human being to a believable level, and even if it could the software required would most likely cost more than the actor.

> If I could make something in a computer that made you think it was Arnold Schwarzenegger then I would want as much as Arnold Schwarzenegger gets. (R. Marie, 1994, quoted B Swain, 1994, P. 12).

4.3 **Motion Capture** : Performance animation, digital motion, motion capture of even "Mocap" for short are all terms which relate to the latest digital tool to have an impact on film production. The technology allows animators to capture the movement of a real person and instill that movement into an animated character.

It has several advantages over current digital animation procedures. It enables the animator to capture the movement of a particular person i.e. Rudolf Nureyve. If the scene requires Jack Nicolson to perform a pirouette for example, then the actor's image can be combined with the movement of the dancer. It is an ideal tool for perfecting timing in animation - whether it's a dancer's movement to music or facial animation to a voice track. The process also allows direction of a character. The director can be instructing the movements of a dancer while the animator surveys the action of the desired character on screen.

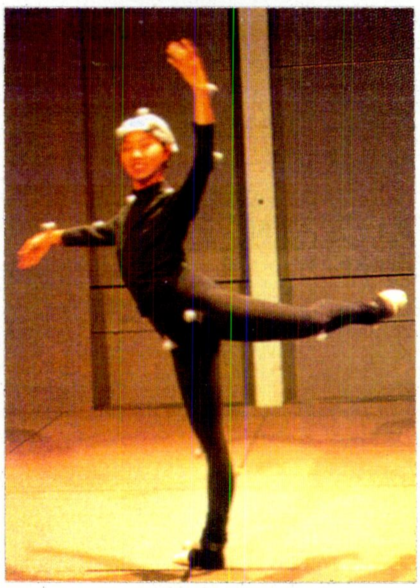


Illus. 21 Magnetic motion capture. The performer is tethered to the processor by several wires.

To capture human motion, most animation production studios use a magnetic system but some use optical equipment. Each system has advantages and disadvantages.

The magnetic system can capture and display the motion of objects in real time. Thus it is often used for the production of performance animation. This is ideal for directing purposes. The major disadvantage of the system however is the use of several sensors worn by the performer which are connected by long wires to the system's processor. "The sensors capture orientational and positional data". (B. Robertson, 1994, P. 23). These wires restrict the movement of the performer and also confine the working space.

Optical systems, while more expensive are wireless. Performers have stick-on reflective dots which are captured with several video cameras and translated into 3D data. A disadvantage however with this system is that one dot might hinder the camera's ability to see another. The optical motion capture system developed by BioMechanics (Marietta, C.A.) called "Junior" can capture motion from twenty dots and display it in a texture-mapped model at thirty frames a second.



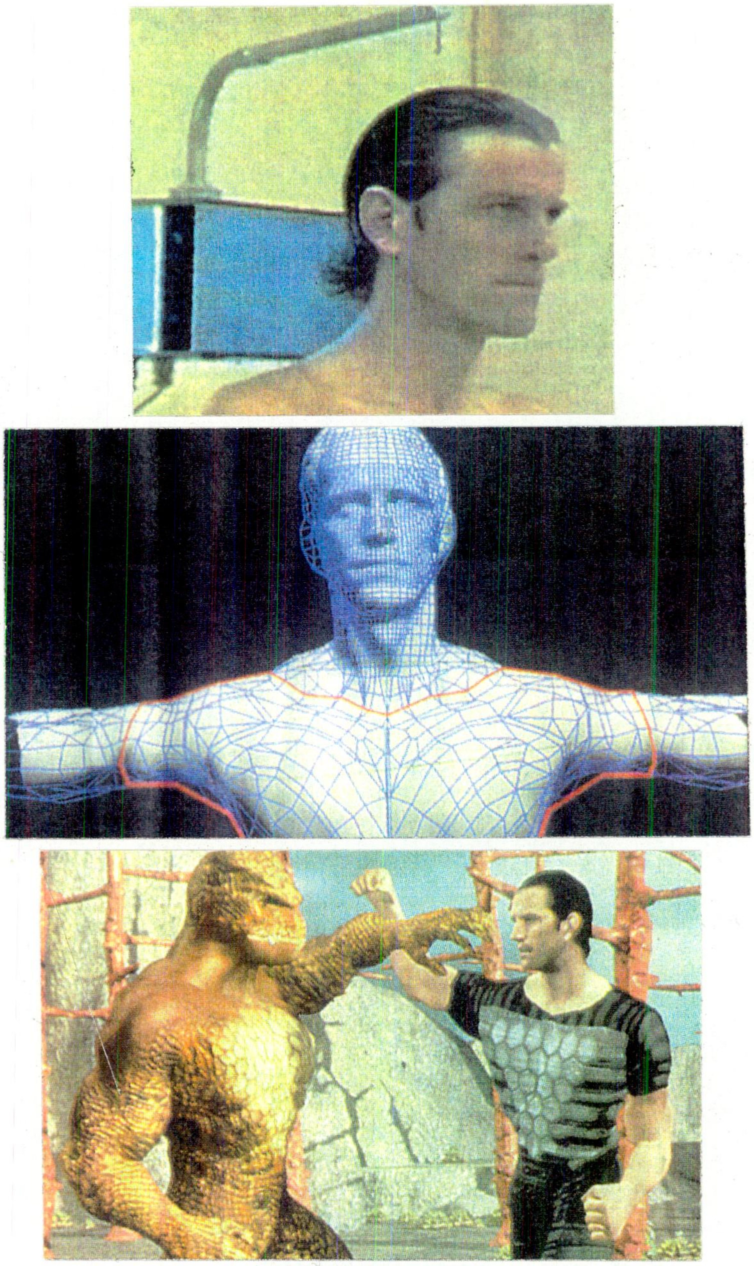
Illus. 22 With optical motion capture technology such as that dipicted above from Adaptive Optics Associates, performers, wear stick on reflective dots which are captured with several video cameras and translated into 3D data.

The biggest advantage motion capture offers the animator is power to aid the production of a lot of animation quickly. "Real-time motion capture was the only way we could have done fifteen minutes of animation in two weeks". (P. Conn, 1994, quoted by B. Robertson, 1994, P. 26).

Motion capture has already been employed to create some of the visual effects for recent movies such as action sequences in The Crow or the yet to be released Batman Forever. Although the announcement of this technological development caused a sensation in Autumn 1994, much of the "hype" is unfounded.

Motion capture is ideal for enhancing difficult and dangerous stunt sequences. The action of a stuntman can be captured and mapped with the physical details of a moviestar.

The technology is not developed to a stage (contrary to press reports in recent months) where an actor can be digitally replaced completely. At present an actor can be captured digitally and animated to perform stunt or action sequences but animation of facial features and other minute details has not been developed to the extent that a graphics department can capture the physiognomy of a movie actor and proceed to animate a sequence, completely independently of the actor so that it is believable.



Illus. 23 An actor is scanned digitally to create a three dimensional body map. The computer "Vactor" can then perform stunts without incurring huge insurance bills.

> We did a test for a 3D character who would lift a heavy object and toss it up overhead. When the real performer lifts it up he kind of stumbles. All of those little nuances are there. (S. Hoon, 1994, quoted by B. Robertson, 1994, P. 25).

So far the moviestar is safe. No computer software has yet been developed which can replicate the millions of barely perceptible nuances of individual actors. In the near future it may be possible to compile a database which records the subtle details of an actor's physical behaviour but to create a scene completely independently of the actor would require a P.C. operator with incredible skills of perception and manipulation.

As of yet the "Virtual Death" of the actor is far from reality. But given the rate of software development over the past five years and the increased role of digital animation within the film industry it may not be long before the glossy pages of the movie periodicals are littered with the faces of P.C. operators alongside their machines instead of moviestar portraits.

4.4 **Personality Cult** : It is important to note that the public's attraction to the moviestar is not solely based on the screen image. The spectator is also attracted to the lifestyle of the moviestar and to the image the

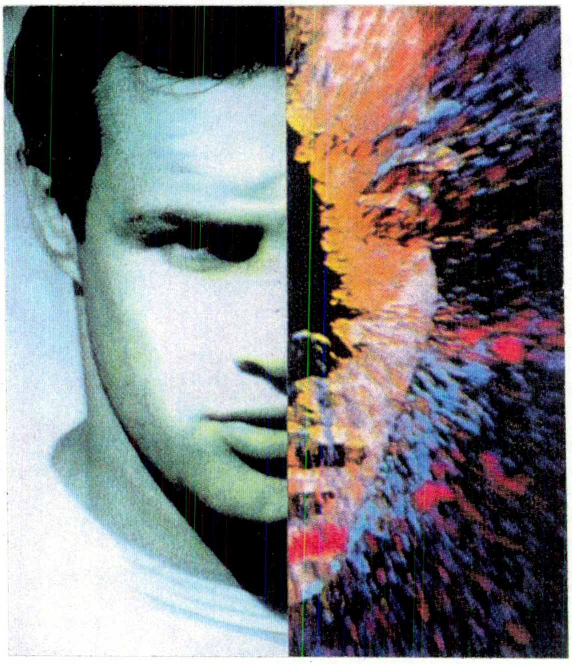
media portrays of a real personality. People search for heroes to look up to and the moviestar is regularly the source of worship.

> The Star is a function of the narrative and visual system at work within film, perhaps inflected by the aura of the star constructed outside the film, but nonetheless contained by the system. (J. Mayne, 1993, P. 123).

Spectators idolize not only the character portrayed but also the real personality behind that character. Furthermore the charisma of an actor can often compensate for poor acting skills towards the creation of a moviestar. The success of a film production is often the result of casting a personality who is idolised by the spectators. The removal of personality can leave the production dry and uninteresting to the viewers.

In the future the creator of spectacular visual imagery may be idolised for his/her technical ability and creative achievements, but it is unlikely that the image and lifestyle of a computer operator portrayed by the media will achieve the hero status comparable to Hollywood personalities like Monroe and Brando on which success is squarely dependent.

> No matter how significant the textural details of individual films or the scope of a directors vision, the role of the star is the most visible and popular reference point for the pleasures of the cinema. (J. Mayne, 1993, P. 123).



Illus. 24 Digital technology will not be capable of compensating for the aura of the movie star.

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