

PRECEDING PAGES: In one of the most iconic images in early cinema, the understandably grumpy Man-in-the-Moon has just endured a rocket full of explorers landing in his eye. Georges Méliès's *Le Voyage Dans La Lune* (*A Trip to the Moon*, 1902) was the very first science fiction film and it remains an inspiration to many lovers of movie magic to this day.

RIGHT: A hand-painted magic-lantern slide dating from the 1800s. Sophisticated slides incorporated mechanical elements to produce the illusion of movement, such as drifting clouds and churning waves.

BELOW: Edison's kinetophone improved on the earlier kinoscope by combining moving images with a soundtrack provided by another Edison innovation, the phonograph.



OUT OF THE SHADOWS

Cinema is now over a hundred years old. The invention of photography in the nineteenth century may have provided Victorians with a remarkable means of recording real-life images, but it wasn't long before their curiosity created the first moving pictures.

At first, the wonder of moving pictures, no matter how dull the deeds they showed, was enough to entertain and amaze. But the ordinary subjects of these early 'flickers' could not satisfy imaginative audiences, eager for the drama of the stage or the fantasy of the page. This led to the development of 'trick photography', which was used to astound viewers with visions of trips to the moon or journeys in flying cars.

As moving pictures developed, 'special effects' grew increasingly sophisticated to match changing audience expectations. What thrilled in one decade seemed quaint and creaky in the next. The animated dinosaurs of *The Lost World* (1925) would have made audiences of the 50s laugh, just as the monsters of the 50s held no terror for viewers in the 80s.

This chapter provides an overview of the development of special effects in cinema's first century. Later chapters examine specific special effects techniques in depth, showing how they have helped to make cinema the most popular and influential of all media forms.

THE PREHISTORY OF CINEMA

Cinema has many ancestors. In Europe, the period from the Renaissance to the eighteenth century saw an explosion of interest in the visual arts, architecture, painting and the theatre. The latter two were married in the ancient art of shadow puppetry, known as *ombres chinoises* ('Chinese shadows'), which came to Europe from the Far East in the late seventeenth century. Its popularity as a form of entertainment sparked a fascination for light shows of all kinds.

There were simple illuminated views, such as the Panorama, devised and patented by the Scottish artist Robert Barker in 1787. His circular paintings, which told a story, were viewed in stages, much like the narrative of a film. At about the same time the German-born British painter and stage designer Philippe de Loutherbourg developed the Eidophusikon, a sequence of paintings exhibited in a theatre, complete with lighting and sound effects to enhance the drama of the scene. Louis Daguerre, one of the fathers of photography, developed another idea with his Dioramas, which were popular in Paris in the 1820s. These were paintings made on layers of transparent gauze, hung and lit separately one in front of the other. By dimming the light on one gauze and raising it on another, primitive yet effective dissolves could be made from scene to scene.



RIGHT: Eastern shadow puppets were one of the visual forms of entertainment popular before the arrival of the cinema. This example is from Java in Indonesia.

BELOW: The zoetrope, a popular Victorian parlour toy, allowed animated sequences to be viewed through slits in a rotating drum.

A popular attraction during the Renaissance was the camera obscura (meaning 'dark room'). For centuries it had been noted that a small hole in the wall of a darkened room would permit an inverted image of the outside world to appear on the opposite wall. This process would later be adapted for the pinhole camera, but in the mid-1500s, patrons would crowd into a darkened room and thrill to the sight of moving images of the outside world that had been focused and turned the right way up with the use of lenses.

By the seventeenth century, the camera obscura's principles had been developed to produce the magic lantern. This had a light source inside the chamber, and was used to project images through a lens into a darkened room, much like a modern slide projector. Scenes were painted on glass 'sliders' (strips of glass that slid between lens and light source just like modern slides), which were manufactured on a large scale. In the nineteenth century the magic lantern reached a peak of refinement. Dissolves could be achieved using dual lanterns to project images onto the same spot. One image would slowly be replaced by another by controlling the amount of light emitted from the lanterns. Slides were manufactured with images on several layers, and by moving them by mechanical means, illusions such as beheadings and beatings could be displayed.

It was the illusion of movement that most beguiled audiences of the day, and a number of innovations were devised to satisfy this fascination. The magic of movement would not have been possible without a peculiarity of human sight. The human retina registers an image for a fraction of a second after it has gone from view. Called 'persistence of vision', this is the principle that makes a rapid sequence of slightly differing images appear continuous and is what allows us to enjoy watching film and television. The principle had been noted by the ancient Greeks and in the nineteenth century it inspired the development of a succession of 'scopes' and 'tropes' – visual toys with names derived from Greek roots.

The most famous of these was the zoetrope. A popular parlour toy from the late 1860s, the zoetrope consists of a drum with a sequence of drawings around the inside, which can be seen through equidistant slits. The drum is spun, and persistence of vision causes the slits to merge into one, while the



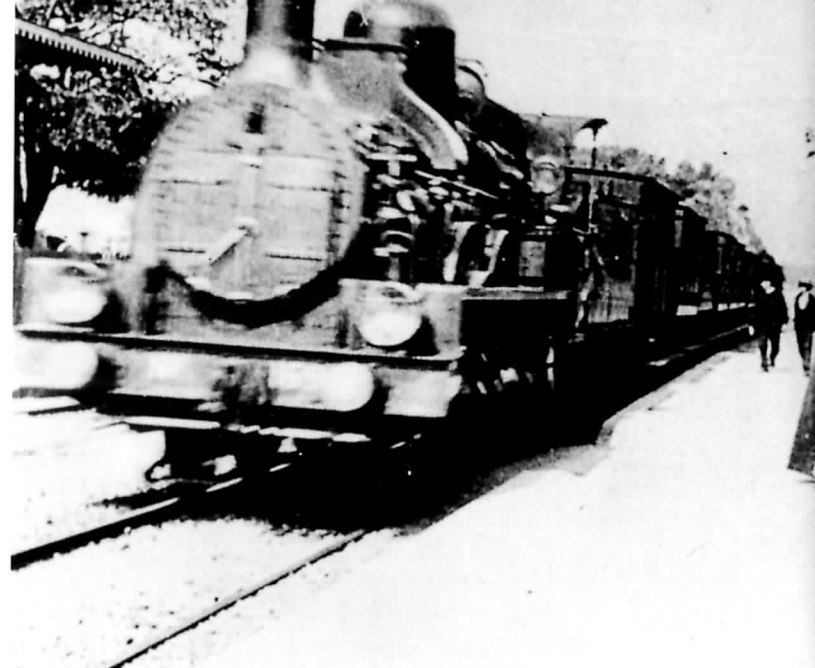
drawings coming into view create the impression of a moving image: a man turning a somersault again and again, for example, or a bird flapping its wings. Many other optical toys of the period worked on the same principle of revealing and obscuring images at a rate that made them appear to have motion. Developed by Emile Reynaud and patented in 1892, the Théâtre Optique used a light source to project sequential images, each of which had been painstakingly hand-painted onto a strip of translucent material. The system produced what we would now call a cartoon, but did not involve any form of photographic process.

The first fledgling photographic processes, developed at the beginning of the nineteenth century, involved light-sensitive emulsions requiring long exposure times to capture any permanent image, and so were not suitable for shots of moving images. It was not until the 1870s that emulsions sensitive enough to take a photograph in a fraction of a second became practically available, although the creation of moving pictures was still hampered by the fact that one glass photographic plate was needed for each picture.

An Englishman working in San Francisco under the name of Eadweard Muybridge (originally Edward Mugaridge) developed a system of individual stills cameras set alongside a track to record the normal movement of men, horses and other animals. His photographs, and the pioneering studies of the Frenchman Etienne Jules Marey (who invented a kind of photographic machine gun), were a major advance in the development of motion picture apparatus. They projected their pictures by slotting photographic plates into large revolving discs, in a device similar to a magic lantern called the zoöpraxiscope.

The development of a sensitized strip of celluloid film by Kodak founder George Eastman in 1888 launched a frenzy of invention. From then on, inventors in Europe and America vied with one another to patent cinematic devices, and studied others' patents with equal frenzy. Cinema as we know it was waiting to be born, but who would be the father?





WHAT THE NINETIES SAW

By the end of the 1880s, all the elements required to make moving pictures had fallen into place. In the United States, Thomas Alva Edison (1847–1931), having already recorded sound with his invention the Phonograph (1877), took up the challenge to develop an apparatus for recording moving images. In 1888 Edison, with so many other ideas to explore, entrusted his assistant, the Englishman W.K.L. Dickson (1860–1935), with the task of inventing something on his behalf.

By late 1890, Dickson had developed the Kinetograph, which could take rapid sequential images. These were then shown using loops of 35 mm film held in a Kinetoscope, a slot machine that provided a brief display of moving images to a single viewer who had to bend down as if looking through a keyhole – hence the nickname 'What-the-Butler-Saw'. Such films were 'single-shot' dramas, where there was no editing and the position of the camera remained fixed. Subjects tended to be risqué, such as women disrobing, and the devices soon began to appear on seaside piers and in special parlours on both sides of the Atlantic. It was quickly recognized that if the moving images could be projected onto a screen, a large paying audience would gather for each display.

The answer was sought in the magic lantern, and was found by two French brothers – whose surname, appropriately, means 'lamplighter' – Auguste (1862–1954) and Louis Lumière (1864–1948). The Lumières devised the Cinématographe, which was camera, film printer and projector all in one. It improved on Edison's Kinetograph by being more portable; as it did not rely on an electric motor, the film could be hand-cranked. The device used a toothed ratchet mechanism and sprocket holes to move the celluloid film, which was the 35 mm standard still used today. The cinema had come, albeit silently, into the world.

The Lumières believed their invention would be a passing craze and decided to exploit it for short-term financial gain. The brothers gave the first public exhibition of their small repertoire of short films at the Grand Café on the Boulevard des Capucines, Paris, on 28 December 1895. Early films included *A Lesson in Vaulting*, *Feeding a Baby*, *Firemen Extinguishing a Fire*, and most famously, *Train Arriving at a Station*. The latter is reputed to have alarmed audience members who thought the locomotive was about to steam out of the screen into the auditorium. The journalist G.R. Baker wrote: 'The station is apparently empty when the train is seen approaching, and gradually gets nearer and larger until the engine passes where we are apparently standing, and the train stops, the guard comes along, passengers get out and in, and all is real!'

Louis and Auguste discovered the power of their invention immediately, and engaged 200 agents to travel to almost every part of the world,

exhibiting their films and shooting new ones to add to their library. The first Cinématographe display in Britain took place in London's Regent Street on 20 February 1896. The show soon transferred to Leicester Square, still the centre of film-going in London. The immense popularity of the moving films was described in the press at the time as the 'Living Picture Craze'.

The invention of moving pictures, much like the making of them, was a collective process. To single out Edison, Dickson or the Lumières as the inventor of movies is unjust to the many others who were at work on moving picture systems at that time. The efforts of men such as Louis Le Prince (1842–96), who experimented with paper rolls of film, or William Friese-Greene (1855–1921), who helped to develop a system for projecting still images at four or five frames per second, should not be forgotten.

Similarly, the creation of a cinema industry did not happen because of the business acumen of any one man or company. The Lumières captured the public imagination, but they could not hold a monopoly on the production and exhibition of films. Their invention was copied and exploited in countries where their patents did not apply. In the United States, Edison initially dominated the market, but soon had competition from people with other moving picture systems – bought or invented – such as the Vitascope of C. Francis Jenkins and Thomas Armat.

It soon became clear to all concerned that, because no particular system had a unique selling point, the only way to make a success in the business would be to produce films that told a story, rather than show the one-shot wonder of a man combing his hair or a woman dancing. Film-makers came to rely on special effects almost from the beginning in their efforts to entertain and involve the audience.

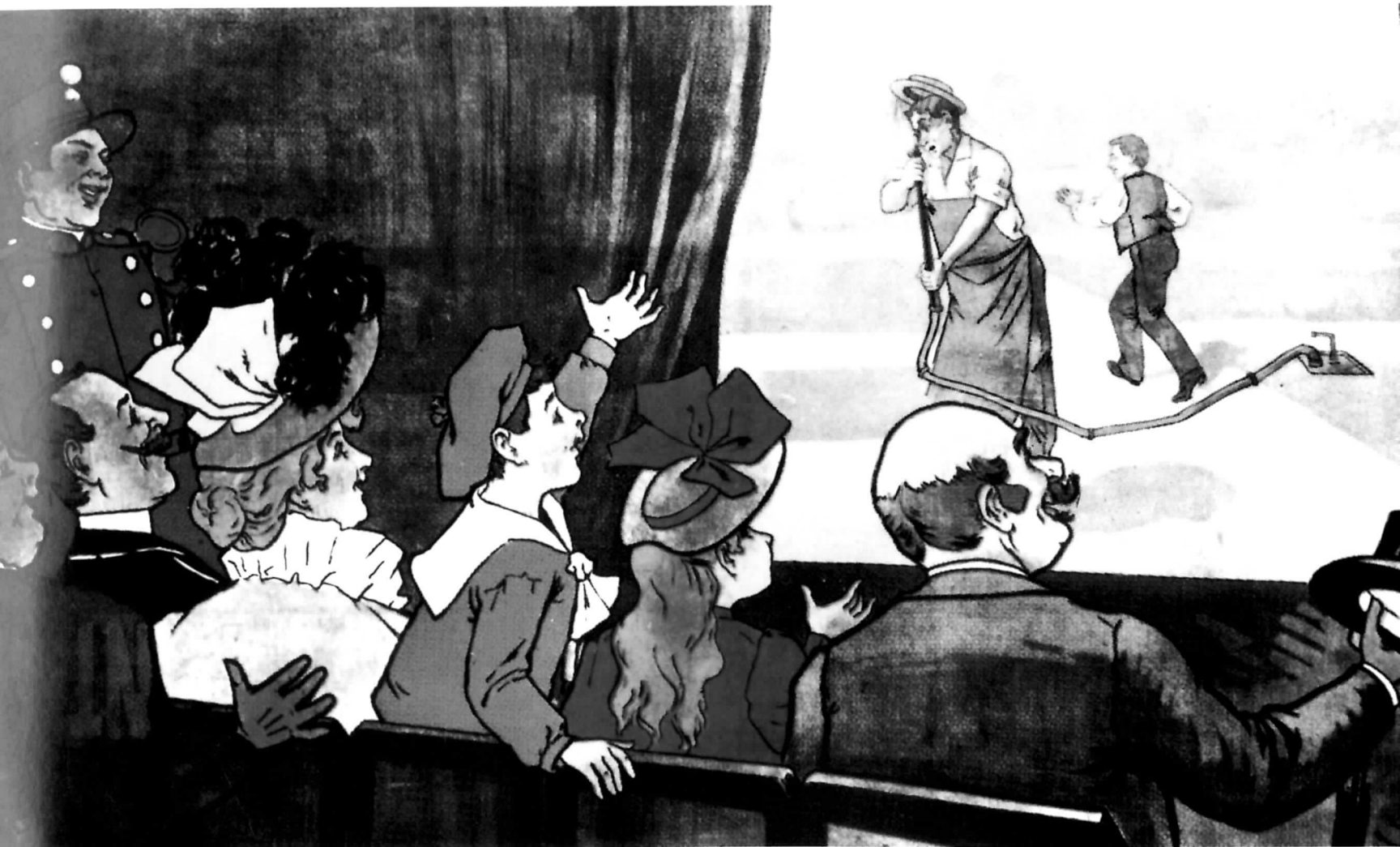
The fundamentals of film spectacle as we know it today – sound, colour, widescreen – were all being striven for within a few years of that first Lumière show. In 1900, at the Paris Exposition, the latest in cinema technology was on display. This included Cineorama, a primitive sound system relying on a separate synchronized sound disc, and hand-tinted films giving a gaudy illusion of colour.

Audience reactions to these cinematic 'effects' can perhaps be judged from these observations on 'living pictures' that appeared in a general family reference work, *The Sunlight Year-Book*, in 1898: 'This ingenious and pleasing exhibition has become very popular. The method . . . though at first incomprehensible, yet becomes fairly clear on examination . . . a French gentleman named Cordy is said to have taken a set of photographs of growing flowers at different stages of development, and flashing them thus quickly on the screen, shows you a plant growing and budding and flowering in a moment or so. This living picture, though no doubt interesting, must, however, be likely to have an unnatural effect, for in nature we do not see plants budding and flowering in a minute.'

LEFT: The Lumières' early film *Train Arriving at a Station* (1896) alarmed more nervous viewers, who thought the approaching train might actually burst through the screen.

RIGHT: In what is considered to be the world's first special effects shot, stop-action was used to create the on-screen beheading for *The Execution of Mary, Queen of Scots* (1895).

BOTTOM: This colourful poster was printed to advertise screenings of the Lumières' film *L'Arroseur Arrose* (*The Waterer Watered*, 1895). The short film showed a young boy enjoying the classic trick of switching off the water only to turn it back on when the gardener peers into the hose. Luckily, simply seeing moving images was enough to amuse audiences of the day.





GEORGES MÉLIÈS

The French magician Georges Méliès (1861–1938) was perhaps the most important innovator in the history of cinema. Within 10 years of discovering the wonder of film, Méliès made hundreds of short films and pioneered many of the methods that would remain at the heart of special effects production for much of the next century. Perhaps no one else has had such a profound and long-lasting influence on special effects production.

The 'father of special effects' was the youngest son of a French boot-making tycoon and was expected to follow his father and two brothers into the trade. His destiny, however, did not lie in filling the family shoes, and when his father retired the young Georges sold his share in the family business. With the considerable proceeds he purchased the Théâtre Robert-Houdin in Paris, one of the most famous magic venues in the world.

As manager, Méliès took to the sulphur and sodium life of the theatre magician with a flourish, conjuring up an array of innovative stage illusions – all of which he designed, built, painted and performed in famously comic style. Magic lantern shows were another attraction on his bill of wonders, with fantastical presentations of hand-coloured and often simply animated glass slides.

So Méliès was aware of both the science and the popularity of theatrical projection when, on 28 December 1895, he was among the first in the world to witness a performance of the Lumière brothers' Cinématographe. Realizing the potential of the new device, Méliès immediately entered into a bidding war with other Parisian impresarios, only to be told that the amazing magic box was not for sale at any price. Méliès was undeterred. Within three months he had bought a device built by Robert W. Paul of London, designed for use with Edison's Kinetoscope films. Méliès then worked with two engineers in his theatre workshop to build an enormous and unwieldy prototype camera of his own. Early warning of a growing obsession came when he took the camera with him on a seaside vacation in July 1896. The frustrations of a family holiday accompanied by a 35 kg (77 lb) camera can only be imagined. Luckily for family harmony, Méliès patented a lighter version in September 1896.

Méliès began making simple one-shot films, usually 60-second scenic views – moving versions of the magic lantern shows that had preceded them. When he was filming one such scene in the Place de

ABOVE: Performing in his own film, Georges Méliès is amazed by the sight of his own rapidly expanding head, the fantastical result of double exposure, in *Indian Rubber Head* (1902).

RIGHT: A scene from Méliès's most famous film, *A Trip to the Moon* (1902). The gun, actually a painted backdrop, is about to fire a manned capsule to the moon, where fantastic adventures will unfold.

FAR RIGHT: Méliès, cinema's pioneering magician, spent his last years supplying toys and trinkets to the children of Paris.

l'Opéra in Paris, a chance incident occurred that appealed to both the innovator and the showman in Méliès, and helped him to become one of the most important figures in the history of special effects.

As he turned the camera's hand-crank, the device jammed. 'It took a minute to release the film and get the camera going again,' Méliès later wrote. 'During this minute the people, buses, vehicles, had of course moved. Projecting the film, having joined the break, I suddenly saw an omnibus changed into a hearse and men into women. The trick of substitution, called the trick of stop-action, was discovered.'

In fact, stop-action photography had already been used by Edison's camera operator Alfred Clarke for the beheading sequence in *The Execution of Mary Queen of Scots* (1893). There is no doubt, however, that Méliès discovered the trick for himself, and that his application of what had been a cinematic accident would make him the world's foremost producer of 'trick films'. Méliès was soon using stop-action, double exposure, fast and slow motion, dissolves and perspective tricks in his films, which became increasingly elaborate. His love of storytelling, his zeal for illusion and his new-found photographic abilities led him to devise spectacles that would have been impossible on stage. To realize his ideas, Méliès built an impressive glass studio in the garden of his family home near Paris. The studio, perhaps the most sophisticated of its age, could claim to be the world's first special effects facility. It was elaborately equipped like a magic theatre, with trapdoors, winches, pulleys, mirrors and flying rigs, as well as workshops and scenery stores.

The convention of the age was to film the world as it was in front of the camera. Méliès created more complex films, weaving his unique spell in what he termed 'artificially arranged scenes'. Each film comprised a number of distinct scenes, filmed from a single viewpoint, as if the camera were in the front row of a theatre. The action took place within this single setting, with characters and their props entering and exiting from stage left or right.

Though Méliès produced war scenes, historical scenes, news reconstructions, operas, publicity films, dramas and comedies, his most popular and famous films were those based on fairy tales and fantasies. In *Cinderella* (1899), stop-action turns a pumpkin into a glittering coach, and Cinderella's rags into a luxuriant gown. Slow motion allowed elfin dancers to glide in the air. Some scenes were even painstakingly hand-coloured one frame at a time.

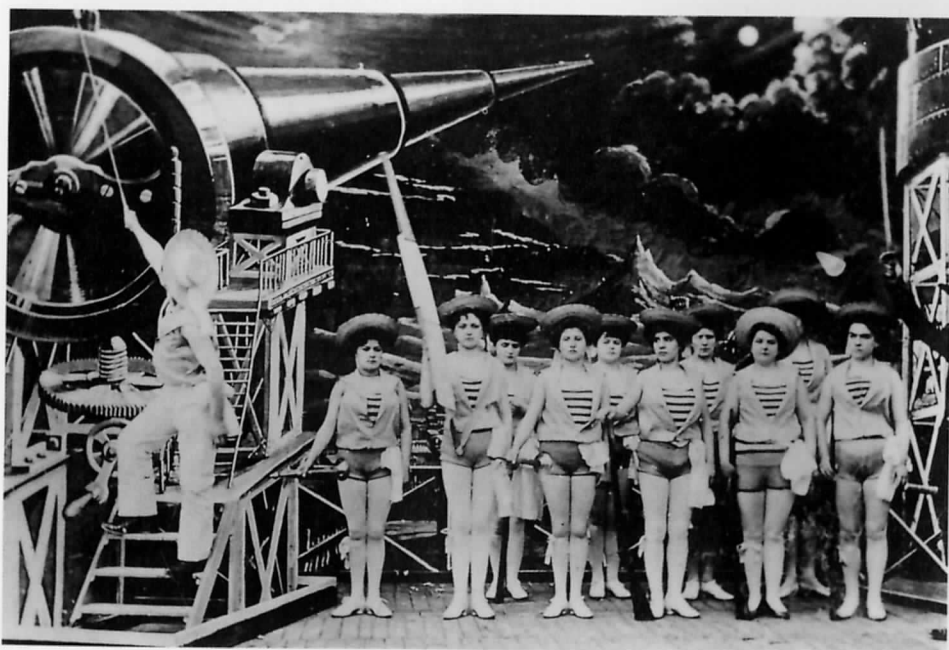
In *Indian Rubber Head* (1902) Méliès used a 'split screen' process, which involved masking off areas of the film so that they did not receive an image in the first exposure, and then adjusting the masking so that only these areas were exposed in the second take. The viewer sees Méliès in the role of a

scientist, placing a duplicate of his own head on a table and beginning to inflate it using a bellows. An assistant takes over and enthusiastically pumps air into the head, which grows enormous, pulling distended faces until finally exploding. The disembodied head was added in the second exposure, and enlarged by wheeling Méliès, sitting in a specially constructed carriage, closer to the camera.

Of the 500 films that Méliès produced between 1896 and 1912, perhaps his most impressive is *A Trip to the Moon* (1902), based on the writings of Jules Verne and H.G. Wells. The 21-minute film – a sprawling epic in an age when films rarely lasted more than 2 minutes – uses every available artifice to tell the story of a group of Victorian explorers who visit the moon. The sets and props were typical of the Méliès style, simply consisting of *trompe l'œil* paintings designed and painted by Méliès himself to give the illusion of three-dimensional depth. The presentation was pure pantomime, with a dash of moonshine. Groups of leggy chorus girls help to launch the spaceship shell from its cannon. Flying through space, the ship passes stars with beaming feminine faces at their centres, while the moon's grumpy crater-face becomes even more cheesed-off when the enormous spacecraft lands in his eye. On the lunar surface, the explorers are confronted by impish aliens who disappear in a puff of smoke, and Méliès exhibits one of his most imaginative effects when the various two-dimensional moonscape elements move in relation to one another to suggest a camera perspective shift.

For more than 10 years Méliès was the most popular film-maker in the world and could justifiably lay claim to being cinema's first star. The simple storylines and visual enchantment of his films meant that they could be enjoyed around the world without subtitling, and they were frequently pirated by foreign producers. However, Méliès's visual style did not evolve, and his narratives were little more than linkage for fantastic special effects. From around 1910 audiences in Europe and the United States began to see the innovative work of the American film-maker D.W. Griffith – films with realistic locations, stories and fast-paced editing. By comparison, the films of the Parisian master magician seemed outdated. Despite conjuring up greater spectacles than ever, Méliès could not hold on to his audience.

The Théâtre Robert-Houdin was closed by the outbreak of war in 1914, and Méliès was bankrupted. He spent the last years of his life running a toy kiosk on the Gare Montparnasse. He enjoyed a minor comeback in the late 1920s, courtesy of the surrealists, who admired the dreamlike sense of adventure and the whimsical treatment of science and logic in his work – and his films continue to beguile appreciative and nostalgic audiences to this day.

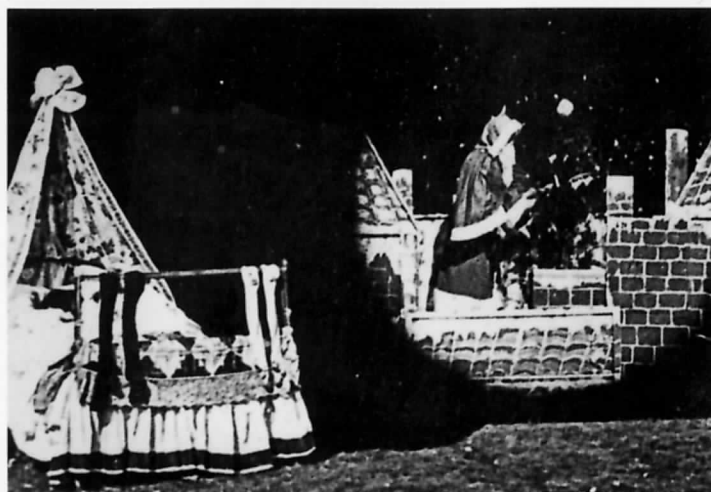
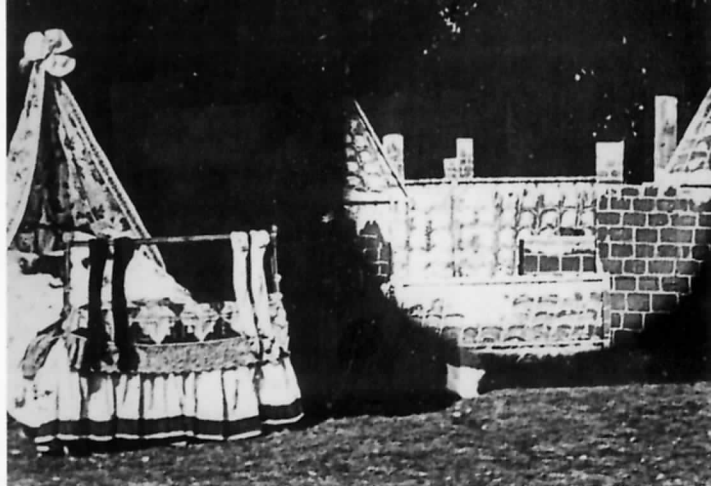


OTHER INNOVATORS

The reputation of Georges Méliès as the father of special effects is undisputed, yet he was not working in a vacuum and many others were innovating at the same time. Film was still a young medium, so the simple process of solving everyday film-making problems frequently led to the discovery or invention of new techniques – making it almost impossible to pinpoint who invented what and when. Many pioneers worked in Britain, and were the founders of a tradition of innovation in the field of special effects.

Méliès bought his first projector from Robert W. Paul, a scientific instrument maker from London. Paul entered the business when he was asked to make six duplicates of an Edison Kinetoscope for two Greek showmen. Although Paul copied the machines legally – Edison having failed to patent the device – the American inventor refused to supply films to run in the machines. Not to be defeated, Paul built his own camera and projection device and went into production himself.

Like other early film-makers, Paul's first efforts were single-shot views, but he quickly realized the value of offering audiences the unusual and fantastic. In 1897 he sent a cameraman to Egypt to capture exotic travelogue scenes such as *An Arab Knife Grinder at Work*. He also produced 'trick films' in a specially built studio in north London. One of his earliest productions gives an idea of the effects that could be achieved in films of the day, using methods such as stop-action and combining elements filmed in different exposures. In the frenetically surreal *The Haunted Curiosity Shop* (1901, directed for Paul by W.R. Booth), the top half of a woman enters a shop, closely followed by her bottom half. When the elderly storekeeper attempts to embrace the woman, she suddenly changes into a mummy, and then again into a skeleton. Three pixies then arrive on the scene, dancing wildly before merging into a single pixie,

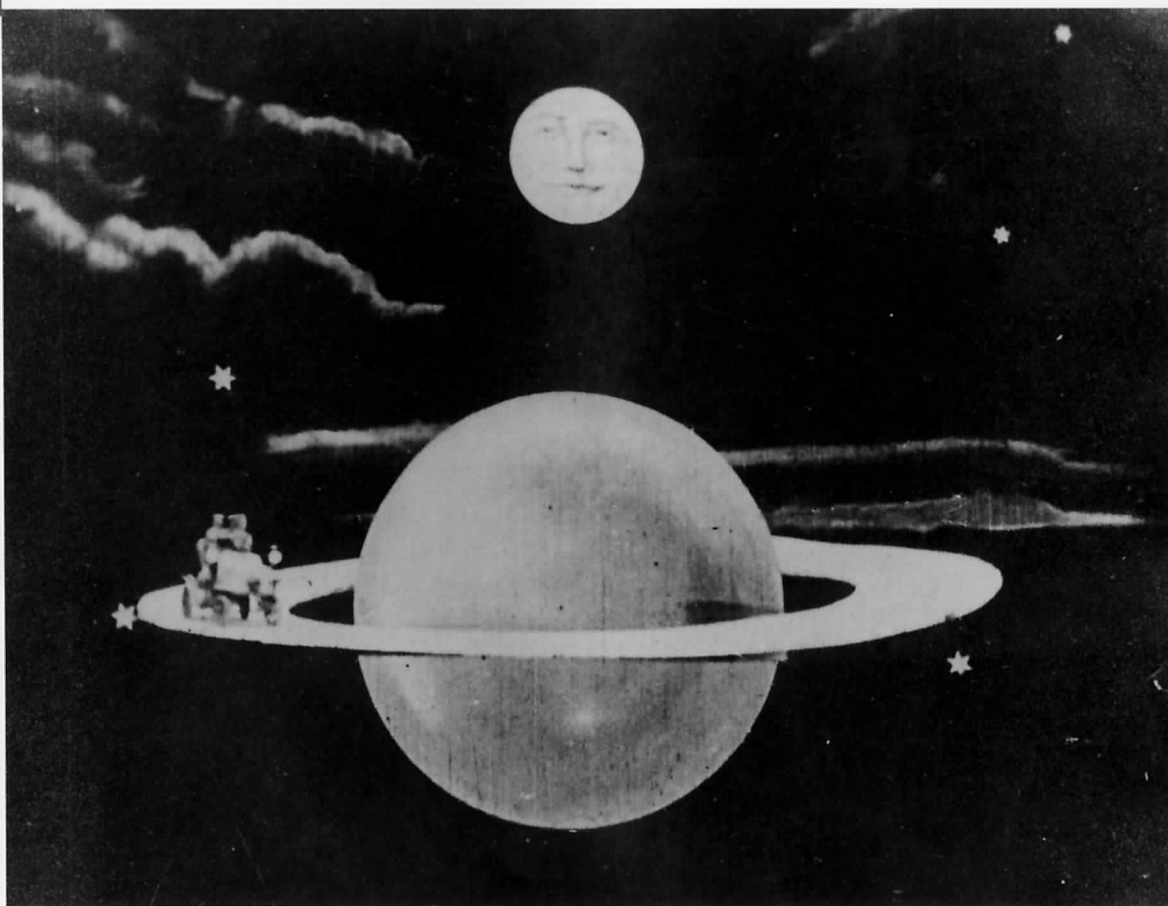


ABOVE: G.A. Smith's *Santa Claus* (1898) was a charming trick film using, among other effects, the film-maker's patented process of double exposure.

LEFT: R.W. Paul's *The ? Motorist* (1906) entertained audiences with its lighthearted vision of an interstellar car journey.

RIGHT: Edwin S. Porter, director of *The Great Train Robbery* (1903) and one of early cinema's true visionaries.

FAR RIGHT: For *The Great Train Robbery* (1903), Porter filmed the live action in the telegraph office in one exposure and the train passing the window in another.



which the old man captures in a jar. A giant head then emerges from a puff of smoke and frightens the old man away.

Of the few surviving Paul films, the confusingly titled *The ? Motorist* (1906) is the most remarkable. Equalling anything produced by Méliès in technique and ambition, the film uses every available trick to tell the story of a couple who exceed the speed limit in their car and fly off the face of the Earth into outer space. Motoring through the solar system, the model car touches down on the Sun and circumnavigates its surface before taking off for a spin around Saturn's rings. Paul did not look upon himself as a filmmaker, however, and only produced films to support the sales of his company's equipment. In 1910 he abandoned film-making, sold his studio and, tragically, burned many of his films.

Another English pioneer was the photographer G.A. Smith, who built his own movie camera in 1896 and produced a number of trick films. In 1897 he took out an English patent on the process of double exposure, and used the method to create the ghost in *The Corsican Brothers* (1909). Smith later joined forces with Charles Urban, a business manager whom Edison had originally sent to England in an attempt to prevent the piracy of his machines and films. Their company produced several notable films, including *Airship Destroyer* (1919, directed by W.R. Booth), in which London is attacked by a fleet of mysterious airships. A large and minutely detailed model of London was bombed and destroyed before the film's hero was able to defeat the zeppelins with radio-controlled missiles.

Among other notable film-makers in Britain was Cecil Hepworth, whose trick films included the evocatively titled *Explosion of a Motor Car* (1900), *How It Feels to Be Run Over* (1900) and *Alice in Wonderland* (1903).

After the dramatic early coup of the beheading in Alfred Clarke's *The Execution of Mary Queen of Scots* (1893), American film-makers remained surprisingly slow to use tricks in their fiction films. There was innovation, however; where Europeans favoured spectacular films in which tricks were the stars, American producers preferred a more subtle approach. A popular form of entertainment was the news film – a short film that claimed to portray real events as they had happened. In fact, many such 'events' were faked for the cameras.

In 1898, artists Albert E. Smith and J. Stuart Blackton, who together formed the Vitagraph Company, filmed *The Battle of Santiago Bay*. The bay was created by laying one of Blackton's paintings face-down and filling the

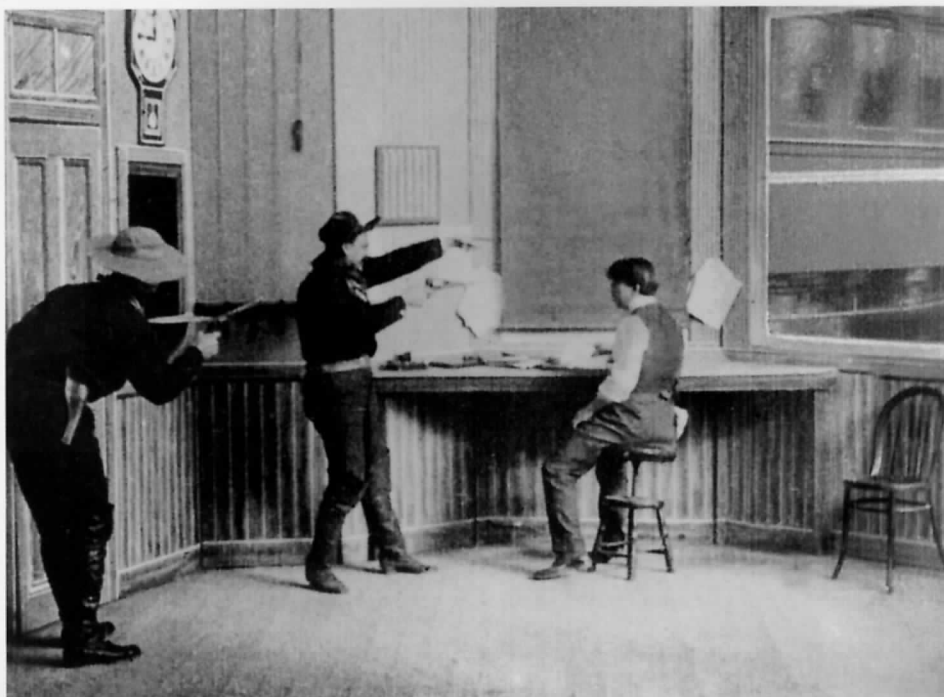
canvas-covered frame with water to produce a small pond. The warring ships were cut-out photographs, pinned to floating wooden bases and pulled along on strings. Explosions were created using gunpowder attached to the back of the photographs. The drifting smoke of battle was produced by Mrs Blackton and an office boy, who stood off-camera and blew cigar smoke into the scene. The result was remarkably convincing. Vitagraph's next reconstruction was of *The Windsor Hotel Fire* (1899), in which small dolls fell from burning cardboard buildings, and water squirted from toy guns suggested the gallant efforts of the fire department.

Vitagraph was not alone in its techniques; other early studios, such as Biograph, Lubin, Selig and Edison, regularly counterfeited current events. Several companies produced films that showed both the real aftermath of the 1906 San Francisco earthquake and reconstructions of the disaster itself. Biograph produced a particularly spectacular model of the city, which was filmed as it burned and fell apart. It may seem extraordinary today that the viewers of such scenes rarely questioned their authenticity, but this was a time when moving pictures themselves seemed a miracle to most and few paused to consider that what they saw might be in any way fake.

The most significant American pioneer of this time was Edwin S. Porter. Joining Edison as a projectionist in 1900, he quickly assumed the rank of director. Porter produced several important films in which he challenged the conventions of editing, but his major contribution to the history of special effects came with *The Great Train Robbery* in 1903. This early 'Western' used shifting camera viewpoints and naturalistic settings, and startled audiences with one of the first known close-up shots. But the film's most significant breakthrough probably passed audiences by at the time – literally.

While the robbery takes place in the railroad telegraph office, a train can be seen steaming past the window. Later, in a mail car, a real moving landscape is seen going past an open doorway. To create these moving backgrounds, Porter adopted the matting techniques that Méliès had used to make himself appear twice in the same shot in *Indian Rubber Head*. In another scene, Porter tinted three frames red to simulate the firing of a gun – a dramatic device that would be used again by Alfred Hitchcock in *Spellbound* (1945).

Porter is remembered for having advanced the use of special effects to increase the naturalism of scenes and to further the drama. Whereas Méliès, Paul and other early film-makers had used trick photography for its own sake, Porter exploited special effects as unobtrusive tools to help tell a story.



THE 1910s

By 1910 film-making and exhibition was becoming a major business, and was beginning to assume the structure that would characterize the industry for much of the century. What was once a cottage industry gave way to film factories – nickelodeons (the first movie theatres) became goldmines.

Many small production companies emerged during this period, including Rex, run by Edwin Porter, who had left Edison in 1909. A considerable number of these companies disappeared almost before they arrived, while a few would survive and go on to dominate world film production for more than three-quarters of a century. Porter's company was among the early casualties. Moving out of production into technical research and manufacture, he was wiped out in the 1929 stock market crash.

As the industry found its feet, artistic pioneers continued to develop the art of film-making. Foremost among these was David Wark Griffith (1875–1948). Griffith joined Biograph in 1907 and quickly began to revolutionize film grammar through his command of editing, camera placing and movement, shot composition and lighting. Not an effects pioneer like Méliès, D.W. Griffith did however standardize a number of photographic effects for storytelling.

He used shot transitions, such as the fade-in and fade-out, to indicate the lapse of time between scenes. Such effects were achieved during photography by opening and closing the camera aperture diaphragm to control the amount of light reaching the film. If a fade was required after photography, the camera negative was lowered slowly into bleach until the start point of the fade was reached. The negative was then slowly withdrawn, producing a linear fading of the image on the negative.

Around 1913, Griffith also began to make frequent use of the iris-in and iris-out for dramatic effect. There is some dispute as to whether the device was pioneered by Griffith or by fellow director Thomas Ince (1882–1924), though it



was undoubtedly Griffith who developed the art of the technique. The iris was a simple device that fitted in front of the lens and could be opened and closed to progressively reveal or conceal areas of the frame. Griffith used the device to draw the eye to the centre of the drama or to reveal previously hidden elements of a scene. In *The Birth of a Nation* (1915), a mother and her children are shown huddling in the upper left-hand corner of an otherwise black screen. The object of their concern is revealed as the iris opens to show the Northern armies marching through the family's devastated town.

By 1914 the movie industry was well established in southern California, where the fine weather and extreme distance from New York's Motion Picture Patents Company (which prosecuted anyone caught using its film equipment without authorization) made for ideal working conditions. Though Europe had developed its own thriving film industry, the outbreak of

1910s PROFILE MACK SENNETT



Buying their tickets, the majority of early movie-goers expected to be entertained. Weepies were fine, but weeping with laughter was better. Visual comedy was loved the world over, and no one developed the art of screen slapstick more than Mack Sennett (1880–1960) – the 'King of Comedy'.

In 1912, after a stint as actor, gagman and comedy director at Biograph, Canadian-born Sennett persuaded two ex-bookmakers to lay money on his sure-fire idea for movies about a blundering troupe of policemen. He called his studio Keystone, and its comical, car-chasing Kops were to arrest audiences for much of the next decade.

Keystone was a laughter factory where two-reel comedies were churned out like custard pies from a bakery. At the peak of production, several films a day emerged from the strictly run studio. Teams of writers, performers and prop builders manufactured gags that formed the cornerstone of all Keystone comedy: the fall from dignity.

Keystone performers underwent all manner of punishing pratfalls to make gags work. Helping them

raise their laughs were a stable of effects men, perhaps the most skilled of their time. Any day might find them making rubber bricks, rigging telegraph poles to collapse on cue or building fake houses for cars to smash through. Central to the Kops films was the patrol wagon. Designed by Del Lord, the vehicle's heavy chassis and specially designed brakes allowed it, loaded with lunatic lawmen, to perform some astonishing stunts.

Sennett was notoriously tightfisted, refusing to pay his performers their worth – names such as Charlie Chaplin, Harold Lloyd, Fatty Arbuckle, Gloria Swanson and even the director Frank Capra passed through the studio on their way up the ladder. The studio flourished in the 1910s, but by the 20s its comedy was seriously challenged by the likes of Hal Roach Studios, whose stars included Harold Lloyd, Harry Langdon and Laurel and Hardy. Though Sennett had made a fortune from investing in oil and real estate, he was bankrupted in 1933 when the Wall Street Crash left him with debts of over \$5 million.

war effectively ended all commercial production. With its European competition crippled by war, Hollywood was set to dominate the hearts, minds and screens of the world.

Typical Hollywood film units consisted of a small all-purpose (and all-male) crew. At the head was the director, and under him the cameraman. Any good cameraman was capable of producing a number of 'live' tricks during the hand-cranked filming process. Among them were the basic fading and iris effects. Cameramen could produce dissolves, by which one image merges seamlessly into another. The effect was achieved by reducing the camera's aperture at the end of a sequence to produce a fade to black, rewinding the film, starting a second exposure and opening the aperture as the new scene was shot. By varying the speed at which they cranked the camera, cameramen could also produce fast or slow motion. The average cranking speed for cameras and projectors at this time was 16 frames per second. Undercranking the camera would speed up the action in the film when it was projected, and became a favourite trick of helter-skelter slapstick comedies.

Methods that required running the film through the camera twice, such as split screens and double exposures, became much more practical after the introduction of the new Bell and Howell type 2709 camera in 1912. This new all-metal camera was unique in the way it moved film and held it steady in front of the aperture on fixed register pins during exposure. The ability to produce steady images, combined with an accurate frame counter, made the Bell and Howell ideal for producing in-camera special effects, which required the exact placing of images on film.

The creation of any unusual effect was generally the responsibility of whoever came up with a workable on-the-spot solution to a problem. However, some people gradually began to specialize in particular techniques and gained a reputation for those skills. One such individual was Norman O. Dawn, Hollywood's first effects man (245>).

Dawn pioneered the glass shot, whereby scenery could be altered or extended on film by the use of highly detailed paintings. The technique was

typically used to add additional height to studio sets that were only built one or two storeys high – the upper levels were added by painting them on a sheet of glass positioned in front of the camera. He later developed the in-camera matte shot, a technique that enabled filmed scenery to be combined with paintings.

The decade also saw the emergence and exploitation of the film 'star'. At first, film actors were happy to appear anonymously; film work was often seen as a sign of failure on the stage. But audiences gradually grew attached to their favourite performers, and came to know them by their nicknames – Mary Pickford was known to millions simply as 'Little Mary' and 'The Girl with the Curls'. Producers and exhibitors quickly grasped the potential drawing power of these audience favourites, and the 'star' was born. By the end of the decade, performers such as Pickford, Douglas Fairbanks and Charlie Chaplin were among the most famous and best loved people in the world, commanding huge followings and staggering salaries.

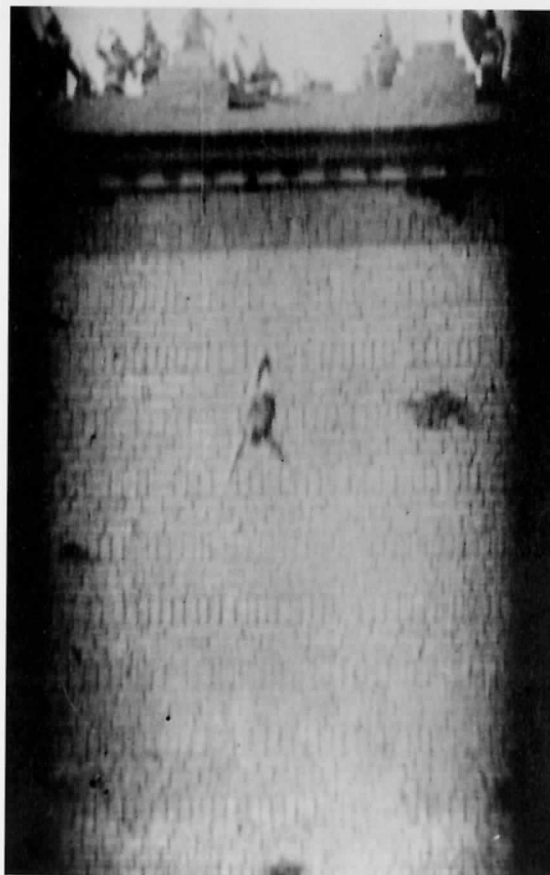
In 1916 cameraman Frank Williams devised a method of filming actors in front of a black background so that a new background filmed at another time and place could be added later. The results were crude but it was the first example of travelling matte photography (57>), a technique that would become a mainstay of special effects production.

Among the decade's other developments was the introduction of the feature film format. Exhibitors had nursed the belief that audiences could only concentrate for the length of one reel, normally around 12 minutes. When D.W. Griffith found himself unable to tell the story of *Enoch and Arden* (1911) in less than two reels, exhibitors insisted on releasing it in two halves. Films several reels in length emerged from Europe at the beginning of the decade, and in 1912 the French four-reeler *Queen Elizabeth*, featuring the distinguished classical actress Sarah Bernhardt, was an international hit. In the United States, producer and future Paramount boss Adolph Zukor took the lead when he began making feature-length productions of 'Famous Players in Famous Plays'. By the end of the decade, the feature film – usually around 90 minutes in length – was on every cinema bill.

ABOVE LEFT: Many film companies settled in southern California in the 1910s. Universal Studios was built among the orange groves of the San Fernando Valley, where film-makers enjoyed fresh air and clear skies.

RIGHT: D.W. Griffith masked the sides of the frame to emphasize the length of a fall from the walls of Babylon in this scene from his epic *Intolerance* (1916).

FAR RIGHT: Griffith and his cameraman Billy Bitzer (*left*) pioneered new standards of motion-picture photography and editing that would be used for decades.



THE 1920s

American film-making flourished in the 20s. Film-makers began to branch out beyond the artistic and technical boundaries established by the pioneers of the previous decade, and came to rely increasingly on special effects to tell their stories. The Hollywood studio system was up to speed, and film-making was an efficient, rationalized and highly profitable business.

Under the fledgling movie moguls, specific departments were created to deal with each aspect of movie production, from scripts and costumes to props and editing. There is uncertainty over which studio established the first department dedicated to the creation of special effects – some claim that it was Fox, while others are sure that it was MGM. Either way, the term 'special effects' received its first screen credit in the 1926 Fox picture *What Price Glory?* It referred in this case to both the film's physical and mechanical effects.

New techniques were developed to help film-makers present the lavish or historical settings their films demanded. The first travelling matte processes, allowing actors filmed in the studio to be placed within settings from a different time and place, were crude but enabled a degree of realism (57>). These processes were helped by the development of much-improved camera and lighting equipment, and faster, finer film stocks (53>).

Since the earliest days of the industry, film-makers had built small models of any object or location that was too big, expensive or impractical to be filmed in any other way. In the 20s, as production budgets soared in line with film-makers' ambitions, studios became increasingly dependent on the use of money-saving models. As a result, effects technicians became highly skilled in the building and shooting of accurately scaled-down landscapes, buildings and vehicles, and in the combination of such footage with live-action full-scale photography for films such as *The Crowd* (1928) and *Just Imagine* (1930).

German films were a major influence on American film-makers of the 20s. Douglas Fairbanks (1883–1939) was particularly impressed by what he saw emerging from the studios of Europe. *The Thief of Bagdad* (1924) used opulent sets and the best effects Hollywood could buy. Fairbanks admitted that they were designed to compete with the German films of the time. Some of the scenes were effective, such as the flying carpet sequences (when the wires didn't show), but *Thief* mainly served to demonstrate that



ABOVE: The sluggish science fiction musical *Just Imagine* (1930) was enlivened by shots of a magnificent model city inspired by Fritz Lang's *Metropolis* (1926).



LEFT: Douglas Fairbanks rides a flying carpet suspended on wires above hundreds of extras populating the enormous sets built for *The Thief of Bagdad* (1924).

RIGHT: Adventurer Bessie Love covers beneath one of Willis O'Brien's animated dinosaurs in the classic effects film *The Lost World* (1925).

while American technicians could build enormous sets, they still had a lot of ground to cover in the field of special effects.

Epics on the scale of *The Thief of Bagdad* were popular, often demanding sets of biblical proportions. *Ben Hur* (1925) required the creation of a full-scale Circus Maximus and a fleet of seven huge Roman galleys on location in Italy. But a number of incidents – including the burning of the galleys (in which some extras are reputed to have drowned when the galleys accidentally caught fire) – combined with bad weather and Italian labour disputes, brought the production back to California. The film was completed in rebuilt sets with significant use of miniatures.

Films created using animation grew in sophistication and popularity. In 1923 Walt Disney (1901–66) began production of his *Alice* comedies, in which a live-action Alice was combined with two-dimensional cartoon figures. The combination of live action and animation went further in *The Lost World* (1925). This ambitious version of Sir Arthur Conan Doyle's novel used startling stop-motion animated dinosaurs created by pioneering animator Willis O'Brien (1886–1962, 182>).

The greatest technical development of the period came towards the end of the decade. The coming of sound was no surprise – sound systems of varying effectiveness had been around for much of the decade. By the time Al Jolson broke into song on film on 6 October 1927, many audiences had experienced Fox Movietone newsreels that used the sound-on-film methods pioneered by Lee De Forest (1874–1961). But Warner Brothers' release of *The Jazz Singer* (1927) – in a last-ditch effort to stave off bankruptcy – fired the public imagination and signalled that the 'talkie' was here to stay.

GERMAN SPECIAL EFFECTS

In the 20s Hollywood was undisputed as the world's leading film factory, but the special effects of German film-makers, combining their technical flair with a traditional love of fairy tales, were far superior.

The German actor and director Paul Wegener (1874–1948), considered by many as the 'father of the horror film', was a great advocate of special effects. In a 1916 speech, which was more prophetic than probably even he imagined, he envisaged the development of a 'synthetic cinema' in which totally artificial scenes would be created by the abilities of the camera. Wegener made significant use of special effects, notably in his religious meditation *Living Buddhas* (1923). For one dramatic sequence, a sophisticated matte technique was used to create the impression of a Buddha in the sky directing a ship lost at sea to safety.

UFA, Germany's largest studio, made the country's most spectacular productions, with Fritz Lang (1890–1976) as their star director. Lang's two-part epic *Die Nibelungen* (1924) was filmed entirely on enormous studio sets and featured an awesome 18 m (60 ft) mechanical dragon – a far cry from the awkward reptile of Douglas Fairbanks's *The Thief of Bagdad*, made in the same year. The production also exploited the Shuftan process (114>), which used mirrors to combine full-sized sets with miniatures – a technique for which German cinema would become famous.

Lang's effects masterpiece was *Metropolis* (1926), a visionary science fiction fable that made stunning use of model animation, matte painting, early rear projection and full-scale mechanical effects. Although a financial failure, *Metropolis* had a huge impact on contemporary American film-makers, and it continues to be one of the most influential films ever made. Futuristic artistry and technical excellence have secured its place in popular culture.

Ironically, by 1930 many of Germany's leading directors and technicians had left for Hollywood. Lang was one of the last to take flight, lingering in Germany to produce *Frau im Mond* (*The Woman in the Moon*, 1929). Though the film was science fiction, Lang strove to make it as accurate as possible, hiring Professor Hermann Oberth (who later designed the Nazis' terrifying V-1 rocket bomb) and Willy Ley (later a designer of rockets for the USA) to work as consultants. The resulting scenes of rocket construction were so revealing that prints of the film, and model rockets used during filming, were later confiscated by the Gestapo.





THE 1930s

Despite the success of *The Jazz Singer* (1927), the new phenomenon of the 'talkie' was largely ignored in most Hollywood studios. For Warner Brothers, however, the gamble had paid off. Audiences couldn't get enough of the talkies. Using their Vitaphone sound-on-disc process, the studio hastily added snippets of music and dialogue to the silent films already in production, and began planning all-talking future projects. Fox also added sound to their films, using their rival technique Movietone – a sound-on-film process that would later become the industry standard. The rest of Hollywood remained silent, resisting sound as no more than a fad.

But the public appetite for talkies was not to be starved, and by the mid-30s, the big studios were producing all their major films in sound. Others, notably the Chaplin Studio, remained to be convinced, and it was another 10 years before Charlie Chaplin was first heard in *The Great Dictator* (1940).

The coming of sound brought massive changes to an industry that was still settling into departmentalized production routines. New studio departments were tasked with sound recording, mixing and dubbing, as well as the scoring and performance of musical soundtracks. Stages needed to be soundproofed and movie theatres equipped for sound.

By the late 20s, silent films had achieved extraordinary finesse. Directors knew how to position and move their cameras to heighten dramatic impact, and when to use intertitles – written cards displayed between and during scenes – to represent dialogue and express plot points. The arrival of sound hijacked everything. Early sound recording was a delicate and demanding process, and the needs of the soundmen began to dictate every aspect of shooting. Cameras were noisy and drowned out dialogue, so they were housed in soundproof sheds, with cameraman and lens peering through a glass window. Action had to be performed before this fixed camera, becoming almost as confined and stagy as it was in Georges Méliès's day.

Early microphones were weak, and actors often suffered the indignity of delivering emotional dialogue into a microphone disguised as a telephone or a vase of flowers. Many early stars didn't progress that far, finding that their voices were unsuitable for the talkies, or that their voices didn't fit their

images. They were replaced by a constellation of newcomers, often from the stage, whose richer diction had the approval of the sound department.

From about 1933, sound recording restricted filming on location, and for the next 20 years the great Hollywood outdoors would be filmed almost entirely within studio walls. The coming of sound is often held solely responsible for this wholesale move into the studios. In truth, the move probably had as much to do with increasing control by studio bosses who, after location nightmares such as those on *Ben Hur* (1925), preferred to keep wayward productions and problematic directors well within view.

For special effects departments, sound brought some new challenges. With films being made exclusively on the studio lot, effects technicians had to find ways to bring exotic and even everyday locations to the set. One result was the first practical form of rear projection, a process enabling background scenery to be projected onto a screen behind actors while filming in the studio (82>). Over the next 20 years the technique would be perfected for use in almost every Hollywood production – providing backdrops for ocean-going romances, stagecoach chases, and journeys in trains, cars and planes.

Although rear projection often replaced the need for travelling mattes (57>), effects technicians continued to perfect travelling matte photography. The development of advanced optical printers, which enabled the various elements necessary for travelling matte shots to be combined on film with greater control, meant improved image quality. The optical printer also found favour in the production of many 30s musicals whose spectacular dance sequences needed flamboyant scene transitions, such as the star-wipe (70>) and the now iconic spinning newspaper effect used to proclaim headline news.

By the middle of the decade, special effects had advanced so much that a single department under the umbrella title of 'special effects' was not enough, and each studio's effects department found itself with a number of subdivisions. At MGM, for example, the special effects department was responsible for rear projection, miniatures, and physical and mechanical effects, while the optical department dealt with matte paintings and optical printing (54>).

Special effects became an integral aspect of movie-making during the decade, perhaps as much for their ability to save time and money as their

1930s PROFILE JAMES WHALE



The English director James Whale (1896–1957) came to Hollywood at the end of the 1920s to make the film of *Journey's End* (1930), a play tracking the horrors of war. An enigmatic man, his best films smiled darkly at terrors of the imagination. Under contract at Universal, Whale then took the director's chair for *Frankenstein* (1931), the success of which would both bless and damn his career.

Frankenstein's laboratory sequences and spectacular lightning effects were created by Kenneth Strickfaden, whose 'Electrical Properties' boosted the fading current of many horror movies of the 1930s. Modelwork by John P. Fulton (69>) was used for the laboratory and the blazing mill at the end of the film. These techniques, combined with Jack Pierce's iconic monster design (272>) and expressionistic lighting, produced a science fantasy unlike anything Universal had made before.

Whale made three more horror films for Universal. *Bride of Frankenstein* (1935) embellished the

achievements of its forerunner with technically superior effects, supervised again by Fulton. The two men also worked together on *The Invisible Man* (1933), in which Fulton used the Williams process (58>) to ensure that when Claude Rains shed his bandages, he revealed nothing. *The Old Dark House* (1932) employed modelwork to create a devastating landslide.

Whale directed two more films of note: *Show Boat* (1936), a musical that convincingly re-created a Mississippi riverboat entirely with models; and *The Man in the Iron Mask* (1939), where double exposure techniques allowed Louis Hayward to speak to himself – his other lines were spoken to him by a stand-in (the young Peter Cushing), who was later edited from the composite image.

Whale became increasingly frustrated by the limits of the horror genre. Like *Frankenstein*, he had unlocked the mysteries of creation, but all the studio gods expected him to create was horror.

FAR LEFT: A young Alfred Hitchcock listens to actress Anny Ondra during the filming of *Blackmail* (1929). The camera stands in a soundproof chamber so that the noise from its motor does not interfere with the sound recording.

LEFT: Disaster movie *The Rains Came* (1939) won an early Academy Award for its special effects. A variety of techniques, including the split-screen combination of live action and miniatures, was used to depict the devastation caused by earthquakes and floods.

power to create the fantastic or the seemingly impossible. As a result there was good investment in technology, and leeway for innovation. In 1932 Carl Laemmle (1867–1939) ordered the construction of Universal's first dedicated special effects stage, inaugurated with the filming of the miniature aeroplanes for *Air Mail* (1932) under the supervision of John Fulton (69>), and soon used for the production of classics such as *The Invisible Man* (1934) and *The Bride of Frankenstein* (1935). Special effects men began to earn considerable respect within the studios, although they rarely received any notice from the outside world, studio bosses believing audiences would feel cheated if they discovered the secrets of on-screen deception.

The studios of Hollywood began to develop distinct personalities in the 1930s. A film's studio pedigree was often clearly recognizable without reading its titles. The type of pictures a studio produced depended largely on its roster of contract stars. The Warners house style, for instance, was built around a string of crime dramas and gangster movies featuring James Cagney, earnest biopics starring Paul Muni, Errol Flynn swashbucklers, and a series of 'women's pictures' starring Bette Davis. Each studio established output patterns related to its stars, market position and resources.

The kind of film a studio produced affected the resources dedicated to its special effects department. Universal maintained a substantial department to provide optical, physical and make-up effects for its famous stream of horror movies, begun with Tod Browning's *Dracula* in 1931 and established by James Whale's *Frankenstein* later the same year. The series, eventually comprising some 24 films, centred on the characters of *Dracula*, *Frankenstein's Monster*, the *Invisible Man*, the *Mummy* and the *Wolf Man*, later combining two or more of these characters. At RKO, a particularly good optical department provided prominent effects for their series of Astaire and Rogers musicals, and contributed astonishing effects to the landmark smash hit *King Kong* (1933). Despite the success of *Kong* and some of Universal's horror movies, special effects films did not flourish in their own right in this decade. Effects people spent most of their time perfecting the type of unglamorous methods that allowed Hollywood's stars to drive convincingly in front of rear-projected traffic.

The craze for talkies had shielded the major studios from the world's financial crisis in the 30s, and at the end of the decade Hollywood remained in good financial shape – unchallenged as the supplier of the world's most popular form of entertainment. The end of the 30s also witnessed one of the greatest periods in Hollywood production history, with the release of classics including *The Wizard of Oz*, *Mr Smith Goes to Washington*, *Stagecoach*, *Goodbye, Mr Chips*, *Wuthering Heights* and *Gone with the Wind* (all 1939).

Special effects were now so important to movie production that they even received the ultimate recognition: their very own category at the Oscars. The first Academy Award for Achievement in Special Effects went to *The Rains Came* (1939), featuring a flood of biblical proportions masterminded by Fox's effects maestro, Fred Sersen (1890–1962).

THE 1940s

The 40s began auspiciously with the production of Orson Welles's *Citizen Kane* (1941). The film, now ranked as one of the greatest ever made, was a tour de force of matte paintings, miniatures, animation, and ingenious optical printing techniques. Perhaps it is a tribute to their invisibility that the film was not even nominated in the recently created special effects category of that year's Academy Awards.

Most of Hollywood's leading effects people now had well over a decade's experience in studio production behind them and were masters of the various techniques available to them. Rear projection, optical printing, matte painting, and to a lesser degree, travelling matte photography, played a key role in the majority of studio productions, and were considered a vital part of the production process.

The rise of colour photography, however, brought significant changes to the industry – although it did not cause a revolution on the scale that the arrival of sound had provoked in the previous decade. Colour film processes had been around since the early days of film, but few systems had been either practical or particularly pleasing to the eye. The first popular system, introduced in the late 20s, was Technicolor's two-strip process (56>). But with very slow film speeds requiring blinding amounts of light – often resulting in false colours on a grainy image – the two-strip technique did not enjoy widespread use. The early 30s saw the introduction of a three-strip Technicolor process (56>), whose colour reproduction was superb. Three-strip Technicolor was first used commercially for Disney's cartoon short *Flowers and Trees* (1932), and RKO's *Becky Sharp* became the first live-action feature to use the process in 1935.

Filming with early three-strip Technicolor still required three to four times as much light as black-and-white photography, so it was largely impractical for interiors. In a break from the studio-bound regime of the 30s, a number of prestigious productions were shot on location in three-strip Technicolor, a move also facilitated by improved sound technology. The first film shot entirely outdoors was Henry Hathaway's *The Trail of the Lonesome Pine* (1936). However, the introduction in 1939 of much faster film stock – requiring far less light – made three-strip Technicolor a viable option for studio production in the 40s.

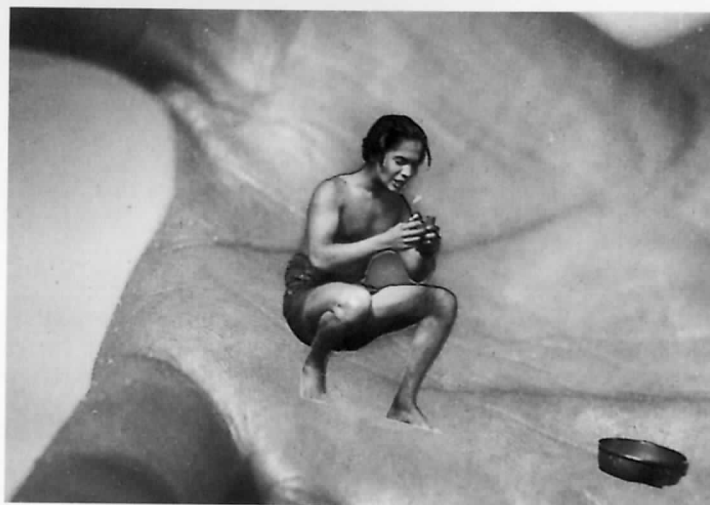
For effects technicians, colour was a challenge. Rear projection in colour was at first a vivid but unattainable dream. The background images projected onto a screen behind actors in the studio were not bright enough to be filmed in colour. However, faster film stocks and a powerful new projection system devised at Paramount helped to overcome this problem in the early 40s.

Travelling matte techniques (57>) also needed modification to accommodate colour. The first successful new method was pioneered in the UK and used in the 1940 version of *The Thief of Bagdad* (61>).

The effects technique most affected by the arrival of colour was matte painting (244>). In black and white the painter and subsequent photographer had to worry about matching the greyscale tones of painting and live action. In Technicolor, every colour and shade of the painting had to match exactly those of the original footage *after* both had been combined under different lighting conditions *and* after the original exposure had been stored undeveloped for some time. The first major display of Technicolor matte painting was *Gone with the Wind* (1939) – an often sumptuous blend of painting and live action born out of months of patient experimentation.

Despite the success of Technicolor, it was both an intensive and expensive system, generally reserved for prestige productions. The majority of films in the 40s continued to be shot in black and white.

The involvement of Europe and the United States in World War II meant that a large proportion of Hollywood's 40s output was devoted to boosting the morale of those in the armed services and their families back home. The number of films made by Hollywood studios fell from an average of 50 pictures a year per studio to a wartime average of 30. But with fewer films being made, more resources were available for the on-screen version of a world at war.



The re-creation of battlefields, destroyer-prowled oceans and fighter-filled skies fell to the effects technicians. Full-scale armaments were out of the question, so war films relied heavily on models and miniature photography – often on an epic scale. The demand for realistic sea battles led to advances in marine model-making and shooting in studio tanks – huge outdoor pools in which naval confrontations were staged. The tank at MGM was 92 m (300 ft) square, but the 15 m (50 ft) vessels that it often contained – such as those for *Thirty Seconds over Tokyo* (1944) – were so cramped that the water had to be pumped past the ships to give the impression that they were steaming forwards at speed. Filming water to scale will always be a problem, though the experience gained in the 1940s brought the art as close to perfection as it would ever be.

Aerial combat was re-created using squadrons of miniature aircraft, held aloft and manoeuvred by complex systems of wires. One of the most remarkable uses of the technique saw two dozen model aircraft take off in convincingly precise formation for *Mrs Miniver* (1942). War films also meant the frequent use of explosives, and Hollywood powdermen were kept busy supplying carefully devised miniature explosions for the destruction of models, in addition to convincing (but safe) mortars and bullet hits for full-scale live-action combat sequences.

Wartime box office takings soared in the US and the UK, more than compensating for the loss of important revenues from much of war-torn Europe and Asia. But after the end of hostilities box office revenues began to slump, partly because of the growth of suburban housing developments away from city cinemas, and increasingly because of the arrival of a mighty challenge to the dominance of the big screen: television.

LEFT: The filming of *Trail of the Lonesome Pine* (1936) was dominated by the presence of the enormous early Technicolor camera.

BELOW LEFT: The use of early blue-screen travelling mattes enabled child star Sabu to sit in the hand of a giant djinn for *The Thief of Bagdad* (1940).

RIGHT: Like many films of the period, *Ships with Wings* (1942) relied on model ships, planes and miniature pyrotechnics for its portrayal of a world at war.



1940s PROFILE ALFRED HITCHCOCK



Alfred Hitchcock (1899–1980) is celebrated as the undisputed master of the thriller genre, but is less often credited as an important special effects director. He entered the film industry as a title card illustrator in 1919, but soon graduated, via scenario writing, to directing – making his first feature, *The Pleasure Garden*, in 1925.

Hitchcock directed Britain's first acknowledged sound film, *Blackmail* (1929). Not content with merely capturing sound, he also employed some adventurous special effects. Using the Shuftan process (114>) – which he had noted during a visit to Germany's UFA studios – he combined models and live action for a large-scale finale that the film's modest budget could not otherwise have provided.

Hitchcock's technical virtuosity continued to grow in the 1930s, with films such as *The 39 Steps* (1935) and *The Lady Vanishes* (1938) demonstrating the director's ability to combine witty scripts and characters with deft camerawork and subtle special effects. Quickly latching

onto the potential of the new process of rear projection (82>), Hitchcock devised some of the most imaginative uses ever of the technique for films such as *Foreign Correspondent* (1940; 83>).

Hitchcock moved to Hollywood in 1940. With *Rebecca* (1940), his first American production, he started to explore the increased potential for special effects that higher budgets allowed, making particular use of miniatures and rear projection. Later experiments included *Lifeboat* (1944), a film set entirely within the confines of a drifting boat, and *Rope* (1948), a film cleverly filmed to appear as one continuous shot. Later films were increasingly reliant on effects, most notably *The Birds* (1963) which used a number of techniques to create both the flocks of birds and the destruction wrought by them. Hitchcock's position as the most creative and influential director of the period was unchallenged. His bold and imaginative use of special effects could not be matched.

THE 1950s

In America, television took hold quickly. Many families moved out of the city to the mushrooming post-war suburbs, and TV provided a cheap and accessible form of entertainment in their new homes.

The massive rise of television ownership terrified Hollywood. With free viewing in their living rooms, families didn't need to visit city centre theatres for their entertainment. For the first time in its history, Hollywood's position as the foremost provider of the nation's entertainment was seriously challenged; average weekly attendances plummeted from around 90 million in 1948 to 51 million in 1952.

But Hollywood's troubles did not end there. In the 30s the trading practices of the big studios became the subject of a US Federal anti-trust investigation. In 1948 the Supreme Court ruled that ownership of both the means of film production (the studio) and the means of distribution (the theatre) was monopolistic. The studios were forced to separate their production and exhibition activities by selling off their theatre chains. The newly independent theatres could show films made by any producer – be it major Hollywood studio or small independent production company. Hollywood had lost the previously guaranteed outlet for its films – good or bad.

Hollywood reasoned that it could win back audiences with innovation and technology. It began with the quality of the image. The small screen provided a fuzzy, black-and-white picture of variable quality. The big screen could dazzle, with enhanced images – huge, sharp and colourful.

The availability of good, economical colour systems, such as Eastman Kodak's single-strip Eastmancolor process, effectively ended Technicolor's market monopoly in the early 50s. In their attempt to outshine television, the studios splashed colour into the majority of their films. Later, it became evident that colour made little difference to the commercial success of most films and after the initial boost, the proportion of films made in colour declined to around 50 per cent from the middle of the decade. Ironically, the number of colour films did not increase significantly again until the mid-1960s, when the TV networks switched to colour broadcasting, and films made in colour became worth more when sold for broadcast.

Efforts were also made to improve the size and quality of the image. In 1952 Cinerama was introduced: a widescreen projection method, using three synchronized projectors to produce an exceptionally wide image with multi-track stereo sound. Spectacular though it was, Cinerama nevertheless caused more problems than it solved, since it required theatres, already desperate to cut costs, to invest in additional screens, projectors and projection staff.

CinemaScope was a more successful widescreen process, which used an anamorphic lens that squeezed wide 'letterbox' images onto film during photography and unsqueezed them during

RIGHT: Effects-filled science fiction fantasies such as George Pal's production *When Worlds Collide* (1951) did much to tempt younger audiences back to the cinema.

BELOW: The widescreen epics of the 50s strove to re-create history in spectacular fashion. This scene from *Ben Hur* (1959) combined live-action photography with a matte painting by Matthew Yuricich to depict a legion's triumphal return to Rome.



1950s PROFILE GEORGE PAL



Though many film-makers ventured into the realms of science fiction during the 1950s, few of them produced so consistent and successful a body of work as George Pal (1908–80).

Pal was born in Hungary, the son of famous stage-acting parents. Though he had planned to be an architect, a clerical error at his Budapest college led Pal to enrol in art classes, sparking a love for animation. Pal's first job was as an animator at Budapest's Hunnia Studios but his knowledge of architecture soon led to a job as a set designer for Germany's renowned UFA Studios in Berlin, where within two months he became head of the animation department. The rise of Hitler prompted Pal to move to Paris, where he established a successful animation business, until the spectre of Nazi invasion forced him to move to Holland and then again to the US.

In the US, Pal secured a contract with Paramount to produce a series of animated puppet films called 'Pal's Puppets', employing the young Ray Harryhausen as an animator (188>) and winning a special Oscar for the

techniques that he developed. Following the success of his Puppets, Pal secured finance for his first feature film, *Destination Moon* (1950). Pal gave his first film the high production values that would come to distinguish all of his features – even hiring the German rocket scientist Hermann Oberth to ensure the film would be scientifically accurate. As producer – and in later films director – Pal's use of special effects was typically restrained; he recognized when it was best to allow character and dialogue to tell a story, and when to rely on special effects and action.

Pal's later productions contained less science and more fantasy, but his commitment to detail, high production values and judicious use of superb special effects ensured that his films, such as *When Worlds Collide* (1951), *The War of the Worlds* (1953), *The Conquest of Space* (1955), *Tom Thumb* (1958), *The Lost Continent* (1960) and *The Time Machine* (1960), were among the most popular, critically acclaimed and best remembered of the period.



projection. The only investment required by theatres was the new lenses, which could be fitted to existing projectors. Fox pioneered the process and unveiled it spectacularly with *The Robe* in 1953. Within a year, every major studio – except for Paramount (which used its own VistaVision process) and RKO (which used SuperScope) – had adopted CinemaScope. By 1957, 85 per cent of the movie theatres in the US were equipped to show films in 'Scope'.

The other major attraction of the 50s was pure gimmickry – *Bwana Devil* (1952) promised audiences 'A lion in your lap!' Persuading itself that 3-D films might be the industry's saviour, Hollywood forced its new perspective on all kinds of film, from musicals (*Kiss Me Kate*, 1953) to thrillers (*Dial M for Murder*, 1954), and from horror films (*House of Wax*, 1953) to Westerns (*Hondo*, 1953). Audiences disliked wearing the special glasses that the process required and within 18 months of its much-touted launch, the 3-D craze had sunk almost without trace.

Studios tinkered with more than image quality. As families sat at home watching Lucille Ball and Jackie Gleason on television, movie audience demographics changed. The movie theatre was now the darkened haunt of teenagers and young couples, glad to slip away from their parents. Drive-in theatres sprang up in response to the post-war boom in car sales and the rise of suburbanization. By 1956 the United States had over 4,000 of these out-of-town sites, and at their height, more people sat in cars to watch a movie than in the traditional theatres. Despite their popularity, the drive-ins did little to stop the overall decline in film-going.

Pulp science fiction novels and comics had become hugely popular since the 40s, but the Hollywood majors had hardly explored the science

fiction genre, considering it the fodder of cheap serials and B movies produced by the Poverty Row studios. But the popularity of sci-fi literature and movie serials among young people – now the front row of film audiences – made it appear a safe bet for greater investment.

Destination Moon (1950) was the first major sci-fi film of the decade. Produced by George Pal, who was to create several of the decade's most significant science fiction films, *Destination Moon* was a critical and commercial success, sparking a meteor shower of similar movies. The fears of the 50s – atomic annihilation and Communist invasion – were echoed vividly in tales of aliens visiting Earth intent on domination and destruction.

From the middle of the decade, a rash of movies offered variations on a range of sci-fi themes, and all kinds of monsters were seen to be populating the planet. These included beasts forgotten by time (*The Creature from the Black Lagoon*, 1954), angry monsters stirred from the deep by atomic explosions (*The Beast from 20,000 Fathoms*, 1953), creatures mutated by atomic experiments (*Them!*, 1954), people whose bodies or even souls had been invaded by aliens (*Invasion of the Body Snatchers*, 1956) and people harmed by modern science (*The Fly*, 1958).

All of this meant plenty of work for Hollywood's special effects departments. Model-makers were kept busy fashioning spacecraft, often in the now classic flying saucer design – though there were notable exceptions, such as the sleek manta-like ships of perhaps the decade's most memorable science fiction film, *The War of the Worlds* (1953). Many sci-fi movies of the 50s were produced on tiny budgets by independent producers, such as the cinematically challenged director Edward D. Wood (1924–78), whose weird, wired and wobbly efforts have become classics in their own right.

Aliens and monsters of the 50s were generally men in rubber suits, with little subtlety of movement or performance. Perhaps the most famous, that which emerged from the infamous Black Lagoon, was a wholly typical creation, requiring stuntman Ricou Browning to flail around in a rubber suit that was half monkey and half lizard in design. A number of notable mechanical creatures did appear, however, including a crude but effective giant ant in *Them!* and the popular Robby the Robot in *Forbidden Planet* (1956). Perhaps most spectacular was the giant squid in Disney's *20,000 Leagues under the Sea* (1954). The mechanical beast, built by Bob Mattey, was originally scheduled to appear in a tranquil sunset scene but its clumsy pneumatic and cable-controlled performance eventually had to be obscured in a tempest whipped up by studio technicians. The genuinely thrilling results won the studio an Oscar for Best Special Effects.

There were some important effects innovations during the decade. In Britain, the J. Arthur Rank Organisation pioneered a superior new travelling matte system using sodium vapour lighting (64>), later adopted and refined by Disney. There were also mechanical inventions, such as an early motion-control system (146>) called a 'repeater', developed at Paramount. This recorded camera motion so that shots of separate elements, such as models and live action, could be taken with identical camera movements, enabling them to be combined effectively.

The decade also saw the rise of the only effects artist ever to become a household name. Gaining attention with the stop-motion ape in *Mighty Joe Young* (1949), Ray Harryhausen (1920–; 188>) continued to produce spectacular animated creatures for a series of 'monster on the rampage' films, including *It Came from Beneath the Sea* (1955) and *Twenty Million Miles to Earth* (1957). Harryhausen ended the decade with the first of a series of spectacular mythical fantasies: *The 7th Voyage of Sinbad* (1959). To produce the Arabian Nights adventure, Harryhausen used perspective tricks, split screens, over- and undersized props, mattes and stop-motion animation of unparalleled complexity.

Hollywood ended the 50s in a beleaguered and somewhat bewildered state, unsure of how to prevent its dominance slipping further from its grasp. The good times were a fast-fading memory as Tinseltown dug in to prepare for whatever the 60s might bring.



THE 1960s

Hollywood entered the 60s with trepidation. Film audiences around the world had dwindled by millions, and once-profitable theatres were closing by the thousand. Still struggling to win back audiences from television, studios continued to produce a broad range of mainstream genre films. With the persistent conviction that size was the one attribute they could offer that television could not, the studios embarked on the production of a number of spectacular historical epics, where scale was everything. Films such as *Spartacus* (1960), *Exodus* (1960), *El Cid* (1961), *Mutiny on the Bounty* (1963) and *The Greatest Story Ever Told* (1965) hyped their casts of thousands and enormous sets.

The most excessive example was Twentieth Century Fox's production of *Cleopatra* (1963), which reputedly spent \$6,500 on a crown of real gold and employed 10,000 extras in period costume. Cleopatra's capital, Alexandria, was rebuilt as an 8-hectare (20-acre) set of huge palaces and temples; the 5-hectare (12-acre) reconstruction of Rome's forum was bigger than the original; and Cleopatra's barge was a full-scale floating vessel built at the cost of \$250,000. The finished film cost an unprecedented \$44 million (around \$300 million in today's money), and its epic failure at the box office almost bankrupted Fox.

However, Fox got rich again with its version of Rodgers and Hammerstein's *The Sound of Music* (1965), which became the most successful film in history and helped to underwrite the continuing policy of lavish adaptation of successful stage musicals, plays and classic stories. Fox also profited from *Fantastic Voyage* (1966), a tremendously entertaining science fiction adventure, which reconstructed

ABOVE: *Fantastic Voyage* (1966) captured the public's imagination with its action set inside the human body.

RIGHT: One of cinema's most popular science fiction series began with *The Planet of the Apes* (1968). The superb ape make-up was created by John Chambers, who later won a special Academy Award for his work.





LEFT: Rear-projected cars chase secret agent 007 (Sean Connery) in *Dr No* (1962), the first of James Bond's big-screen adventures.

BELOW RIGHT: *2001: A Space Odyssey* (1968) established a new benchmark in special effects photography. Its meticulously rendered space scenes remain an inspiration to this day.

the organs of the human body as enormous sets in which wire-suspended actors floated around. Other sci-fi successes of the decade included *Planet of the Apes* (1968) – an impressive film, pointing towards the maturity of science fiction cinema. The superbly expressive ape make-up allowed for subtle and believable performances that no 50s creature could have achieved.

Continuing the theme of excess, movies in general became increasingly fast-paced, action-packed and violent. The beginning of the decade saw audiences shocked by the graphic horror of *Psycho* (1960). The 1962 release of the first James Bond film, *Dr No*, delighted large audiences with a new style of flamboyant macho action. Soon the limits of on-screen violence were being extended, as audiences responded positively to faster chases, fiercer fights and bigger explosions in films such as *A Fistful of Dollars* (1964) and *Bonnie and Clyde* (1967). The 'bigger is better' ethos continued with war films such as *The Great Escape* (1963), whose makers crashed real planes instead of models. *The Hellfighters* (1968), an oil-fire drama, capitalized on audiences' love of explosions by setting the entire film against a backdrop of blazing oil rigs. Even comedy had to be of epic proportions – *It's a Mad Mad Mad Mad World* (1963) combined an all-star cast with over three hours of increasingly frenetic slapstick comedy, chases and explosions.

The 60s hunger for the spectacular had little use for the traditional skills of Hollywood's special effects departments. Where biblical cities might once have been rendered by the matte artist or the model-maker, 60s epics had to have reality. Planes crashing into trees were full-scale aircraft flown by living pilots, and real racing cars were fired from pneumatic cannons to create spectacular crashes (*Grand Prix*, 1966). The predominance of such extravagant physical effects (306>) and the increasing reliance on location shooting – diminishing the need for rear projection (82>) or travelling matte effects (57>) – reduced many special effects departments to workshops for producing mundane optical effects and titles.

Hollywood had started to streamline operations in the late 1940s. The severe financial difficulties faced in the 60s, combined with the new policy of distributing more independent films (by the early 60s two-thirds of films distributed by the major studios were independently produced), increased

the drive to downsize facilities and reduce overheads. In the climate of the 60s, the effects departments became a costly overhead that studios no longer wanted to bear.

By the end of the decade, only Disney maintained a full-time effects department to service its range of fantasy-based family entertainment films, such as *The Nutty Professor* (1963) and *Mary Poppins* (1964). Elsewhere, a generation of artists left their departments. Some discovered a life outside the studios and set up their own small companies to service independent productions. Many, reaching the end of their working lives, chose to retire for good. The accumulated skills of more than a quarter of a century were discarded in order to save a few dollars, and like silent stars faded by the glare of the talkies, special effects were reduced to bit parts.

But in 1968 a film of unprecedented visual impact, drawing on the most astonishing special effects yet seen, was released to critical bewilderment and impressive box office business. Stanley Kubrick's *2001: A Space Odyssey*, with its balletic space stations soaring to the music of Strauss, challenged everyone's concept of space travel, and made the real moon landing of the following year something of an anticlimax. For Kubrick, realism was the key, and his quest to make the film the most visually arresting portrayal of man in space led to an obsession with the quality of his special effects. The production of *2001* was also responsible for the only major effects technology developments of the decade. Rear projection was not effective enough for Kubrick's vision, and so the relatively untried process of front projection (84>), which offered the potential of much bigger, brighter and clearer background images behind actors, was developed and used for the first time in a feature film. A new process of mechanically repeatable camera control, the forerunner of modern motion control (146>), was also developed for the photography of the film's enormous model spacecraft. Most visually striking of the film's innovations was the now legendary 'Stargate' sequence, produced using an inventive animation method dubbed 'slit scan' (178>).

Audiences had never seen anything like it, and it seemed as if the success of *2001* might make the studios regret the closure of their effects departments.

1960s PROFILE ROGER CORMAN



When the studios were at their most vulnerable, one director found a way to make a profit, quickly becoming one of the most prolific and commercially successful film-makers in Hollywood history.

Roger Corman (1926–) entered the industry as a messenger boy at Twentieth Century Fox before finding work as a story analyst and scriptwriter. Frustrated by studio interference during the shooting of his first script, *Highway Dragnet* (1954), Corman decided to form his own company to shoot his next script, *The Monster from the Ocean Floor* (1954).

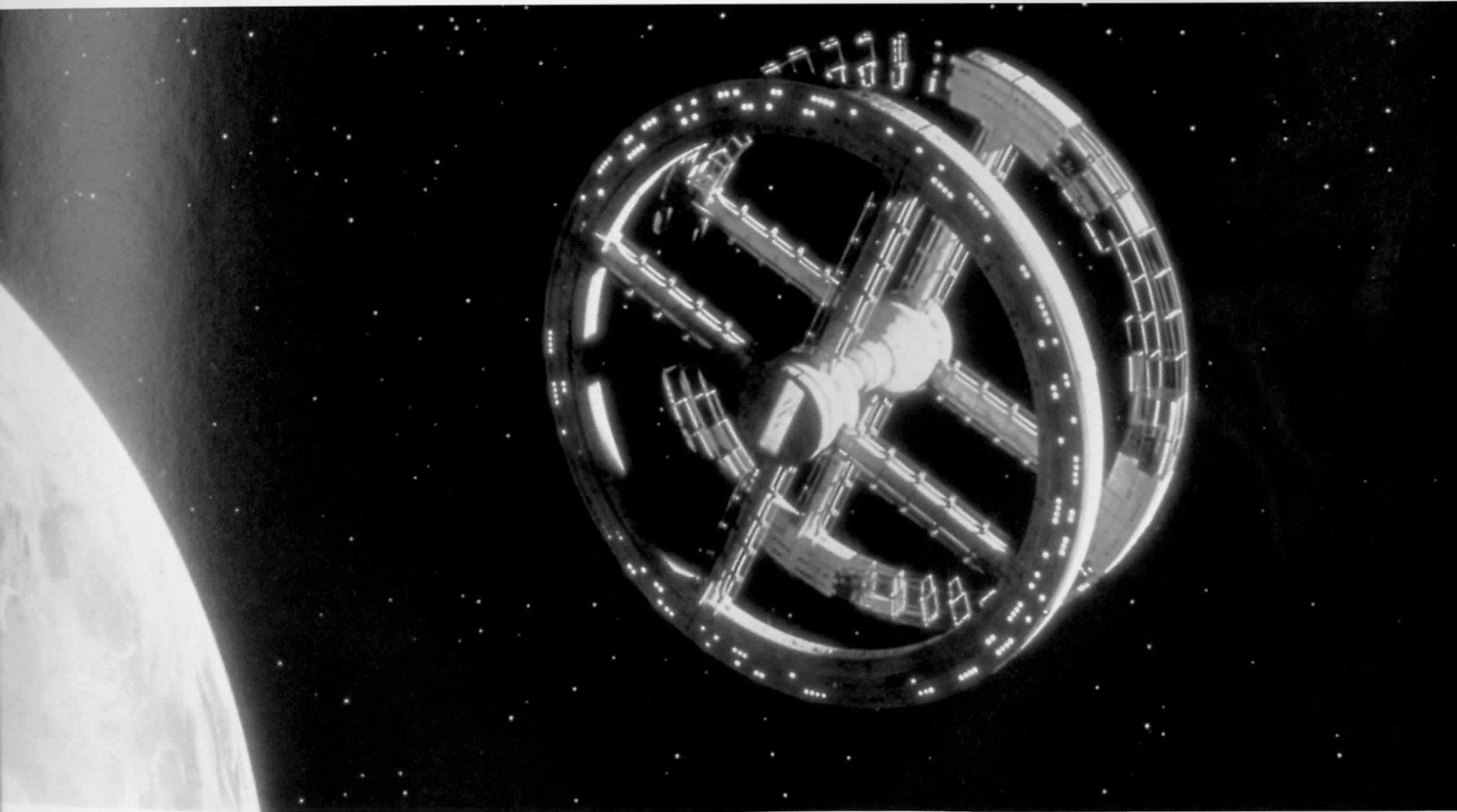
By the time he directed his own first feature, *Apache Woman* (1955), the Corman formula was in place. His productions were invariably characterized by offbeat plots and quirky characters. They were made at lightning speed (sometimes in under a week) on minuscule budgets, with largely untried performers and young crews.

Although Corman's science fiction films and creature features cried out for lavish special effects, budgets dictated otherwise. Effects were generally limited to the simplest physical or mechanical methods – avoiding the use of costly post-production processes. Occasionally budgets stretched to elaborate

monsters, such as the 4.5 m (15 ft) radioactive crustacean that sidled into *The Attack of the Crab Monsters* (1957) to snap up \$1,200 of the film's \$70,000 budget. More often, budgetary constraints meant that alien invaders would be no more than actors wearing special contact lenses, as in *Not of this Earth* (1957).

The 50s fare of monsters and aliens gave way to slightly more sophisticated horror in the following decade. Corman's Edgar Allan Poe adaptations had time and money 'lavished' on them – they could be in production for as long as three weeks. Despite their almost crippling constraints, however, some have become classics of film horror.

Corman has made over 200 films to date, and has prospered in one of the toughest industries in the world. Despite the sometimes laughable quality of his films, Corman has earned great respect in Hollywood – not only for his ability to produce profitable movies on shoestring budgets, but also for the start he has given to many ambitious youngsters, including Martin Scorsese, Francis Ford Coppola, Peter Bogdanovitch, Joe Dante, Jonathan Demme, Penelope Spheeris, Robert De Niro and Jack Nicholson.



THE 1970s

The success of *2001: A Space Odyssey* (1968) was heaven-sent. At 141 minutes long it had no big stars, an ambiguous narrative, and no one could say for sure whether or not it had a happy ending. In Hollywood, where the popularity of one film normally has studios scrambling to cash in on any perceived trend, *2001* was something of a mystery. Executives didn't quite know what had drawn audiences to the film – although the popular rumour that it was best enjoyed while stoned was suspected of having some influence. Stanley Kubrick's film was a freak success, made by a brilliant, obsessive director, who went over schedule by a year and doubled his original budget.

2001's special effects were undoubtedly stunning, but they were created by a disparate group of talents in a studio in England, halfway across the world from Hollywood. How these skills could be profitably re-employed was unclear. The studios needed to identify a much more predictable, and repeatable, formula before they could take advantage of any 'trend'. Although there were some effects-laden science fiction films in the wake of *2001* – such as *Journey to the Far Side of the Sun* (1969) – it would be a decade before the influence of Kubrick's masterpiece would truly be felt.

After the poor performance of its costly late-60s musicals and historical epics, Hollywood had entered the 70s in its most perilous financial condition ever. Tinseltown had been run by movie people for half a century, but the financial vulnerability of the studios in the late 60s had led to a series of takeovers and mergers. Much of Hollywood now lay in the hands of business conglomerates for whom movie-making was a sideline.

The new Hollywood management rang the changes in film marketing. For decades studios had used a pattern of releasing films gradually. Starting its run in big city theatres and gradually moving out into smaller regional venues, a feature film might have gone on release for over a year. In the early 70s the studios began to use television and the national press as launch pads. Rather than going the rounds, a film now opened in hundreds of theatres simultaneously to capitalize on a nationwide campaign built around a single release date.

While they couldn't define – and therefore exploit – the success of *2001*, the executives interpreted the popularity of *Airport* (1970) as proof that audiences would pay to see disaster on a major scale. The studios embarked on a series of star-stuffed disaster epics, in which people were threatened variously by doomed ocean liners (*The Poseidon Adventure*, 1972), flaming skyscrapers (*The Towering Inferno*, 1974), seismic catastrophes (*Earthquake*, 1974) and even an ill-fated airship (*The Hindenburg*, 1975). These films brought some good opportunities for Hollywood's underemployed special effects artists, and many found temporary work producing and shooting miniatures, matte paintings and pyrotechnics.

Massive national promotion leading to a blanket release made these films early beneficiaries of the new marketing strategies. Although the disaster cycle was largely successful, studios realized that traditional genres with their built-in audience bias (Westerns aimed at the male audience, melodramas for women, science fiction for teenagers and so on) would require adaptation. With the rapidly increasing cost of production and national promotion, it was imperative that films should appeal to broad cross-sections of the modern audience. To help meet this need, the studios turned to a new generation of film-makers.

Later dubbed the 'movie brats', the young directors of the early 1970s were mostly film school graduates with a deep love of classic Hollywood cinema. These directors, including Francis Ford Coppola (1939–), George Lucas (1944–) and Steven Spielberg (1947–), felt indebted to the traditions of Hollywood but were keen to make the type of big-budget, broad-appeal genre films that the new-style studio marketing sought. Beginning with Coppola's hit *The Godfather* (1972), the young directors started to produce movies of unprecedented mass appeal. Lucas's first success, *American Graffiti* (1973), was made on a small budget, but its surprising enormous success was only the starter. The main course was Spielberg's *Jaws* (1975). The young director caused a sensation with the first film to make over \$100 million for a studio. The film was the prototype for an important new marketing strategy that would later become known as the 'event movie'.

Jaws used mechanical special effects to produce an occasionally

1970s PROFILE IRWIN ALLEN



Irwin Allen (1916–91) entered film production in the early 1950s, after a career that had included stints as a magazine editor, Hollywood columnist, literary agent (clients included P.G. Wodehouse) and radio producer. After producing some modest features such as the comedy *Double Dynamite* (1951), starring Frank Sinatra and Groucho Marx, and several award-winning documentaries including the Academy Award-winning *The Sea Around Us* (1953), Allen made the 1956 documentary *Animal World*, which included 12 minutes of dinosaur footage animated by Ray Harryhausen (188>).

In 1960 *The Lost World* marked the beginning of a long and profitable relationship between Allen and Twentieth Century Fox. The film was a colourful but flimsy interpretation of Sir Arthur Conan Doyle's novel of the same name that forfeited the delights of Harryhausen-style animation in favour of live lizards with stuck-on appendages to portray its dinosaurs. Despite its many failings, the film offered the right mix of action, adventure and romance to make it a major financial success.

Allen then produced several effects-heavy adventure films such as *Voyage to the Bottom of the Sea* (1961), but concentrated on producing fantasy and sci-fi television, including a TV series of *Voyage to the Bottom of the Sea* (1964–8), *Lost in Space* (1966–8) and *Land of the Giants* (1968–70). Ever resourceful, Allen liked to recycle his feature-film footage – especially the dinosaur material from *The Lost World*, which regularly reappeared in his various TV productions.

Perhaps the films for which Allen is most remembered are his disaster epics *The Poseidon Adventure* (1972) and *The Towering Inferno* (1974), and to a lesser extent *The Swarm* (1978) and *The Day the World Ended* (1980), all of which helped to earn him the title 'Master of Disaster'. These movies were object lessons in how stars, large-scale action and impressive special effects, such as models of burning skyscrapers and sinking ships, could be mixed into a box office winner despite the lack of a first-rate script or interesting characters – an irresistibly profitable equation that has guided some producers ever since.



TOP LEFT: The temperamental mechanical shark built for Steven Spielberg's *Jaws* (1975) worked long enough to keep summer audiences sitting in movie theatres and out of the sea. It was the first film to make \$100 million at the box office.

TOP RIGHT: Spielberg's second big hit, *Close Encounters of the Third Kind* (1977), featured some of the most magical and awe-inspiring visual effects photography ever created.

ABOVE: Turning tragedy into entertainment, *The Hindenburg* (1975) was one of a series of 70s disaster epics that used special effects to replicate scenes of destruction.

convincing performance from an oversized rubber shark, but the film itself did not advance the art of special effects. Indeed, the difficulties of filming with the temperamental mechanical beasts caused the movie to sail beyond its original schedule and budget, and served as a warning to anyone considering a similar enterprise.

But it was the subsequent offerings of these young directors that would have a significant role to play in the revival of movie special effects.

George Lucas's *Star Wars* (1977) was like no other science fiction film that had gone before. In fact, Lucas played down the film's science fiction heritage with the now legendary opening titles – 'A long time ago in a galaxy far, far away...' – which promoted the film as fantasy and legend rather than science and futurism. The film relied heavily on spectacular special effects to portray its unique blend of mythology and science fiction. Lucas had been inspired by the quality of the effects in *2001*, but the graceful waltz of elegant space stations was not his style – nor did he have the time and money that such work would take. With no studio effects department to call on for help, Lucas decided to build his own. He assembled a team of talented young artists and technicians, many of whom had cut their teeth in the world of TV commercials, where creative demands and budgets often allowed more innovation than modern features did.

For space battles, Lucas wanted to re-create the speed and excitement of the airborne dogfights of World War II movies. Existing effects technology did not permit the production of this type of material, which involved filming many fast-moving spaceships and then filming background elements with the same, complicated camera movements, to enable them to be combined seamlessly. As a result, Lucas's team of technicians built a new computer-linked camera control system, to record and repeat the exact movements of a camera – the first of its kind. Many traditional effects were also employed with renewed vigour; optical effects, matte paintings, models, make-up, effects animation and pyrotechnics all helped to produce the vividly alien worlds that Lucas had imagined.

Steven Spielberg's *Close Encounters of the Third Kind* (1977) was equally reliant on breathtaking special effects. Again, this film was not science fiction in the traditional sense, and although clearly influenced by science fiction of the 50s, Spielberg shunned the shock tactics of earlier alien-invasion movies to create a powerful fusion of science, myth and religious iconography. To help him create his vision, Spielberg assembled a team of effects talent, including some of the crew from *2001*. Making extraordinary use of convincing Earthscape models, miniature spacecraft, matte paintings, animation, optical effects, mechanical creature effects and clever camera tricks, Spielberg and his collaborators produced one of the most visually stunning spectacles ever to illuminate the screen.

Star Wars and *Close Encounters* were phenomenal box office successes, earning their creators sizeable fortunes and giving them unparalleled power in Hollywood. The studios hadn't known how to react to *2001*, but they had now seen the light and there seemed no doubt about what audiences wanted to see. Large-scale action films with show-stopping special effects were the order of the day. The closing years of the 70s saw vintage special effects equipment dusted off, effects artists coaxed out of retirement and new talent given its opportunity with the production of extravagant, effects-intensive movies, such as *Superman* (1978), *Star Trek: The Motion Picture* (1979), *The Black Hole* (1979) and *Alien* (1979). While the studios continued to release smaller movies of all types, the emphasis was on finding the next blockbuster, and studio executives developed an almost fanatical faith in the money-spinning properties of spectacular special effects.

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convincing performance from an oversized rubber shark, but the film itself did not advance the art of special effects. Indeed, the difficulties of filming with the temperamental mechanical beasts caused the movie to sail beyond its original schedule and budget, and served as a warning to anyone considering a similar enterprise.

But it was the subsequent offerings of these young directors that would have a significant role to play in the revival of movie special effects.

George Lucas's *Star Wars* (1977) was like no other science fiction film that had gone before. In fact, Lucas played down the film's science fiction heritage with the now legendary opening titles – 'A long time ago in a galaxy far, far away...' – which promoted the film as fantasy and legend rather than science and futurism. The film relied heavily on spectacular special effects to portray its unique blend of mythology and science fiction. Lucas had been inspired by the quality of the effects in *2001*, but the graceful waltz of elegant space stations was not his style – nor did he have the time and money that such work would take. With no studio effects department to call on for help, Lucas decided to build his own. He assembled a team of talented young artists and technicians, many of whom had cut their teeth in the world of TV commercials, where creative demands and budgets often allowed more innovation than modern features did.

For space battles, Lucas wanted to re-create the speed and excitement of the airborne dogfights of World War II movies. Existing effects technology did not permit the production of this type of material, which involved filming many fast-moving spaceships and then filming background elements with the same, complicated camera movements, to enable them to be combined seamlessly. As a result, Lucas's team of technicians built a new computer-linked camera control system, to record and repeat the exact movements of a camera – the first of its kind. Many traditional effects were also employed with renewed vigour; optical effects, matte paintings, models, make-up, effects animation and pyrotechnics all helped to produce the vividly alien worlds that Lucas had imagined.

Steven Spielberg's *Close Encounters of the Third Kind* (1977) was equally reliant on breathtaking special effects. Again, this film was not science fiction in the traditional sense, and although clearly influenced by science fiction of the 50s, Spielberg shunned the shock tactics of earlier alien-invasion movies to create a powerful fusion of science, myth and religious iconography. To help him create his vision, Spielberg assembled a team of effects talent, including some of the crew from *2001*. Making extraordinary use of convincing Earthscape models, miniature spacecraft, matte paintings, animation, optical effects, mechanical creature effects and clever camera tricks, Spielberg and his collaborators produced one of the most visually stunning spectacles ever to illuminate the screen.

Star Wars and *Close Encounters* were phenomenal box office successes, earning their creators sizeable fortunes and giving them unparalleled power in Hollywood. The studios hadn't known how to react to *2001*, but they had now seen the light and there seemed no doubt about what audiences wanted to see. Large-scale action films with show-stopping special effects were the order of the day. The closing years of the 70s saw vintage special effects equipment dusted off, effects artists coaxed out of retirement and new talent given its opportunity with the production of extravagant, effects-intensive movies, such as *Superman* (1978), *Star Trek: The Motion Picture* (1979), *The Black Hole* (1979) and *Alien* (1979). While the studios continued to release smaller movies of all types, the emphasis was on finding the next blockbuster, and studio executives developed an almost fanatical faith in the money-spinning properties of spectacular special effects.

THE 1980s

Jaws (1975), *Close Encounters of the Third Kind* (1977), *Star Wars* (1977) and the films that rode on the back of their phenomenal success brought new hope to Hollywood.

The studios were making money again. In executive minds, there was no doubt about the type of films they should be making: the quest was on for the next \$100 million blockbuster.

Movie theatre admissions were on the rise. In 1985 the anti-trust legislation of the 40s (<28) was reversed and some of the studios began to invest in theatre chains once more. Smart new multiplex theatres were springing up everywhere, funded by studio cash.

Home video became available in the mid-70s, and within 10 years, half the homes in the United States owned a VCR. The studios initially feared the effect of video on movie-going, but it soon became evident that video 'sell-through' and rentals could provide important additional income. By 1986 the US revenues from video cassette sales matched those from movie theatres. What's more, video actually renewed public interest in the movies and helped to revive film-going culture.

Studios also began to discover the worth of their libraries of vintage films, as increasing demand on video and the rise in cable and satellite broadcasting brought new markets for the movies of yesteryear. In the 30s a film was considered a 'spent' product within two years of its release, but by the mid-80s the post-theatrical life of a movie promised to be long and profitable – especially for a blockbuster.

The production of 'blockbuster-style' films was expensive. Hollywood now planned about 100 major releases annually, compared with 350 in the 40s, but these films had much bigger budgets. The films of the 80s became increasingly glossy, action-packed and violent, youth-oriented and special effects-intensive.

As the decade began, the immediate future for science fiction and fantasy seemed assured. George Lucas had promised at least another two *Star Wars* films, and sequels of *Star Trek* and *Superman* seemed almost perpetual. Enthusiastic audiences for futuristic and fantastic films led to the

production of movies such as *Flash Gordon* (1980), *Blade Runner* (1982) and the record-breaking *E.T. the Extra-Terrestrial* (1982).

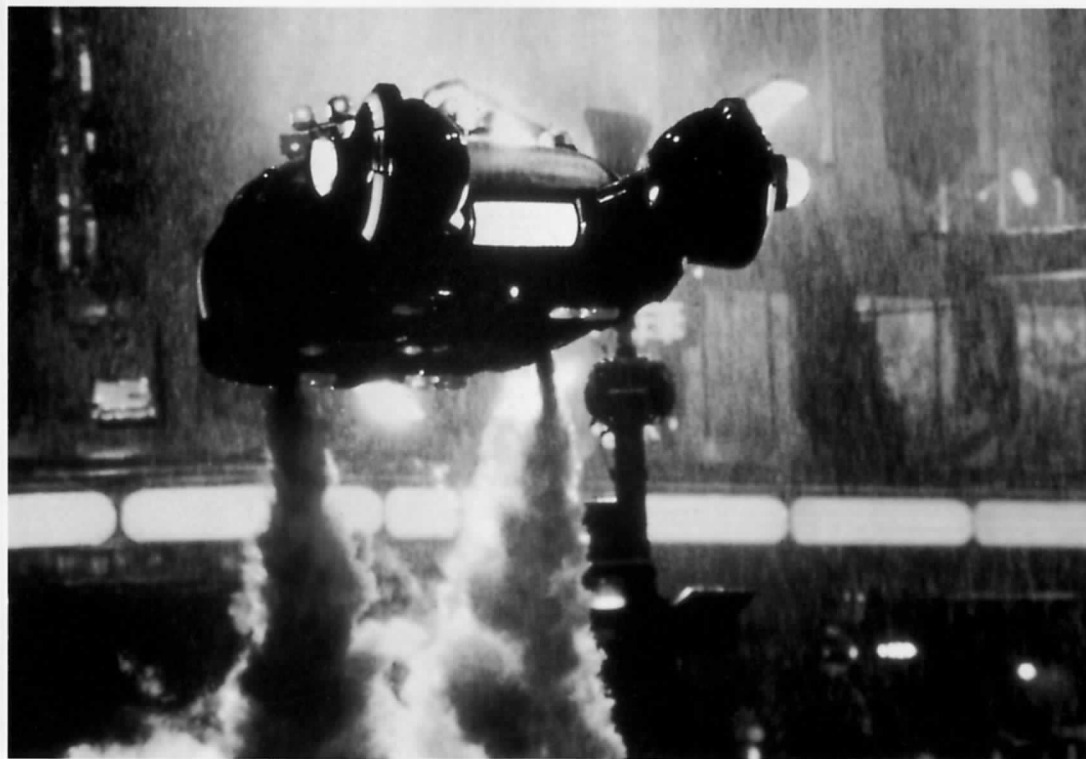
An affluent and influential youth market also displayed an appetite for comedy. Steven Spielberg's expensive belly-flop *1941* (1979) had been a huge disappointment, and led for a while to less ambitious fare such as *Airplane!* (1980) and *Trading Places* (1983). Though not exactly brain food, they were mouth-wateringly successful. Producers went on to perfect another recipe for profit – comedy, action and spectacle, mixed in a pot of money – in films such as *Ghostbusters* (1984) and *Back to the Future* (1985).

The action genre was pumped up in the 80s with the musclebound, high-density efforts of Stallone and Schwarzenegger. In-your-face heroics and comedy were combined in films like *Lethal Weapon* (1987) and *Die Hard* (1988). Romantic, swashbuckling action resurfaced in the triumphantly popular *Indiana Jones* trilogy (1981, 1984, 1989) and its various imitators.

For their big earners, the studios became increasingly reliant on 'event movies' – high-profile films with major stars that were released at key dates (Christmas, Easter and summer holidays) to a fanfare of publicity. These films were not cheap to produce. In 1972 production costs for the average movie were \$2 million. By 1980 the average cost had reached \$10 million, and by the end of the decade it would be \$23 million. The intense pressure for films to perform led to enormous publicity campaigns that could send costs spiralling. *Alien* (1979) cost \$10 million to produce and an estimated \$15 million to promote.

The huge cost of films was partly due to the growing demands of big-name stars and directors, whose fees could equal a film's other production expenses. The price of movies was kept down, marginally, through a reliance on independent production. By the 80s the major studios had largely given up making films, preferring instead to commission movies from smaller production companies. In a typical arrangement, Spielberg's Amblin Entertainment – the most successful 'independent' company of the 80s – was provided with a lavish home at Universal Studios in return for offering its productions to Universal first for financing and distribution. This method of production cost the studios less, but it also meant receiving a smaller portion of eventual profits.

The reliance on sophisticated special effects was another factor in the escalating price tag of major movies. Special effects were no longer just a way



LEFT: Ridley Scott's atmospheric science fiction classic *Blade Runner* (1982) was among the stream of effects-packed movies to emerge in the wake of *Star Wars* (1977).

RIGHT: Steven Spielberg's *E.T. the Extra-Terrestrial* (1982) combined cutting-edge visual effects and special effects make-up with a heart-warming story to create box office magic.



of producing difficult or impossible shots – they were becoming the star of the show, and audiences wanted to see more. *Star Wars* had been the first film to promote itself partly on the quality of its special effects. As the film took off, articles were written and documentaries made about how the special effects were achieved. For the first time, the movie-going public became familiar with the concept of matte paintings and blue screens. Rather than destroying the magic, as the old moguls had predicted, people actually wanted to know about the technology behind what they saw. A knowledge of how special effects were produced appeared to fuel public interest in a film, and helped die-hard fans to get inside their favourite movie.

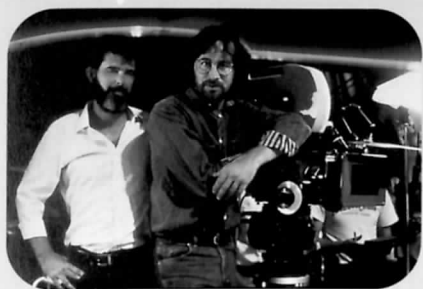
In the wake of *Star Wars*, independent companies were established to service the increased demand for film and television special effects. George Lucas's own outfit, Industrial Light and Magic (ILM), was temporarily disbanded after *Star Wars*, but reassembled permanently for its sequel, *The Empire Strikes Back* (1980). During the 80s ILM grew into the most successful special effects house in the world, serving the films of Lucas and Spielberg as well as many other landmark productions. The effects business became a well-established, if not especially stable, sector of the film industry. When films went into production, special effects houses would break down scripts to assess their potential effects content and bid for the work on a competitive basis. Of the many small companies established, most were short-lived, though others would prosper and grow into the next decade, forming a core of dominant industry leaders.

The sheer bulk of special effects-dependent movies led to an unparalleled period of research and development. The early blockbusters had

made significant use of effects, but for the most part these involved skilful variations on traditional methods. The major breakthrough in effects technology had been the use of simple computers to control the movement of cameras filming models. The real revolution came when the computers began to generate visuals.

In 1982 Disney produced *Tron*, a film based largely within a computer. Several minutes of footage were computer-generated, and Disney used this as a major promotional tool. The failure of *Tron* at the box office might have short-circuited the immediate interest in computer-generated imagery (CGI), but research continued. Several important CGI sequences were created in the following years, such as ILM's 'Genesis sequence' in *Star Trek II: The Wrath of Khan* (1982) and the space battle elements of *The Last Starfighter* (1984). But it wouldn't be until the 90s that the dazzling potential of computers would become fully apparent.

Hollywood had undergone a remarkable revival; 1989 was the most successful year in Hollywood history, with the American public spending \$5.03 billion at the box office. The film business was an integral part of the global leisure industry, and hit movies spawned enormous sales of merchandise: computer games, toys, books, clothing and music. Many of the studios – now really clearing banks for celluloid commodities – were owned by multinational conglomerates, including soft drinks manufacturers and Japanese electronics firms. The 80s may not be remembered as a golden age for quality, but it was a time of plenty for the money men, and paid for a remarkable renaissance in the art and technology of special effects.



1980s PROFILE GEORGE LUCAS AND STEVEN SPIELBERG

Studying film at the University of Southern California, George Lucas (1944–; *left*) made a 20-minute dystopic vision of the future, which – with the backing of his friend Francis Ford Coppola (1939–) – he later developed into a feature film. *THX 1138* (1971) was a stark, intelligent science fiction film that gained cult status and earned Lucas the mantle of an ‘intellectual’ film-maker. He next surprised everyone with *American Graffiti* (1973), a semi-autobiographical film crystallizing teenage life on one night in 1962. Made for a pittance, it took a fortune at the box office, becoming one of the most profitable films of the decade. The success of Lucas’s next project, *Star Wars* (1977), is legendary, and – together with Spielberg’s *Close Encounters of the Third Kind* (1977) – resurrected the big-budget sci-fi/fantasy movie and ushered in the age of special effects on a grand scale.

To furnish the effects for *Star Wars* (1977), Lucas created his own facility, Industrial Light and Magic (ILM) – a company that would become an industry byword for innovation and quality. ILM has since contributed many of the most memorable special effects to modern films, and earned dozens of Academy Awards for its extraordinary work. Lucas himself, with his Lucasfilm organization, has played a key role in the development of digital visual effects and other digital cinema innovations.

Making *Star Wars* (1977) was such an ordeal for Lucas that for the next 20 years he gave up the director’s chair for the role of creative producer, becoming the architect of massive commercial success with the *Star Wars* sequels (1980, 1983) and the *Indiana Jones* trilogy (1981, 1984, 1989). *Indiana Jones* was revived in the popular *Young Indiana Jones Chronicles* TV series (1991), which pioneered the use of digital visual effects in television production.

Despite immense commercial successes, there have been occasional disappointments for Lucas, including *Willow* (1988), *Tucker: The Man and His Dream* (1988) and *Howard the Duck* (1986).

After two decades, Lucas finally returned to the director’s chair to bring the long-awaited *Star Wars* prequels to the screen. *Star Wars: Episode I The Phantom Menace* (1999), *Episode II Attack of the Clones* (2002) and *Episode III Revenge of the Sith* (2005) received a mixed reception from fans and critics but were smash hits at the box office. The three films were a showcase for the dazzling potential of digital visual effects, using techniques largely pioneered by and promoted by Lucas and his organization.

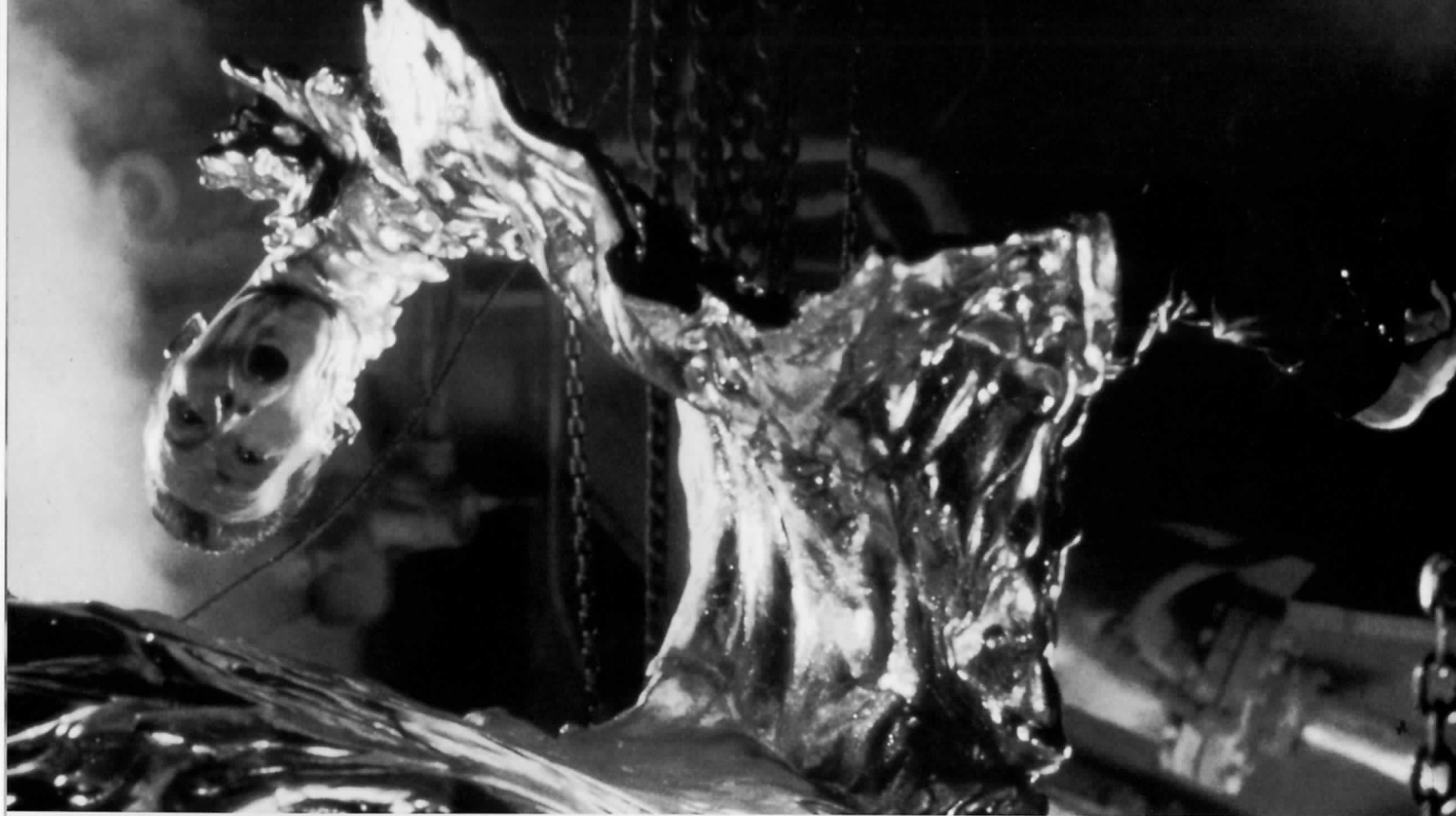
Unlike Lucas, Steven Spielberg (1946–; *right*) had no formal film training, learning his craft and polishing a natural talent with a series of childhood home movies. His college film *Amblin’* (1969) won critical praise and, more importantly, a contract to direct at Universal. After a number of television assignments, including episodes of *Night Gallery* (1969, 1971) and *Columbo* (1971), the apprentice moved up the ladder to TV movies. The popularity of *Duel* (1971), in which a lone driver is pursued relentlessly by a mysterious, menacing truck, earned Spielberg the opportunity to direct his first theatrical film, *The Sugarland Express* (1974). Though it was not a commercial success, by the time it was released, he was already directing *Jaws* (1975).

The worldwide popularity of *Jaws* (1975), and then *Close Encounters* (1977), was not matched by Spielberg’s rip-roaring misfire *1941* (1979), though what the film lacked in dramatic subtlety it compensated for in some exquisite miniature work. However, the first collaboration between Spielberg and Lucas, *Raiders of the Lost Ark* (1981), was a barnstorming success that demonstrated the value of fantasy and dazzling special effects in the creation of earthbound historical adventures.

The 80s were a golden time for Spielberg. In addition to his own directorial projects, he mined an endless seam of popular movies produced by his company Amblin Entertainment. *Gremlins* (1984), *The Goonies* (1985), *Back to the Future* (1985), *Innerspace* (1987) and *Who Framed Roger Rabbit* (1988) were just some of the hits that emerged. All were heavily reliant on ILM’s visual treats.

Spielberg continued to helm popular blockbusters throughout the 90s and 2000s and also garnered critical acclaim with a series of more personal movies including *Schindler’s List* (1993) and *Saving Private Ryan* (1998). With partners David Geffen and Jeffrey Katzenberg, Spielberg even formed his own studio, DreamWorks SKG, to produce and distribute movies, music and computer games. The live-action part of the business was sold to Paramount in 2006, but DreamWorks Animation, parent to the successful *Shrek* movies (2001, 2004) continues to operate under Spielberg’s influence.

More than any others, George Lucas and Steven Spielberg were responsible for the commercial rejuvenation of cinema in the 80s. They made movies that aimed unashamedly to please their audiences and their emphasis on visual spectacle and ground breaking special effects demanded technical achievements that would benefit the entire industry.



THE 1990s

By the centenary of its birth in 1995, the American film industry had developed into an efficient money-making machine and the country's most profitable export. The cost of making movies continued to mushroom, and by the middle of the decade, the average studio film cost \$50 million to produce, and the big seasonal blockbusters considerably more. By their very nature, blockbusters must surpass whatever has gone before if they are to attract a large audience; the concepts must be more outrageous and the special effects more stunning. In an attempt to limit the risks involved in investing so much money in a single movie, studios came to rely heavily on sequels in the 90s. In a notoriously volatile business, the sequel's potential for success seemed marginally more predictable.

The 90s also witnessed the resurgence of the feature-length animated movie. After years in the doldrums, Disney followed its smash hit *The Little Mermaid* (1989) with *Beauty and the Beast* (1992), which was an even greater box office success and became the first animated feature to be nominated for a Best Picture Academy Award. Other major studios, including Twentieth Century Fox, Warner Brothers and the newly created DreamWorks SKG, developed their own feature animation programmes, banking on a share of Disney's box office magic.

The profits from animated features can be enormous, even though the majority of tickets sold are for low-priced children's seats. Box office success is just one part of the equation, however, and Disney – more than any other studio – became supremely accomplished at extending the commercial value of its films by licensing its animated characters for use in every imaginable consumer product, from toys and books to clothing, computer games and fast food tie-ins.

In 1996 the launch of the DVD format resulted in the fastest consumer adoption of any new technology in history. Within five years, 40 million US households owned a DVD player and were spending an annual \$20 billion buying movies to watch at home – more than twice what was spent at the

box office. In addition to the actual film, DVDs offered a host of extra features, spawning a new industry to produce behind-the-scenes footage and 'making-of' documentaries for both new and classic movies. Chapters showing how a film's special effects were created became a particular favourite, helping to reinforce the role of visual effects 'hype' in the marketing of a major movie.

In the realm of visual effects production, the 90s saw a monumental breakthrough in digital imaging. Although generating original imagery with a computer had become faster and easier by this time, such images still had to be manipulated and incorporated into film footage using traditional optical techniques. However, the development of fast and reliable scanning and recording technology (92>) at the beginning of the decade allowed film images to be converted to the digital medium, manipulated within a computer and recorded back onto film for exhibition. The ability to get film in and out of the digital realm with no loss of quality opened the floodgates for Hollywood's digital revolution.



1990s PROFILE JAMES CAMERON



James Cameron (1954–) began his film career working for Roger Corman (<33) as art director, miniature set builder and rear-screen photography supervisor for *Battle Beyond the Stars* (1980).

Cameron made his directorial debut in 1981 with *Piranha II: The Flying Killers*, which he co-wrote. The film barely betrayed the talent of its director, but did signal Cameron's interest in science fiction and special effects, which resulted three years later in *The Terminator* (1984), an exciting and inventive sci-fi thriller that was the first of several collaborations with action star Arnold Schwarzenegger.

Aliens (1986) saw Cameron using striking visuals and Oscar-winning special effects to create a landmark in science fiction action films. *The Abyss* (1989) was a critical and commercial disappointment, but featured some ground-breaking computer-generated effects that helped to assure the future of digital imagery in filmmaking and won Industrial Light and Magic an Oscar for its work on the film.

Terminator 2: Judgment Day (1991) relied on the computer-generated wonders of ILM to provide one of

its key characters – a shape-shifting android that could assume any form or texture that it wished. The stories that Cameron wanted to tell had become so reliant on cutting-edge special effects technology that after making *T2* he became a partner in a new visual effects facility, Digital Domain.

True Lies (1994) saw the director's first foray into real-world action adventure, and the use of digital effects to create naturalistic environments and events – perhaps a rehearsal for his epic *Titanic* (1997), which became the first film to pass the \$1 billion figure at the box office. With *Titanic*, Cameron showed that digital effects could be equally effective at conjuring historical eras as they were at creating futuristic ones.

Perhaps more than any other film-maker of the 1990s, James Cameron had the imagination and ambition to harness the potential of both traditional and cutting-edge special effects techniques. He has since pioneered the use of 3-D video technology to produce several IMAX documentary films and is planning to make his future feature films in stereoscopic video.

ABOVE LEFT: Audiences were amazed by ILM's incredible computer-generated character effects in James Cameron's *Terminator 2: Judgment Day* (1991), a landmark in digital visual effects production.

BELOW LEFT: The massively popular *Jurassic Park* (1993) awed audiences with its magnificently realistic computer-generated dinosaurs. More than a decade later, its pioneering creature effects still hold up well.

James Cameron's *Terminator 2: Judgment Day* (1991) offered stunning, digitally created characters that performed feats impossible to achieve in the physical world. Audiences were amazed. Steven Spielberg's *Jurassic Park* (1993), which used computers to produce amazingly lifelike images of extinct dinosaurs, took digital imaging to a new level of sophistication and became the highest-grossing film in history at that time.

The special effects industry was taken by storm. *Jurassic Park* confirmed that digital effects were the way of the future. Almost overnight, machinery and skills that had been in use for over half a century became outmoded. Special effects facilities scrambled to recruit people who had never touched a frame of film in their life, but who could operate computers and write code. Producers were impressed by the new technology, and scripts whose impossible scenarios had made their productions unfeasible in the past were dusted off and put into production.

Toy Story (1995) became the first entirely computer-generated feature film. Its stunning images, appealing characters and compelling storyline ensured that it was a huge hit. Several wholly computer-generated films followed, including Disney/Pixar's *A Bug's Life* (1998) and DreamWorks' *Antz* (1998).

As the decade progressed, digital technology, once the preserve of big-budget movies, quickly became affordable and available to even the most modest productions. Crowds could be replicated, removing the need for hundreds of extras in expensive costumes. Physical effects were made practical and safe because safety wires used to protect actors during filming could easily be digitally removed. Futuristic or historical locations could be conjured up with the minimal use of sets and locations. Directors could make grass greener and skies bluer at the touch of a button. The most glaring on-set errors could be corrected during post-production, to the extent that effects artists commonly complained that careless filming methods were causing unnecessary digital work at a later stage of production.

At the end of the century, George Lucas released *Star Wars: Episode I The Phantom Menace* (1999), the long-awaited addition to the *Star Wars* saga, which had sparked a big bang in special effects 20 years before. Taking advantage of the progress in digital effects technologies that had developed largely as a result of his own earlier successes, Lucas produced a landmark movie in which otherworldly locations and fully interactive characters were created almost entirely within the computer. Lucas even experimented with digital video as a means of capturing images, challenging the supremacy of film as the movie-making medium for the first time since its invention.

For the first time in the 100-year history of the cinema, film-makers were able to put literally anything that they could imagine onto the screen. It remained to be seen whether such power would truly benefit the art of cinematic storytelling.



THE 2000s

Hollywood entered the new century in a position reminiscent of that enjoyed by film-making pioneers exactly 100 years earlier. The extraordinary technological advances made in previous years meant that they had at their disposal powerful new image-making technologies that had been almost inconceivable just a few years earlier. The world waited to discover what wonders would be conjured to delight them.

The start of the decade saw several big-budget, effects-laden successes that spawned sequels and imitators that would dominate our screens for the following five years. Landmarks among these were a trilogy of trilogies in the form of the *Star Wars*, *Matrix* and *Lord of the Rings* films. Each movie pioneered new effects techniques and worked hard to amaze us with increasingly elaborate imagery. A remarkable series of movies that would span the decade also began in 2001 with the first adaptation of J.K. Rowling's *Harry Potter* books. These epic films with superb visual effects have been produced at a rate of one a year and have been phenomenally popular, taking almost \$1 billion per film at the box office.

The ability to create any image desired, particularly scenes of mass destruction, prompted a clutch of movies based on the adventures of comic-book superheroes. Spider-Man, the Hulk, the Fantastic Four, Hellboy and the X-Men, among others, made the leap from page to screen with varying degrees of critical and commercial success.

The popularity of *Gladiator* (2000) seemed to show that 'sword and sandal' epics, largely abandoned since the 60s, could again blow the dust off the history books to create cinematic gold. Digital technology was used to conjure vast armies and spectacular historical vistas in films such as *Troy* (2004), *Alexander* (2004) and *Kingdom of Heaven* (2005). But unlike their computer-generated armies, these films performed less than impressively in the battle of the turnstiles.

One reliable source of success remained the computer-generated feature film. Following its early triumphs with the *Toy Story* films (1995, 1999) and *A Bug's Life* (1998), Pixar again showed how solid storytelling, colourful characters and plenty of well-timed comedy could be mixed with breathtaking digital animation to create sure-fire hits with *Monsters, Inc.* (2001), *Finding Nemo* (2003) and *The Incredibles* (2004). Meanwhile, DreamWorks had a monster success with two films starring a lovable green ogre (*Shrek*, 2001 and *Shrek 2*, 2004) and again with a zoo full of pliable animals in *Madagascar* (2005). The almost unbroken record of success for these films has encouraged many other companies to establish their own CGI animation divisions. Twentieth Century Fox, Disney, Sony Pictures Imageworks and Lucasfilm, among others, have invested heavily in the format.

Budgets in the first half of the decade continued to rocket. Due largely to their reliance on extravagant visual effects and big-name stars, the so-called 'tent-pole' movies, genetically engineered to prop up cinema-going in the important holiday seasons, cost an average of \$120 million. The biggest productions could make the studios dig even deeper into their pockets; *Terminator 3: Rise of*

ABOVE: Increasingly sophisticated digital effects made it possible to successfully simulate natural phenomena including rain, snow and storms in movies such as *The Day After Tomorrow* (2004).

RIGHT: Digital technology allowed film-makers to paint on the largest possible canvasses. *Gladiator* (2000) was the first of a series of historical dramas that re-created the past on a scale that the makers of 60s epics could only dream of.

BELOW: By the beginning of the new century, digital effects had made anything possible in the movies, including the aerial antics of superheroes such as Spider-Man. Smash-hit sequel *Spider-Man 2* (2004) featured exhilarating scenes of computer-generated characters fighting in digital city environments.



2000s PROFILE ROBERT ZEMECKIS



Chicago-born Robert Zemeckis (1952-) was a keen filmmaker when still at high school. While studying film at USC his student movie *A Field of Honor* brought him to the attention of Steven Spielberg (<39). Spielberg helped Zemeckis and his writing partner Bob Gale get a studio deal for one of their screenplays, a project which later became Spielberg's World War II comedy *1941* (1979).

Zemeckis made his feature-directing debut in 1978 with *I Wanna Hold Your Hand*, followed by *Used Cars* (1980), both written with Gale and made in association with Spielberg. Zemeckis hit the big time with his next film, *Romancing the Stone* (1984), a large-scale action-adventure starring Michael Douglas and Kathleen Turner.

After trying to sell their next idea to a number of unimpressed executives, Zemeckis and Gale found themselves working with Spielberg again to produce their ingenious sci-fi action-comedy *Back to the Future* (1985). The film was a massive hit, spawning two elaborate sequels and allowing Zemeckis to employ increasingly sophisticated visual effects to tell his stories.

Back to the Future saw Zemeckis's first collaboration with visual effects supervisor Ken Ralston (299>), who would become a vital contributor to all his future films.

Who Framed Roger Rabbit (1988) was a technically ambitious combination of live action and cartoon animation that dazzled audiences worldwide. *Death Becomes Her* (1992) saw Zemeckis relying again on cutting-edge effects to tell his story. This time the fledgling technology of digital image manipulation was used to conjure the film's comically gruesome events. Zemeckis next made *Forrest Gump* (1994), a box office smash that starred Tom Hanks and some technically astonishing, often subtle effects work. Zemeckis won an Oscar for his direction.

With films such as *Contact* (1997), *What Lies Beneath* (2000), *Castaway* (2001) and *The Polar Express* (2004), Zemeckis has continued to create strong, story-driven entertainment that uses pioneering visual effects both to dazzle the audience and underpin the narrative. He is indisputably one of the great special effects directors.





ABOVE: Entirely digital films continued to wow audiences of all ages. *Shrek 2* (2004) combined entertaining stories and loveable characters with new animation techniques to create one of the most popular CGI films to date.

the Machines (2003) smashed its way through a budget of \$170 million and *Superman Returns* (2006) swooped in with an estimated bill of \$250 million. The cost of hyping these films to the point where the movie-going public feels obliged to see them can add as much as half again to the overall bill.

The time taken to get movies off the storyboard and onto the screen began to diminish during this period. While projects might still spend several years languishing in development, once a film has been green-lit and vast sums are committed, it is expected to start earning its keep as soon as possible. Steven Spielberg, never one to linger over the making of his films, produced *War of the Worlds* (2005) in a dizzying 10 months from the first day of pre-production to delivery of the final cut.

The desire for films to make their money back quickly has been reflected in the shrinking time between a movie's theatrical premiere and its release on DVD and home video. *Star Wars: Episode III Revenge of the Sith* (2005), for example, was released in cinemas in mid-May and was on supermarket shelves by early November the same year. Rapid release for home viewing helps to beat piracy and quickly recoups production costs. It also allows films to piggyback their original marketing hype while it remains fresh in people's minds. At a time when box office revenues are faltering, studios now make most of their money from home entertainment. The theatrical run of a film therefore often serves as a marketing exercise to support its future retail release.

The need for movies to be completed quickly has changed the way that visual effects are created for a film. In previous decades the job of providing effects for a movie was typically awarded to a single vendor – with possibly one or two others supplying additional specialized services. Today's tight schedules mean that it is only possible for the largest of facilities to create all of the effects for a major film. Visual effects are now tendered out on a shot-by-shot basis to studios known for their expertise in particular areas. *Harry Potter and the Goblet of Fire* (2005), for example, employed no fewer than 10 companies to create its visual effects.

This system has helped create a tiered structure of effects houses. At the top are the biggest studios such as ILM, Digital Domain, Rhythm and Hues, and Sony Pictures Imageworks. These facilities employ hundreds of artists, possess vast computing networks, and have the resources to research and develop new technology. Such companies tend to be awarded the most difficult and expensive effects shots, often involving character animation or complex environmental scenes. Next are the medium-sized companies, typically employing 50–100 artists. These may do some original research and development but mostly use off-the-shelf technology to help them provide sophisticated work for major films or perhaps provide all of the shots for smaller productions. Finally there are the 'boutique'

2000s PROFILE PETER JACKSON



Growing up in New Zealand, Peter Jackson (1961–) made miniature war epics and James Bond spoofs with his parents' 8 mm camera. With what would become trademark resourcefulness, the budding auteur built his own equipment, made models, animated puppets and created gory make-up effects.

Jackson spent four years of weekends creating his first feature *Bad Taste* (1987), which was critically acclaimed and became a cult hit among horror fans.

Meet the Feebles (1989) was a gory, vile, and often hilarious puppet movie that strengthened Jackson's reputation and resulted in offers from Hollywood. But Jackson was determined to make films his own way and in his own country. Though shockingly violent and grisly, *Braindead* (1991) was well crafted on many levels, using superb miniature effects to recreate 1950s Wellington. *Heavenly Creatures* (1994) was the true story of two teenagers whose obsessive relationship drove them to murder. Slick and compelling, it was Jackson's most mainstream movie to date. The film's special effects requirements led Jackson to establish Weta, his own effects facility.

When Jackson and partner Fran Walsh were approached by Robert Zemeckis (<43) to write an

episode for his *Tales from the Crypt* TV show, Zemeckis liked the resulting script so much that he asked Jackson to direct a feature-length version. *The Frighteners* (1995) was disappointing commercially but did showcase Jackson's growing mastery of visual effects and complex action.

The world was astonished by the size, scope and visual splendour of Jackson's next offering. With *The Lord of the Rings: The Fellowship of the Ring* (2001) Jackson achieved what many had thought impossible: a version of Tolkien's classic that satisfied both fans and a general audience. Spectacular and innovative effects helped make this and its two sequels among the most commercially successful films ever. The films earned Jackson and his collaborators a clutch of Oscars and established Weta as one of the world's leading effects facilities.

In 2005 Jackson released *King Kong*, the fulfilment of a long-term dream to remake his boyhood favourite. Praised by critics, though less commercially successful than predicted, the movie was nevertheless an outstanding effects achievement with superb miniature and digital environments and a breathtakingly emotive central performance from an all-CGI Kong.



ABOVE: Almost three decades after the original *Star Wars*, George Lucas's *Revenge of the Sith* (2005) displayed digital visual effects of extraordinary sophistication that would have been unimaginable to a previous generation. This battle scene was made massively complicated by setting it just above the surface of a planet, so that atmospheric effects such as smoke, fire and water were required to obey the laws of gravity.

companies. These tend to employ perhaps only a dozen artists using a few modest computer workstations. These companies might be hired to produce one or two stand-alone shots for a big feature film – perhaps a digital matte painting, for example. They may also do the more mundane and less visible effects work such as relatively simple wire-removal shots.

The astonishing developments in digital visual effects technology mean that top-quality work can now be produced by any talented person with the money to buy the necessary off-the-shelf software and hardware. For less than \$10,000 a 'desktop studio' can be used to create imagery that the biggest companies would have struggled to deliver less than a decade ago. It is now possible to rent an office, lease workstations, recruit artists and be ready to create feature-film effects within a few months. Some companies have even been established solely to provide the effects for a single film, such as *World of Tomorrow*, which was set up to produce over 1,000 shots for the modestly budgeted *Sky Captain and the World of Tomorrow* (2004). However, the biggest studio productions can still spend huge sums on effects, particularly if any significant research and development is required. As much as 40 per cent of the \$200 million spent on *Spider-Man 2* (2004) was lavished on its Oscar-winning effects work. Studios consider this investment a worthwhile risk, however. Nineteen of the top 20 box office earners have been effects-reliant productions.

Visual effects remain a significant part of the marketing for any major movie. Effects vendors are typically obliged to finish their most spectacular shots early enough for them to be used in advance trailers and, increasingly, internet sneak previews. They will also find themselves demonstrating their techniques as part of the movie's DVD bonus features.

It is now no longer a case of whether any visual effect is possible but of how quickly and economically it can be done. Today much effort is put into developing systems and production 'pipelines' that allow spectacular work to be achieved more efficiently. Like many other industries, outsourcing to foreign companies is becoming more common. Countries such as Korea and India have rapidly developing visual effects sectors and are likely to become major competitors to the traditional vendors in the US and Europe.

Whether or not digital technology has enhanced the *art* of film-making is open to question. But there can be no doubt that, with access to such powerful tools, directors now have the means, more quickly and perhaps economically than ever before, to produce the film that they have conceived in their mind's eye. Given a computer and some powerful software, it can only be imagined what wonders Georges Méliès might have produced.



ACADEMY AWARDS

On one night every year, over a billion people around the world tune in to watch the Oscars, the most glamorous and anticipated event in the Hollywood calendar.

For weeks beforehand, the world's media will speculate about which performer, director or movie deserves to walk away with the treasured trophy. Less often discussed in this flurry of excitement, however, are the more technical nominations such as cinematography, sound editing and visual effects. Yet the list of past winners in these categories provides a fascinating insight into the development of film-making skills and technology through the decades.

The Academy of Motion Picture Arts and Sciences (AMPAS) was established in 1927 and held the first of its award ceremonies on 16 May 1929 at the Hollywood Roosevelt Hotel. Guests paid \$5 per ticket to attend a banquet followed by a ten-minute inaugural awards ceremony. However, that first ceremony had little of the drama and suspense that we associate with today's Academy Awards. With the results made public several weeks earlier, the evening was simply a formal occasion to present trophies to the winners. Their prize, the iconic golden statuette later nicknamed 'Oscar', was designed by MGM art director Cedric Gibbons, who would eventually win 11 of the awards during his career.

The first awards contained just 12 categories, compared with today's 25. Given the limited number of prizes in that first year, it is perhaps surprising to find the inclusion of an award for 'Engineering Effects'. The winner was the Academy founding member Roy J. Pomeroy (1892–1947), who had created a range of fires, crashes and explosions for the World War I flying epic *Wings* (1927).

However, it wasn't until the 11th ceremony in 1938 that the Academy again recognized the importance of special effects by giving a 'special award' to *Spawn of the North* (1937). This was for 'Outstanding Achievement in Creating Special Photographic and Sound Effects'. From then on an 'Achievement in Special Effects' category was included in each year's nominations, covering both photographic and sound effects with one award. In 1964 photographic and sound effects were separated into two distinct categories.

In addition to the regular competitive categories, the Academy also bestows occasional discretionary awards for particularly outstanding achievements. These have included an Academy Honorary Award to Walt

Disney in 1938 for *Snow White and the Seven Dwarfs* (1937), which was considered a 'significant screen innovation'. Charmingly, the animator was presented with one normal-sized Oscar and seven small ones.

The Academy also honours several classes of Scientific and Technical Awards to those who have created and developed innovative new film-making technology. These are chosen by a technical committee and awardees have included Dennis Muren (see panel) and Stuart Ziff for their creation of the Go-Motion animation system for *Dragonslayer* (1981), for example.

In 1995 AMPAS created a Visual Effects branch to select the films to be nominated for each year's Visual Effects Oscar. The chairman of the branch since its formation has been Richard Edlund, himself the recipient of multiple Academy Awards (79>).

'The Visual Effects branch is currently comprised of about 250 distinguished effects professionals who represent the many various disciplines of our craft,' states Edlund. 'Prospective branch members, except in exceptional circumstances, must have worked in a key creative position for at least eight years before being eligible to become members of the Academy.'

Edlund explains the process of selecting the films that are nominated for each year's Visual Effects Oscar: 'Every year a Steering Committee of forty members will be charged with the selection of seven movies which contain the most outstanding visual effects.' The selection process proceeds as follows. 'We begin by reading off the titles of the movies that have qualified for Academy consideration – usually about 250 films. We then select those which are considered to have significant special effects work in them, usually resulting in a list of perhaps forty movies. We then discuss these in more detail, our objective being to narrow the field down to a short list of less than twenty contenders. We then vote,' continues Edlund. 'Each Committee member is asked to complete a ballot on which they list what they consider the ten best visual effects efforts in order of merit. The accountants of Price Waterhouse Coopers then tabulate those votes and the seven top films are officially announced the next day.'

Letters are then mailed to the producers of the seven productions, inviting them to formally submit their movie for consideration in the form of written material and a demonstration reel of visual effects, not to exceed 15 minutes.

'These producers are asked to select up to four individuals who most contributed to the visual effects on each film,' Edlund continues. 'These are

PROFILE DENNIS MUREN



Fascinated with the creation of moving images from an early age, Dennis Muren (1946–) began making films with an 8 mm cine camera at the age of 10. Before long Muren was experimenting with techniques such as stop-motion and rear projection.

Muren studied business at California State University but invested his spare time in the production of an ambitious science fiction film, *The Equinox*. The picture was later bought by a distributor who replaced almost everything except the impressive effects before releasing it in 1970.

Realizing that special effects were his talent, Muren spent several years shooting TV commercials before finding work at Industrial Light and Magic as second cameraman on *Star Wars* (1977), specializing in stop-motion and miniature photography. After working with Douglas Trumbull (1942–) to film the mothership sequences for *Close Encounters of the Third Kind* (1977) and a stint on TV's *Battlestar Galactica*, Muren returned to ILM as director of effects

photography for *The Empire Strikes Back* (1980).

Muren is currently senior visual effects supervisor at ILM, having overseen the creation of groundbreaking work for many important special effects films. In 1989 he took a one-year sabbatical to learn about computers and digital technology. Since then he has supervised some of the most important digital visual effects films including *The Phantom Menace* (1999), *Hulk* (2003) and *War of the Worlds* (2005).

Muren has won more Oscars than any other living individual, with Awards for his work on *The Empire Strikes Back* (1980), *E.T. the Extra-Terrestrial* (1982), *Return of the Jedi* (1983), *Indiana Jones and the Temple of Doom* (1984), *Innerspace* (1987), *The Abyss* (1989), *Terminator 2: Judgment Day* (1991) and *Jurassic Park* (1993). He was also awarded a technical Oscar for his contribution to the development of Go-Motion for *Dragonslayer* (1981). In 1999 he became the first effects artist to be honoured with a star on Hollywood's Walk of Fame.

ABOVE LEFT: William A. Wellman's *Wings* (1927) was the first film to win an Oscar for its special effects. At the first-ever Academy Awards ceremony, the film was presented with a statue for the 'Engineering Effects' used to re-create the aerial battles of World War I.

BELOW: At the 78th Academy Awards ceremony in March 2006, Joe Letteri, Brian Van't Hul, Christian Rivers and Richard Taylor proudly display their Oscars, received for Achievement in Visual Effects for *King Kong* (2005).



the people who will actually receive an Oscar should their film win. This in itself is always a tough decision since in the digital age hundreds of people will often contribute to the effects in a film!

'Finally, we have what we call the "bakeoff", the night when the entire branch comes together to view the reels and to then nominate the three films that will be in competition on Oscar night.'

The bakeoff takes place in the Academy's Samuel Goldwyn Theatre in Beverly Hills. The 250 members of the Visual Effects branch and their guests gather to view submissions from the teams behind the seven selected movies. A line forms early for those anxious to get a good seat as this widely anticipated event is also open to all members of the visual effects community – on a first come, first served basis.

The programme begins with the first visual effects supervisor, who gives a five-minute presentation followed by up to fifteen minutes of clips from the finished film. Finally, the team of four come onstage and are allowed up to three minutes to answer any questions. 'Twenty-three minutes doesn't seem like much time to persuade people that you deserve a nomination,' admits Edlund. 'But we do have to pack seven presentations into one meeting. It's a great evening all round, and a rare chance for so many people from the effects industry to meet and catch up.'

Asked about what makes the effects in one film more deserving than those in another, Edlund can only speculate: 'We don't have any written criteria by which we must judge the effects in each film – I don't know if that would ever be possible. How could you compare a sea battle from *Master and Commander* with the animation of Gollum, for example? These are two completely different challenges that have been successfully met in very different ways.'

At the end of the bakeoff, the members of the Visual Effects branch will vote to determine which three films will be nominated for the year's Academy Award: the three finalists will then be listed on the final ballots which will be cast by the 6,000 Academy members who vote in each of the major categories.

On Oscar night a small band of special effects professionals will attend one of the most spectacular ceremonies to be held anywhere in the world. Technicians and artists who rarely get away from their cameras or computers find themselves sharing the red carpet with some of the most famous names on the planet.

It is recognized that an Oscar win can transform the career of an actor and massively improve a film's box office performance. But what does winning an Academy Award for Visual Effects mean for those involved? 'I'm not sure if winning an Oscar for Visual Effects would make a great deal of difference at the box office,' muses Edlund, 'though just printing how many Academy Awards a film has won on the posters helps enormously. But winning an Oscar for Visual Effects can really help to establish an artist's name and boost their career. In the end, to receive a nomination or an Oscar is the ultimate reward, because you know that your own peers – those who are in the trenches with you and who really understand what you have achieved – have judged you. That's what makes that golden statue such a treasured goal in our industry.'

See appendix for a full list of Visual Effects Academy Award winners.

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FRONTISPIECE: *King Kong* (2005), Weta's extraordinary creation.

BELOW: Special effects have played a prominent part in many movies during cinema's first century: *Santa Claus* (1898), *T2: 3-D – Battle across Time* (1996), *Manslaughter* (1922), *When Worlds Collide* (1951), *The Living Daylights* (1987), *The Godfather* (1972).

