

## Film Stock

The world's first and longest lived moving image carrier was the combination of two technologies, and the culmination of a process of research and development that took place throughout the nineteenth century. Photosensitive emulsions – that is, chemical compounds that are capable of recording a permanent image through exposure to light – evolved gradually since Thomas Wedgwood first saturated a leather canvas with silver salts in the early 1800s. The first film base – a flexible and transparent solid which offers the mechanical tolerances necessary to enable the images to be exposed and projected in rapid succession, thereby creating the illusion of a moving image – was developed over a similar timescale. Film stock in roughly the form we know it today was first manufactured by George Eastman's Kodak company in New York in 1889.

The most widespread film format to be used during the following century was standardised, effectively by market forces, over the following decade. It was 35mm wide and perforated along each side. Each frame occupied a space adjacent to four perforations, producing an aspect ratio (ratio of height to width) of approximately 1:1.33. It was soon discovered that a shooting and projection speed of 16 frames per second was necessary to reproduce the illusion of movement without flicker, though speeds were not standardised until the conversion to sound in the late 1920s.

As with all other areas of production, non-fiction filming took place almost exclusively on this format until the 1930s. A number of smaller gauges were introduced during the intervening period, intended mainly for amateur use. Three of these formats achieved widespread sales of stock and equipment: 9.5mm, introduced by Pathé in 1922; 16mm, introduced by Eastman Kodak in 1923; and 8mm, introduced by Eastman in 1932. Of these, 16mm would eventually make the transition to a professional medium: in the post-war period it was used extensively for documentary, experimental film and television news.

The main developments in black-and-white film stock during the silent period were improvements to its speed, chromaticity and grain structure. The speed at which the emulsion registers an image in response to exposure (as distinct from the speed at which it moves through a camera or projector) determines the extent to which shooting in natural light is possible, and was therefore a significant factor in the production of documentary and other non-fiction genres. The earliest stocks had required bright, direct sunlight and the use of wide lens apertures in the absence of any artificial light. A number of developments in the late 1920s significantly increased the creative possibilities available to documentary makers working with film, notably the introduction of higher speed emulsions (stocks equivalent to EI50 in today's terms were in mainstream use by the end of the decade) and of panchromatic film. This was sensitive to the entire visible colour spectrum, as distinct from the orthochromatic stocks it replaced, which could only 'see' red and green. The newsreel industry was one of the first widespread users of panchromatic stock.

Colour film systems had been the subject of research and development almost as long as film itself. Although they were used on a limited scale before the 1930s, the early methods all fell by the wayside due to a combination of flawed technology, cost, and compatibility with existing industrial practices. The earliest feature-length non-fiction film to have been made using a method which attempted to capture and reproduce colour photographically was probably *Britain Prepared* (UK 1915), a World War I recruitment propaganda film using the two-colour Kinemacolor process. The first successful three-colour (i.e. able to reproduce the entire visible colour spectrum) systems to be mass-marketed were Dufaycolor, introduced in 1934, and Kodachrome, introduced in 1935. Both were reversal systems (which made mass-duplication difficult, expensive and of poor quality), and therefore sold mainly for amateur use. The significant quantity and breadth of amateur colour film produced during the 1930s and '40s has been the subject of significant interest from television documentary makers at the start of the 21<sup>st</sup> century, notably in Trans World International's 'in colour' series, which has been broadcast worldwide. However, despite one or two documentaries shot on Kodachrome and then printed using the Technicolor process (e.g. *Western Approaches*, UK 1943, dir. Pat Jackson), colour was not used on any significant scale for non-fiction until the 1950s, when the arrival of dye coupler emulsions made colour film cheap and easy to duplicate.

The two principal developments in the immediate post-war period were the replacement of cellulose nitrate by cellulose triacetate as the standard base (the former was highly inflammable, which had been a significant obstacle to its use outside studios) and the growth of 16mm as a professional format, prompted mainly by the needs of television. A new generation of documentary makers represented by figures such as Lindsay Anderson, D.A. Pennebaker and Frederick Wiseman embraced the portability of 16mm cameras and sound equipment, and the emergence of new, high-speed film stock to produce work which would have been logistically impossible in 35mm.

Although the speed, grain density and (in the case of colour) tonal range of film stocks in all the remaining formats have continued to improve, the use of film as an origination medium by documentary makers has been in an overall steady decline since the 1980s. Videotape technology has become cheaper and more versatile, and the predominant outlet for documentaries continues to be television, in which the superior image quality of film is considered less important. Eastman Kodak has discontinued the manufacture of a number of 16mm stocks since 2002 (most notably the Ektachrome reversal film, a mainstay of TV news origination in the 1970s and '80s), and the film stock manufacturer Ilford went into liquidation on 24 August 2004. It seems likely, therefore, that by the end of the 00s, the only remaining uses for film on any significant scale will be in the 35mm format for studio origination and archival preservation.

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## **Great White Silence, The** (UK 1924, dir. Herbert Ponting)

*The Great White Silence* was the first feature documentary version of the footage shot by the photographer and cinematographer Herbert Ponting (1870-1935) during the failed attempt to reach the South Pole on foot by a team led by the naval officer and explorer Robert Falcon Scott in 1910-12.

Scott was the best known of a group of Polar explorers who mounted expeditions on foot across the Arctic and Antarctic continents during the late Victorian and early Edwardian period. The 1910-12 expedition – his last, as it would turn out – followed a previous unsuccessful attempt to reach the Pole in 1901-04, and voyages by others including his arch-rival Ernest Shackleton and the Australian Sir Douglas Mawson. Their work coincided with the rapid growth of still photography as a mass medium and of cinema as industrialised entertainment, hence the reason both Scott and Shackleton enlisted the services of cameramen on their later journeys. Fundraising was always a problem, and advance sales of the distribution rights for both still and moving images provided much-needed income (it took Scott over a year to raise the £40,000 needed to finance his attempt on the Pole).

Scott's second voyage was an unmitigated disaster. His colleagues were largely inexperienced and the party relied heavily on untested motorised sledges, all of which broke down at an early stage in the expedition. Scott and his party of five colleagues had to manually haul their supplies almost 800 miles from Ross Island to the South Pole. They achieved this on 18 January 1912, only to discover that Scott's rival, the Norwegian Roald Amundsen, had got there first. Due to a combination of exhaustion and unusually bad weather on the return trip, Scott's party became stranded and all eventually died.

Despite the expedition not only having been a failure, but one which could have been easily foreseen and prevented (as demonstrated by Amundsen's having reached the Pole with relatively little difficulty), Scott was celebrated as a national hero when news of its outcome reached Britain in February 1913. A memorial service held the following month characterised Scott's attempt as a 'heroic failure', rhetoric which would characterise the commercial exploitation of Ponting's footage over the following two decades.

Herbert Ponting was born in Salisbury in 1870 and emigrated to California in the early 1890s. Within a decade he had gained a formidable reputation as a documentary photographer, largely as a result of his visits to Japan in 1902-05. It was on the strength of this that he persuaded Scott to hire him to photograph and film the 1910-12 expedition. Ponting was not among the group of five who died on the return march from the South Pole, and on his return to London he devoted the remainder of his life to publicising the work of Scott through the medium of his photographs and films. He presented over a thousand lectures during the following years, illustrated by both slides and film; and in 1921 published *The Great White South*, the first of many illustrated books documenting Scott's final expedition.

*The Great White Silence*, released in 1924, was the first of three stand-alone feature versions of Ponting's edited film footage. The continuity is clumsy and relies heavily on intertitles, and the film was not shown widely (and nor is it readily available for viewing today). The second version, *90° South* (1933), featured recorded music and a synchronised commentary by Ponting. It is far more fluently edited and uses animated diagrams to recount the details of Scott's final march (on which, given that Ponting did not take part, no actual footage was shot). A shortened version was released in 1936 as *The Story of Captain Scott*, shortly after Ponting's death the previous year.

The two decades spent by Ponting in tirelessly promoting his Scott footage undoubtedly established the 'heroic failure' genre as a mainstay franchise in British documentary and realist cinema, especially in depicting military conflicts with negative outcomes. Its influence can be seen in settings as diverse as the politically controversial account of Edith Cavell's execution in *Dawn* (UK 1927, dir. Herbert Wilcox), and the Arnhem landings in Brian Desmond Hurst's reconstruction, *Theirs Is the Glory* (1946).

The image of Scott as the gallant loser was further cemented in a highly budgeted and publicised biopic (shot in Technicolor and featuring music by Ralph Vaughan-Williams), *Scott of the Antarctic* (UK, 1948, dir. Charles Frend). Though a fictionally recreated account of Scott's last expedition the film appears to have been based very heavily on Ponting's work, including staged versions of some of the more memorable scenes in both *The Great White Silence* and *90° South*. With this film Scott's final expedition took its place alongside the Charge of the Light Brigade or the battles of Trafalgar and The Somme as a distinct strand in the British cultural memory, which the historian Jeffrey Richards argues is characterised by an emphasis on self-belief and on trying rather than succeeding. It is perhaps for this reason that *Scott of the Antarctic* was a box-office failure in the US. Interestingly, the Ealing version does explicitly note a number of key errors made by Scott as having contributed to the eventual disaster (most notably the decision to rely on motorised sledges), while the Ponting films give a more simplistic impression of a visionary battling elements beyond his control.

In this respect, therefore, both *The Great White Silence* and *90° South* have been seen as overtly propagandist in the context of Ponting's largely unproblematic and sycophantic depiction – at times bordering on worship – of his protagonist, and the hindsight of what we now know to be a number of serious errors on Scott's part. That having been said, it must be borne in mind that Ponting (and, for that matter, his counterpart on the 1914-16 Shackleton expedition, Frank Hurley) was primarily a photographic ethnographer by trade, and did not approach film-making with the same institutional and cultural baggage as Grierson's generation of documentary-makers and the 'social realist' tradition of British film-making which followed subsequently.

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## Ministry of Information – World War I

The significance of the first Ministry of Information in relation to documentary film production is largely in the precedents that it set for the activities of its better known successor during the 1939-45 conflict. Although it was short-lived and its immediate influence on the British film industry and culture was minimal, its establishment marked the first time in which the British government had systematically produced (either directly or by commissioning the private sector) non-fiction films with stated propaganda objectives.

The Ministry had its origins in the War Propaganda Bureau (WPB), established by David Lloyd George (then Chancellor of the Exchequer) shortly after the war broke out and headed by the Liberal MP Charles Masterman. The Bureau's early efforts focused primarily on the production of war propaganda through such media as literature, drama and fine art, and to this end enlisted to co-operation of cultural celebrities such as Rudyard Kipling, Thomas Hardy, Siegfried Sassoon and Paul Nash. Film did not figure prominently on the WPB's list of priorities – in fact, the most immediate effect felt by British filmmakers in the aftermath of war breaking out was the imposition of widespread censorship on what had been a rapidly growing newsreel sector.

The film industry lobbied hard for a more prominent role in the government's propaganda initiatives, and partly as a result of this the War Office Cinematograph Committee (WOCC) was formed. The event which kick-started the government into taking film seriously was the release of *Britain Prepared* in the winter of 1915, a three-hour compilation of actuality footage consisting of scenes including armaments manufacture, the training of armed forces personnel and naval manoeuvres. It was produced and directed by Charles Urban, the pioneer filmmaker and inventor of the Kinemacolor process. Kinemacolor was used in some of the *Britain Prepared* footage, making this film the first British feature-length production to include photographically recorded colour (though the Kinemacolor material is no longer extant). Though the film was produced and distributed with private capital, *Britain Prepared* was made with the co-operation of the WPB and several other government departments, and can therefore be considered the first 'official' propaganda film ever to be made with the direct involvement of a British government.

Partly as the result of *Britain Prepared*'s successful release, two 'official' cameramen – Geoffrey H. Malins and J.B. McDowell – were appointed by the War Office, and by the spring of 1916 were operating at the Western Front along similar lines to the 'official' artists and writers. The impact of moving image as propaganda was dramatically proved when their feature documentary *The Battle of the Somme* (1916) was released in Britain in the immediate aftermath of the battle. It is estimated that some twenty million tickets were sold, and the extent of its box-office success established cinema as arguably the most dominant mass-medium to represent the events of the war to the British public.

*The Battle of the Somme* is also notable for having precipitated a debate over the extent to which cinema newsreels and documentaries should represent military defeat and loss and life while a conflict is in progress. This debate took place within official circles, the film industry and beyond. It included a notable series of letters to *The Times*, some of which argued that the inclusion of shots showing dead and dying casualties risked undermining morale, while others pointed out that the ‘over the top’ scenes could clearly be seen to have been faked and therefore undermined the film’s effectiveness as propaganda. The relationship between realism and the effectiveness or otherwise of propaganda was one which would be revisited many times by Allied and Axis film-makers during World War II.

While *The Battle of the Somme* had used footage which had been filmed under official sanction and released by the WOCC for the purpose, its editing and distribution had been undertaken by the British Topical Committee for War Films, a lobbying group established by the newsreel (or ‘topical’ as they were termed in those days) industry and chaired by Urban in order to boost the role of that sector in producing war propaganda. The central role of the newsreel in the remaining two years of the war was confirmed when, in May 1917, the War Office entered into an exclusive agreement with the owners of the *Topical Budget* newsreel, temporarily renaming it the *War Office Official Topical Budget* for the remainder of the conflict. In addition, Malins and McDowell produced two more ‘big battle’ spin-offs following *The Battle of the Somme: The Battle of the Ancre* (January 1917) and *The German Retreat and the Battle of Arras* (June 1917).

After Lloyd George became Prime Minister in December 1916, the production of all forms of propaganda was gradually consolidated, a process which culminated in the formation of a full-scale Ministry of Information (MOI) in March 1918, under the direction of the Canadian newspaper proprietor Lord Beaverbrook (formerly Max Aitkin). The MOI took over the functions of the WPB and the WOCC in relation to film. During the eight months of its existence it oversaw the production of the *War Office Official Topical Budget* and produced or sponsored a number of military instructional films (e.g. *Anti Aircraft Guns – France* and *Demobilisation Film*) and propaganda shorts (e.g. *Women’s Work on Munitions of War*) for general distribution.

The MOI was disbanded immediately following the end of the war, in November 1918. In itself it did not play a major role in the evolution and practice of film propaganda. Its establishment marked the culmination of a learning curve which had begun with private-sector approaches to a sceptical government in 1915, and at the close of the First World War it represented a prototype for the next one. When war broke out again in September 1939, the lessons had been learnt and the MOI was reformed almost immediately. Within a few months, the infrastructure and objectives in regulating the private sector and producing the government’s own ‘official’ film output were in place, a process which had taken almost three years the first time.

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## Pathé (UK)

The main significance of Pathé's UK operation is that this company produced the earliest and longest-lasting newsreel to be regularly released in British cinemas. There were also a number of cinemazine series and individual non-fiction films made by Pathé's UK unit.

The Pathé company has its origins in the two decades between the Lumière Brothers' Paris screening on 28 December 1895 (believed to be the first successful projection of moving images to a paying audience) and World War I, during which the France dominated the global film industry. The entrepreneur Charles Pathé had been dealing in film-related equipment (notably pirated versions of Edison's Kinetoscope) since 1895, but the birth of the Pathé empire proper came in December 1897, when he formed a partnership with a wealthy French industrialist and began manufacturing film stock. Along with the other corporate giants of French cinema, Gaumont and Éclair, Pathé generated most of its revenue from hardware sales and laboratory services during the first decade of its existence. However, all three firms gradually moved into film production, and in 1908 the *Pathé Fait-Divers* began to be released, which is believed to have been the world's first newsreel in the generally accepted sense of the word.

Pathé had sold his products and services in Britain since the early part of the decade, and in 1910 he decided to export the newsreel, too. He established an office in London and took on a team of cameramen and editors, and in February 1910 the *Pathé Animated Gazette* released its first issue. In the period before World War I, the average length of a typical newsreel was 300 feet (approximately five minutes) and issues were released weekly. This had risen to 700-foot bi-weekly editions by the early 1920s, a format which became established as the industry norm for the remainder of the newsreel's life as a mass-medium.

Early Pathé cameramen, notably Jock Gemmell and Jack Cotter, who later became prominent figures in the 'newsreel wars' of the 1930s, quickly established a reputation for delivering high-quality location footage from a range of topical events and issues. World War I saw the infrastructure of all the major newsreel companies pooled under the auspices of the War Office Cinematograph Committee (between October 1915 and February 1919), with footage taken at the European fronts being made available to the newsreel companies and government film-makers. After the war the 'Animated' was removed from Pathé's title, making it simply the *Pathé Gazette*, a title which would remain until the newsreel's next relaunch in January 1946. In addition to its core newsreel, other Pathé releases included the cinemazines *Pathé Pictorial* (1918-69) and *Eve's Film Review* (1921-33), the latter marketed specifically to female audiences. Pathé was also the only newsreel to regularly include colour footage during the silent period, releasing a number of fashion and sport-related items in the *Pictorial* using the Pathécolor stencil process.

The conversion to sound saw the British newsreel industry consolidate into five major production companies, with many of the smaller ones (most notably *Topical*

*Budget*) being forced out of business by the increased costs. Those which remained by the middle of the decade were Pathé, Gaumont-British, British Movietone (owned or controlled by British film or print media interests), British Paramount and Universal Talking News (offshoots of their respective US operations). The 1930s saw intense competition between them over the speed and exclusivity with which footage was released, especially coverage of prominent sporting and ceremonial events. The decade was also characterised by extensive and wide-ranging political censorship of practically everything which was shown in British cinemas. Although newsreels were the only films which did not have to be vetted by the British Board of Film Censors (BBFC), the Home Office maintained an effective system of informal control, and the two most widely shown newsreels (Gaumont-British and Movietone) also had close links to the political establishment. The result is that newsreels rarely covered politically or ideologically contentious issues and virtually never criticised the government of the day: the bulk of their output consisted of royal appearances, sport and other events which roughly fitted the definition of current affairs but which met cinema exhibitors' and the government's demand for apolitical entertainment.

World War 2 once again saw the newsreel industry being semi-nationalised, this time under the auspices of the Ministry of Information. A rota system was introduced for allocating cameramen to be attached to units of the armed forces, while the Ministry's Films Division was responsible for footage pooling and censorship. The role of the newsreel within the British mass-media also underwent a fundamental change, arising largely from their role as a public information provider on the progress of the war. This process reached its climax in April 1945, when all five newsreel producers independently made the decision to devote an entire issue to footage taken shortly after the liberation of the Bergen-Belsen concentration camp.

In the aftermath of World War II, Pathé's producer, Howard Thomas, made the decision to avoid a return to what he perceived as the banality of the 1930s and to follow the lead of the Documentary Movement, promoting a more discursive approach and encouraging the expression of political viewpoints (this put him directly at odds with Sir Gerald Sanger of Movietone, who sought an immediate return to the pre-war model and even argued against covering the 1945 general election at all!). To this end the *Gazette* was relaunched as *Pathé News* at the beginning of 1946. Typical of what Thomas had in mind is issue 46/60 (29 July 1946), *Germany's Food – The Truth*, which examined arguments for and against the British taxpayer continuing to commit a significant proportion of her GDP to maintaining occupied Germany. Thomas also founded the Pathé Documentary Unit, which produced a significant output of educational films for schools during the 1950s.

The 1950s and '60s witnessed the gradual decline of the British newsreel, as current affairs coverage shifted gradually to television and declining cinema audiences eroded the newsreels' income. Pathé was the penultimate of the 'big five' to cease production, releasing its last national newsreel to cinemas on 26 February 1970. However, the company remained in existence for a further three decades, exploiting

its 60-year archive by licensing footage to broadcasters and TV documentary producers. In 2002, almost a century after Pathé launched the first regular newsreel in Britain, the company achieved another 'first', publishing its entire surviving output as streamed digital video available from the Internet. It was taken over by ITN Archives the following year, which continues to market the Pathé material both as complete films and as stock footage.

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**South** (UK 1919, dir. Frank Hurley)

*South* is the best known and most widely shown version of the feature documentary compiled from footage taken by the photographer and film-maker Frank Hurley (1885-1962), during the 1914-16 attempt to cross Antarctica undertaken by a team of Polar explorers lead by the former merchant seaman Sir Ernest Shackleton (1874-1922). Its restoration by the UK's National Film and Television Archive (NFTVA), completed in 1998, has stimulated renewed interest and research in British polar exploration in general and Shackleton in particular.

The first decade of the twentieth century saw intense interest in Polar exploration, focused primarily on the race to reach the South Pole on foot between Shackleton's former colleague Robert Falcon Scott and the Norwegian explorer Roald Amundsen in 1910-11. The Scott expedition set a precedent which Shackleton's would follow, in that a celebrity photographer (Herbert Ponting) was hired to accompany the expedition and produce still and moving images for subsequent commercial exploitation. As the opening scenes of the Ealing dramatisation of the Scott expedition, *Scott of the Antarctic* (UK 1948, dir. Charles Frend), point out, fundraising was always a major problem for the Edwardian polar explorers. Advance sales of exploitation rights for photographs and film had proved to be an important source of revenue for Scott.

Although initially reluctant to do likewise, Shackleton was eventually persuaded to hire the Australian photographer Frank Hurley on the strength of his photographs and film (released in Australia as *Home of the Blizzard*) taken on the 1910-14 Douglas Mawson expedition. The Imperial Trans-Arctic Film Company was filmed to manage the exploitation rights, and the expedition eventually set off in July 1914.

In terms of its stated objective, the Shackleton expedition was, like Scott's, a complete failure. Their ship, the *Endurance* became trapped in pack ice some 80 miles from the Antarctic ice shelf, from where it was carried north by tidal currents for nine months before being abandoned on 27 October 1915 and crushed by the pack ice on 21 November. The events which then unfolded, however, provided Hurley with some spectacular material which formed the basis of the film as it was eventually released four years later. Footage of the *Endurance's* gradual destruction by the ice is one such example, and interest in the film was stimulated when details of Shackleton's spectacular rescue operation began to emerge. After abandoning the ship, a group of six crew members sailed a small wooden dinghy seventeen days and 800 miles across the storm-ridden Southern Ocean, eventually reaching the island of South Georgia on 10 May 1916. There then followed a two-day forced march across the island in order to reach its only inhabitants. With help from the Uruguayan and Argentinian navies Shackleton then organised a fresh expedition to rescue his remaining colleagues, including Hurley.

*South* is the edited version of Hurley's film as released in 1919, two years after the survivors' return to Britain. It performed moderately well at the box office, but suffered to a certain extent from the fundamental change in political climate which

had resulted from the events of World War I. This is clearly demonstrated in the opening intertitles to the film as released, which state that the expedition had set off ‘...one month after Shackleton had offered his ship, stores and all personnel to the cause of the country, only to be told that the authorities desired that the Expedition which had the full support of the Government, should proceed.’ Though the rescue operation was universally acknowledged to be an astonishing achievement and a vastly preferable outcome to that of the Scott expedition (which had resulted in several deaths), there was a school of thought which held that Shackleton’s abilities might have been more usefully deployed fighting the Kaiser than on yet another bungled Polar exploration venture. On the back of the release of Ponting’s sound version of the Scott footage, *90° South*, a subsequent version of Hurley’s footage was shown in 1933 with a synchronised commentary and music. The title says it all - *Endurance: The Story of a Glorious Failure*.

*South* remained out of circulation for almost 80 years after its initial release until it was restored from a wide range of surviving elements by the NFTVA. The archivists who worked on the project took several years to establish the correct running order of each shot and select the best quality extant elements from which to construct the version used to produce the new preservation master. The NFTVA finally released the film in new tinted and toned 35mm prints and a DVD with extensive contextualising material. The marketing of Caroline Alexander’s book on the expedition, published in the same year, was co-ordinated with that of Hurley’s film.

This raises the issue of the role moving image archives play in mediating our access to moving image heritage, especially in the area of non-fiction film where exposure through other means (e.g. broadcasts and retail video sales) is significantly lower. *South* was an obvious candidate for a major restoration, both from a technical standpoint (i.e. the techniques were available to enable high quality photochemical duplication from surviving elements, which themselves enabled the complete film to be reconstructed) and a cultural one. The pre-existing, almost mythological status of Captain Scott as established by Ponting’s footage and *Scott of the Antarctic* created a public interest in and a market for the polar exploration genre. The details of Shackleton’s spectacular rescue mission also ensured the newsworthiness of the restoration of the film, not to mention a revival of interest in Hurley’s career as a photographer. But it also illustrates the increasing tendency of national moving image archives to prioritise major projects around a restricted range of films, which some would argue is to the detriment of other titles which are of equal cultural importance but a less attractive marketing proposition.

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## Video

The term 'video' (from the Latin 'videre' – 'to see') refers to the means of electronically recording and reproducing the signals which can be reproduced as the images and sounds on a television display. Attempts to develop these technologies go back as far as television itself. The earliest example which is known to have been successfully demonstrated was the 'Phonovision' system. Developed by the British engineer John Logie Baird in the 1930s, this used modified audio recording technology to capture the broadcast signal from his electromechanical TV system as grooves in a record. It was only ever used experimentally, and there is no evidence that any recorded material was ever broadcast or captured live off air.

Regular television broadcasts began in 1941 in the United States and in 1946 in the United Kingdom, following their suspension during the Second World War. Throughout the 1940s and '50s the principal medium used for transmitting recorded material and for recording live broadcasts was 16mm film, which has been used extensively as an offline medium throughout the history of the television industry. The first 'telecine' devices consisted of modified film projectors fitted with a cathode ray tube camera to capture the image for broadcast, while the 'telerecording' (or 'kinescope' in US English) process exposed images onto film from a high definition monitor.

Magnetic tape had been developed and used extensively for audio recording and broadcasting by the Nazis since the 1930s, and this technology was subsequently developed and mass-manufactured in the United States in the immediate aftermath of the war. The tape consisted of a thin, flexible base (initially the same cellulose acetate as was used in photographic film, but subsequently polyester) onto which was coated a layer of iron oxide particles. When subjected to an electromagnetic force, the particles could be magnetised or demagnetised to represent a pattern of modulation. This could then be reproduced by passing the tape over a second 'head' which generated a modulating electrical current in response to the signal on the tape. Given the vastly greater signal bandwidth needed to store the video information, the development of magnetic video recording into a commercially viable technology happened almost a decade later than with audio.

One of the first successfully demonstrated prototypes was developed for the American singer and comedian Bing Crosby, who commissioned engineers to develop equipment to pre-record his performances in order to reduce the number of live broadcasts needed for different time zones. The Radio Corporation of America (RCA) produced a modified version some years later, while the British Broadcasting Corporation (BBC) developed its own prototype videotape recorder, the Visual Electronic Recording Apparatus (VERA), in 1957. The first internationally adopted videotape format was the one launched by the American Ampex corporation in the previous year, which used open-reel tape two inches wide and which passed a static head at a speed of 30 inches per second.

This first generation of mass-manufactured videotape technology was only used on any significant scale as a 'time shifting' device by television studios. Initially, videotape had two crucial advantages over film: a recording could be replayed instantaneously, and the tapes themselves could be erased and rerecorded without practical limit (tragically, this perceived advantage inadvertently resulted in a significant proportion of the world's television heritage from the 1960s and '70s being permanently lost). There were also some drawbacks: initially, tapes could only be played back on the actual machine that recorded them, and editing was difficult and cumbersome.

For these reasons videotape was not used on any significant scale for documentary production until the advent of the videocassette in the 1970s. The U-Matic (¾-inch) format, introduced by Sony in 1971, was the first to enter mainstream use among broadcasters and programme makers. Portable and rugged recorders became available, which did not require extensive technical expertise to operate. This development marked the beginning of 'electronic news gathering' within the television industry, a process which would ultimately cause the decline of 16mm film as an origination medium in television news and documentary production. This process was further accelerated by the advent of the 'camcorder' – a television camera and videocassette recorder housed within a single, compact, battery-powered unit. These were originally sold from 1984 for amateur use as a replacement for Super 8mm film, but as their versatility and ease of use became apparent, broadcast standard camcorders became an established technology within the television industry.

The emergence of digital videotape in the early 1990s further increased the versatility and image quality offered by the medium. Editing was now possible without any loss of signal quality (with videotape, editing is carried out by selectively copying content from one tape to another, hence the generational signal loss with analogue). The increased definition offered by the higher end digital formats has served to make video a genuine alternative to small gauge film in situations where large quantities of footage need to be shot on a limited budget, even for documentaries intended for theatrical release on film prints. Examples include *East Side Story* (Germany, 1998, dir. Dana Ranga & Andrew Horn) and *Buena Vista Social Club* (Germany/Cuba/US, 1999, dir. Wim Wenders), for which original footage was shot using the Digital Betacam format; and *Bowling for Columbine* (US 2002, dir. Michael Moore), which incorporated footage shot both on 16mm and digital video.

Even lower definition video formats and those intended for consumer and industrial use have had a significant impact on the role of non fiction in film and television culture. The broadcast of surreptitiously taken amateur footage shot on VHS, showing a racially motivated attack by Los Angeles policemen in 1991, is believed to have been a major cause of riots which took place shortly afterwards. The use of miniature cameras designed for CCTV and surveillance use is now routine practice by investigative journalists, with such footage being broadcast almost daily. While there are many who believe that video and other electronic moving image technologies will never match the quality of film, its lower cost and comparative

versatility has made video the medium of choice for the majority of documentary production, a situation which is likely to continue for the foreseeable future.

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