



A fascinating article by Dion Hanson of Dolby Laboratories, Chairman of the BKSTS Cinema Technology Committee, based on the 1997 Annual BKSTS Bernard Happé Memorial Lecture which Dion presented under the title *Fantastic Formats*. Bernard Happé was a Member, Fellow, and Past-president of the BKSTS and a member of the Technicolor team who played a great part in the development of film formats, including 70mm. *Fantastic Formats* is a visual experience giving the audience a chance to see some of the older formats they have only read about. Dion says that it is impossible to recreate in print, but this article is based upon the presentation, and provides useful reminders for the older members who can remember some of the developments taking place, and gives an excellent history lesson for those who are newer to the cinema sound scene. Thanks are due to Dolby who kindly sponsored the Bernard Happé Lecture.

The History of Sound in the Cinema

The 1997 Bernard Happé Memorial Lecture

Most people consider that sound movies were not invented until 1928 with the release of Warner's 'The Jazz Singer'. It is certainly true that this was the first notable film using sound, but we must go back to the invention of the cinematograph to realise that experiments were being carried out using sound as well as picture from the very beginning. Edison wrote in one of his papers " In the year 1887, the idea occurred to me that it would be possible to devise an instrument which should do for the eye what the

phonograph does for the ear, and that by a combination of the two all sound and motion could be recorded and reproduced simultaneously". Looking at diagrams and pictures of his early work certainly shows the inclusion of a phonograph to deliver sound with his pictures.

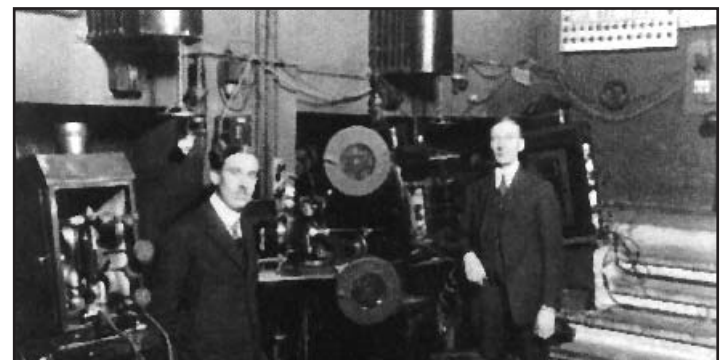
When reading books about the development of sound in the cinema it is not uncommon to think that the only research was being carried in America. This is far from the truth and it is often found that other inventors were actually in front of the Americans. Using Edison's phonograph Frenchman Auguste Baron synchronised sound with picture in 1896 and gave a demonstration at an exposition in 1900 featuring Sarah Bernhardt reading Hamlet. Both Pathe and Gaumont were also working on disk systems based on the phonograph.

Eugene Lauste and Lee De Forest were also working on sound systems to accompany pictures but their systems

were actually printing the sound photographically onto the film. However, it was not until the invention of the photocell by Hertz in 1887 and the 'Audion' valve by De

Forest in 1907 that film sound became a real possibility for large auditoria. In 1923 Petersen and Poulsen gave a successful demonstration of their sound on film system at the Palads Cinema Copenhagen. In America Fox set about securing the rights to a German sound on film system called Tri-Ergon which pre-dates De Forest's Phonofilm system, but it was Theodore Cases system which Fox adopted and called Movietone. Fox released several short films in 1926 with

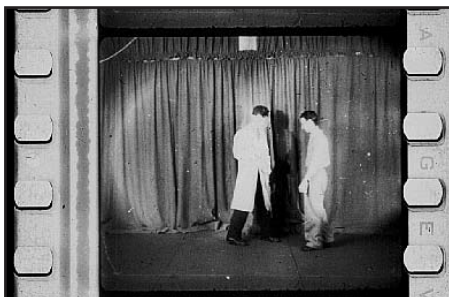
successfully synchronised a turntable with a film projector. They tried to interest Hollywood in the system but as the studios were doing good business with silent films they were not interested. Warner Brothers on the other hand were not making so much money since they did not own their own theatres and were finding difficulty in getting their product screened. Consequently they decided to give talking pictures a go. Signing exclusive contracts with Western Electric they



Forest in 1907 that film sound became a real possibility for large auditoria. In 1923 Petersen and Poulsen gave a successful demonstration of their sound on film system at the Palads Cinema Copenhagen. In America Fox set about securing the rights to a German sound on film system called Tri-Ergon which pre-dates De Forest's Phonofilm system, but it was Theodore Cases system which Fox adopted and called Movietone. Fox released several short films in 1926 with

christened the system Vitaphone and released their first sound movie 'Don Juan' in 1926. Having been completed earlier as a silent movie the sound track consisted of music and some synchronised sound effects, the screenings did what Warner's had hoped for, and that was to raise the public's interest in sound movies. 'The Jazz Singer' released in the following year was the film that set the industry talking, sound movies had arrived. Although sound on disc was the first successful commercial system, it only lasted for about two years, after which it was replaced by the more versatile 'Movietone' sound on film system. Whichever system the theatres chose they both relied on amplifiers and speaker horns to deliver the sound to the theatre, and so Bell Telephone Laboratories' manufacturing division Western Electric became synonymous with film sound. Not wishing to back the wrong system they developed their Universal Base which was able to replay both Vitaphone and Movietone films.

Even from these early days of sound on film companies were investigating the possibilities of stereo sound, one of the earliest such examples was in 1931 at Columbia's Studios in



Hayes, Middlesex. Alan Blumlein began using a twin microphone technique he had developed to record a stereo signal on to film in the same area taken up by the then standard mono optical track. These experiments were curtailed by the advent of war, which resulted in his untimely

death whilst he was researching the use of RADAR.

RCA and Disney were however, carrying out research in America into a stereo system specifically for Disney's now classic film 'Fantasia', the system ultimately taking the name 'Fantasound'. Using optical sound the three tracks were recorded on to a separate piece of film run in synchronisation with the picture. A fourth track on the sound film acted as a gain control for the three stage channels.

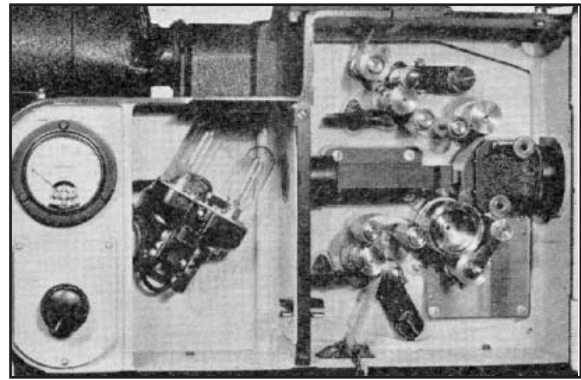
The Fantasound equipment was installed in only 14 theatres, causing quite a stir, before RCA had to concentrate all their production in to the war effort. Though no equipment survives the stereo mix is still preserved and was re-mastered for the films last re-release a few years ago.

Cinema audiences had to wait another ten years to hear true Hi-Fidelity stereo sound in the cinema in the form of Fred Waller's Cinerama system which was first screened at the Broadway Theatre in New York in September 1952. This used three 35mm projectors running in synch to create a

huge high definition picture covering the viewer's whole field of vision, along with a separate 35mm magnetic film strip

carrying seven channels of audio to surround the audience with sound.

Cinerama was doomed from the outset because of its

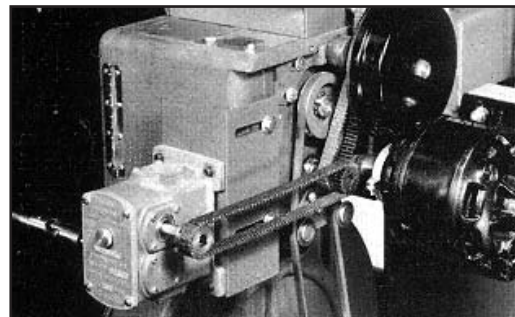


Fantasound equipment

cost and complexity, but it did show to the world the superior quality that could be obtained in the cinema that would never be available to its rival, television.

Warner Brothers in the meantime were experimenting with stereo images in the form of 3-D which they called NaturalVision, again to try and offer audiences that extra something that television could not. Their first film being 'Bwana Devil' in November 1952.

Warners' system used two

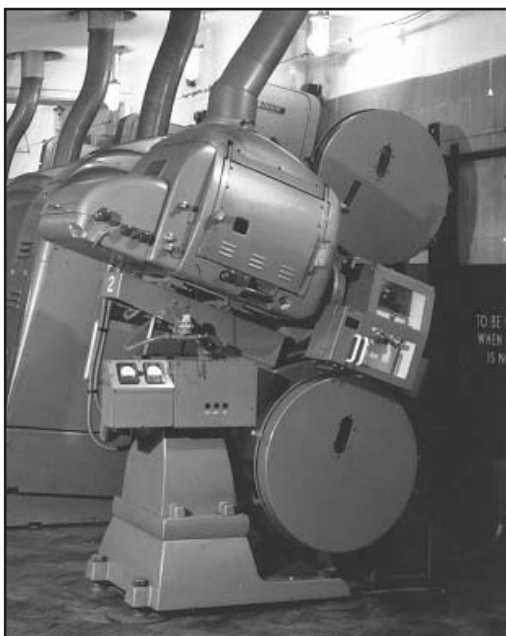


projectors mechanically locked together and running two copies of the same film, one for the left eye, and one for the right, and using polaroid filters



on the projectors to complement the polaroid glasses worn by the audience. The sound was again carried on a separate magnetic film. The screen channels were left, centre, and right, on the magnetic film, with the 'surround' or effects channel being carried on the optical track of the right projector. The optical track on the left projector being a mono back up or for use in theatres not equipped for stereo.

Film distributors were also searching for a system that would give the same effect as Cinerama but for a lot less cost, a system that was relatively simple to install and would fit into a normal sized theatre. Twentieth Century Fox employed a system using an anamorphic lens developed earlier by Frenchman Henri Chretien. The lens squeezed the photographed image horizontally, enabling a wide image to be photographed onto 35mm film. This image was then expanded during projection back to its wider ratio. Four channels of magnetic sound were laid down the sides of the release print to give three screen channels and an 'effects' channel to place sound around the auditorium.



Vistavision projection equipment

Daryl F. Zanuck, the head of Fox at the time, had all production stopped on their latest films 'An American in Paris' and 'The Robe' to have them remade in the new system. The film 'An American in Paris' was in fact completed first but its release held until after 'The Robe' which was thought to be a more



impressive film to launch their new system called 'CinemaScope' in September 1953. In fact for the launch Fox were still having problems getting the magnetic stripes onto the film and the cinemas which opened initially with 'The Robe' had the sound on separate film utilising the sound equipment previously used for 3-D.

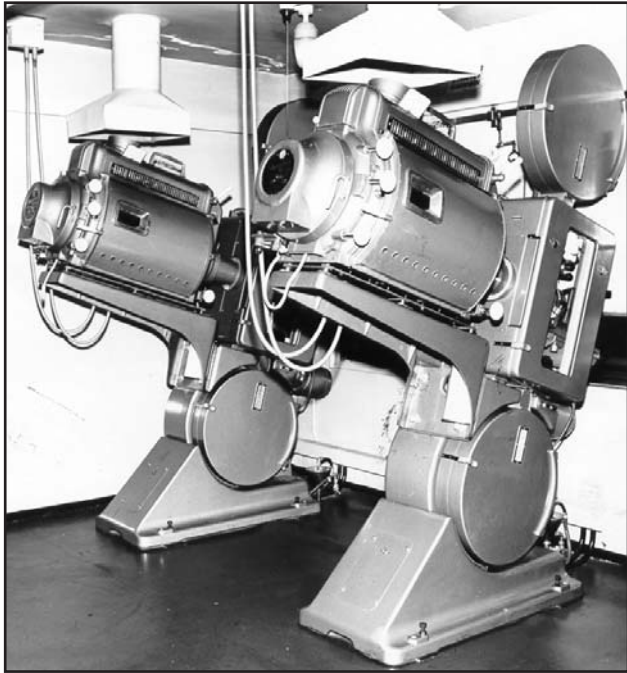
Although Fox offered CinemaScope to all its rivals the other studios were loath to use it as it meant they would have to pay royalties to one of their competitors. To enable the release film to carry the four tracks the size of the sprocket holes had to be reduced making them less robust and thus the film more prone to wear and damage. Adding to this the fact that the film did not carry an optical track limited its release to a small number of equipped theatres, making it expensive in more ways than one for the Film Company.

Consequently several companies looked towards competitive systems to give them more cost-effective ways of creating stereo sound. MGM adopted Fairchild's 'Perspecta' sound system which basically took a standard mono optical track and embedded into it sub audible switching tones, these then switched the audio signal between left, centre, and right, or to all three screen channels simultaneously. This system had the added advantage that the same copy could be played quite successfully in a

mono cinema. One of the more notable films being 'Seven Brides for Seven Brothers'. Both MGM and Paramount opted for this system and it is said that because of this Fox were forced to reduce their picture size on CinemaScope copies to add an optical mono track, thus making their release prints compatible also.

To achieve a larger picture MGM adopted a similar anamorphic system and called it 'Metroscope' whereas Paramount developed 'VistaVision'. VistaVision was a method of filming where the 35mm film was run horizontally through the camera to give a widescreen image without having to compress it with an anamorphic lens. The release print derived from this negative had an aspect ratio of 1:1.85 and was printed onto the film with the normal configuration. The film ran through the projector in the conventional way but the high quality image allowed it to be magnified greatly without any great loss in definition, which is more than can be said for the CinemaScope images of the time.

Several films were shot this way, 'White Christmas' being the first, and opened at the Radio City Music Hall New York in October 1954. As an experiment Paramount equipped a few 'Roadshow' theatres with horizontal projection systems, but these were few and far between, as the projection room had to be large enough to also house the two conventional projectors for normal releases. The sound system used for VistaVision prints was 'Perspecta', and if an old film is played today the switching tones are still embedded in the track and can be decoded with modern equipment to retrieve the three channels once more. In fact several films have been re-issued, most recently 'Forbidden Planet', and the



70mm projection equipment

original Perspecta tracks still remain.

Whilst all these various studios were fighting to win the format wars one man was quietly working away to develop probably the most famous and technically superior system to date. Michael Todd working with the American Optical Company was developing a wide film format that would give the audience the same effect as Cinerama with far less complexity. However, wide film was not a new concept. Paramount, MGM, and Fox had all experimented with film widths from 55mm up to 70mm between 1920 and 1930 but none had been developed on a large scale. This new system was called Todd-AO and remains today as the Rolls Royce of film formats.

The image was filmed on specially designed 65mm cameras running at 30 frames per second and transferred to 70mm wide film for release. The extra 5mm being occupied by the six track magnetic sound down each edge of the film. Five channels were behind the screen, the original three of CinemaScope not having enough coverage for the larger picture. The sixth

track was used for the surround, and in some cases Perspecta encoded to give a left, centre, right surround channel. The first film released in the format was Rogers and Hammerstein's 'Oklahoma', which opened at the Rivoli Theatre in 1955. Todd insisted it be screened as though it was a live theatre presentation, with one show a night including an interval, and the audience in evening dress. He even banned the sale of popcorn during the films run. After its huge success Todd sold the rights to the system to Twentieth Century Fox which then gave him the money to achieve his life long ambition of filming 'Around the World in Eighty Days' in Todd-AO.

However, because he had sold the rights to the system Fox stopped him from releasing his film in 70mm in many countries, one of which being England. Consequently anyone seeing the film at the Astoria Charing Cross Road in the fifties saw it in 35mm CinemaScope.

Strictly speaking this is not quite true, as at the time cinemas had to show a certain 'quota' of British films a year unless they were a 'special venue cinema'. That was a

cinema showing a special format film, i.e. not in 35mm. To overcome this rule Todd had 0.5mm shaved off each side of the print to make it only 34mm wide and thus making it a 'Roadshow Presentation'. Inspectors from customs and excise called at the theatre weekly to verify that the 34mm print was still being played, and that the cinema would not have to show its 'British

recorded on. Track 2 was centre channel only and tracks 1 and 3 were matrix encoded to give a left front and back and a right front and back. This system was developed by John Mosley in America, and engineered for him by Dolby, for which they built the CP100 cinema processor. The matrix system employed became the heart of their now famous Dolby Stereo optical sound



Quota'. The sound was on separate 35mm full coat magnetic with five screen channels and the surround channel Perspecta encoded to give a left, centre, and right surround channel.

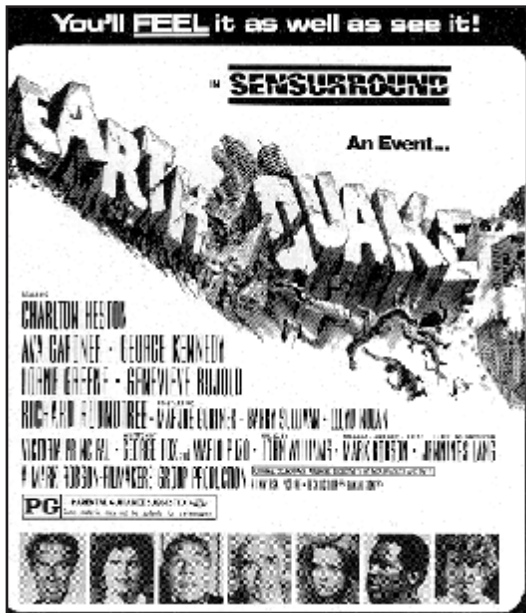
After the heyday of development in the fifties the cinema industry did not see any new innovations until the seventies. This being mainly due to the dwindling audiences and a general apathy throughout the industry. Although there had been several attempts to improve optical sound quality in cinemas it was not until Dolby Laboratories, working out of Clapham at the time, looked to apply their already successful 'noise reduction' system to film sound. The first experiments were only mono and it soon became obvious to the engineers at Dolby that what the industry really wanted was high quality optical stereo.

The film 'Tommy' starring the rock band The Who used 35mm striped film to achieve five-channel stereo in the cinema in 1975. The film layout was the same as for CinemaScope but had only three of the four tracks

system.

Although the first Dolby Stereo film was 'Lisztomania' in 1975 it is perhaps 'Star Wars' in 1976 that everyone associates with the launch of the system. The matrix allows four channels of sound to be encoded down to two to record on the film, and then decoded back to four when replayed in the cinema. The stereo optical track on the film being in the same position as the mono optical and thus fully compatible. Because the track is now split into two the reduced size gives rise to noise problems and the application of their noise reduction system overcomes this.

One other system that 'shook' the industry at this time was Paramount's Sensurround. Although not a sound system as such it did become a gimmick for three films. These films were Earthquake in 1974, followed by Tora Tora Tora, and finally Rollercoaster all had sequences with low frequency rumbles which were required to shake the cinema. This was achieved by embedding a sub audible switching tone into the sound track to trigger a low frequency



signal generator. This signal was then amplified greatly and played into the cinema through massive sub bass speaker cabinets, which literally shook the theatre. There were cases reported of pieces of ceiling falling down in some of the older theatres that installed the system. The system was designed for those three films and has never been used since.

Dolby in the mean time were going from strength to strength and had revitalised the sound side of the industry. Having improved optical sound they then looked at 70mm magnetic, firstly employing noise reduction and secondly devising a system which used the two inner tracks for sub bass signals giving an effect similar to Sensurround as well as adding stereo surrounds channels. Used experimentally for Warners' film 'Superwoman' at the Empire, Leicester Square in 1978 and then on a world wide basis for 'Apocalypse Now', a year later.

However, it was Dolby's optical stereo system which took the industry by storm, and became the industry standard. Cinemas world-wide began upgrading to stereo particularly the newly built American Multiplex style of cinemas. With this new building

programme audiences were beginning to grow again, but the new audiences were younger people who were more aware of sound quality. With the advent of digital sound at home with the Compact Disk it was not long before this new

audience was demanding the same quality of sound from the cinemas.

Except for a few one off systems cinema goers were not able to hear digital sound in the cinema until Kodak and ORC (Optical Radiation Corporation) released their digital sound on film system CDS (Cinema Digital Sound) in



1990 with 'Dick Tracey'. The standard adopted for speaker placement was that of Dolby's devised for 70mm, left, centre, and right screen channels, left and right surround, and a sub bass. This configuration is now the standard for digital releases. The one major drawback of the system was that it removed the analogue optical sound track and replaced it with their digital one. This rendered the copy unplayable in a non-digital house, not unlike Fox's dilemma with magnetic in the fifties. Although fraught with difficulties it did show the way forward and proved to a sceptical industry that this was what audiences wanted. This was the first time in the cinema industry's history that the

audience were dictating which technology they wanted.

This time, however, Dolby weren't to have it all their own way. Although they were first on the scene with their digital sound on film, with Warner Brothers' 'Batman Returns' in 1992, the data being placed rather cleverly between the sprocket holes.



It was Spielberg's blockbuster 'Jurassic Park' the following year that primarily cornered the digital market with 1000 cinemas equipped for the launch of the film. The system developed by DTS (Digital Theater Systems) placed the digital sound not on the film but on a separate CD-ROM synchronised to the picture via a time code on the film. Using computer based hardware and software to decode digital data on the disk. A similar system developed in France by two individuals working as



LC Concepts was subsequently taken over by DTS.

It was later in 1993 with the release of Columbia's 'Last Action Hero' that a third digital system came on the scene, this one developed by SONY engineers in America. Again putting the digital data on the film, but this time down either edge, it also has the advantage of two extra channels, the old 70mm

configuration of inner right and inner left being reintroduced.



This now makes digital sound very expensive for the cinema owner as none of the systems are compatible forcing him to purchase all three to keep up with his competitor.



Finally with the advent of digital sound we again see an improvement in the 70mm format. DTS have begun putting time code onto 70mm releases and using the same CD-ROM to generate digital sound for this new 70mm format. Now with DTS adding digital to 70mm, magnetic striping becomes unnecessary, bringing the cost of 70mm printing down enormously and making it once again the premier release format.

The 1997 BKSTS Bernard Happé Memorial Lecture was sponsored by Dolby Laboratories inc.

