3 'A real brake on progress'? Moving Image Technology in the Time of Mitchell and Kenyon

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INTRODUCTION

1899 saw the emergence of two new production companies in England, one formed by Cecil M. Hepworth, and the other by Mitchell and Kenyon.[1]

The bringing together of these two names illustrates elegantly the nature of the challenge in researching and understanding the relationship between Mitchell and Kenyon and the moving image technologies they used. The latter's evolution during the period covered by the Collection is analogous to that of the Internet in the early 1990s: it was rapid, market-driven, a cottage industry and largely unregulated.[2] By the early 1910s, the rapidly expanding and globalising film industry had caused economies of scale to kick in, prompting the industrialised supply of equipment, film and lab facilities; just as by the late 1990s, major companies and organisations were starting to have websites.

Hepworth was a key player in British film technology's 'cottage industry' phase of the 1890s and 1900s, and the epitome of the Victorian inventor. Although as far as we know he didn't manufacture his own film, Hepworth did, at some point during his career, design and fabricate virtually every other item of hardware needed in the production process, extensive details of which can be found in his various writings.[3] Furthermore, he eventually produced large-scale feature films and was a significant political figure in the industry while at the height of his career, ensuring that his activities received extensive coverage. None of this applies to Mitchell and Kenyon. Like many other early producers in the north of England (e.g. Bamforth and the Sheffield Photo Company), their core business was originally still photography, they only produced films for about a decade and mainly to order, their output was mainly in the form of actuality footage and they purchased their technology 'off the shelf' from a rapidly emerging sector of third-party suppliers who took no direct part in production activity themselves.

Given the relative lack of surviving primary evidence other than the actual films, any attempt to discuss the impact of technology on Mitchell and Kenyon's career and the content of the films themselves must seek to apply contextualising evidence from secondary sources. This is primarily the approach I shall take in this chapter, though there are two important primary sources which will form a key element in this discussion. The first is the films themselves, and the second are surviving models of the camera used to shoot them. This chapter will consider the six areas of technology used to produce, duplicate and exhibit film in the 1900s: film base manufacture, the characteristics of film emulsions, the camera, editing, duplication and projection. By examining these, I hope to illustrate some of the advantages and limitations of these technologies during the period of Mitchell and Kenyon's production, and to show how these impacted on the form and content of the films.

FILM BASES AND EMULSIONS

The chemical composition of the base used for most professional film production remained largely unchanged from the first experimental production by George Eastman in 1889 to the introduction of cellulose triacetate in 1948. In crude terms, it was made by dissolving cellulose in nitric acid, manipulating the resulting compound into a consistent flat surface and then 'drying it on a polished support'.[4] The end product, known as cellulose nitrate, was a flexible, transparent material of extraordinarily high tensile strength. Nitrate had one key drawback: it was highly inflammable. The combustion process also produced highly toxic nitric acid fumes and generated its own oxygen, making a fire impossible to extinguish other than by letting it burn out in controlled conditions.

The earliest recorded film fire in Britain took place at a cinematograph operated by Birt Acres in Piccadilly Circus on 10 March 1896.[5] No one was hurt on that occasion, but the incident which really pushed health and safety irreversibly onto the nascent industry's agenda was a film fire at a fair in Paris the following year, which killed 125 people and seriously injured many others.[6] The volatility of film impacted on its use in a number of ways during the Mitchell and Kenyon period: safety precautions were necessary whenever it was handled or transported, and when projected, reels tended to be kept short. Purpose-built cinemas did not emerge on any significant scale until the late 1900s', and segregated projection boxes were not a legal requirement until the 1909 act. Although the magazine capacity of cameras used by Mitchell and Kenyon gradually increased from seventy feet (1'20" at 16fps) to 500 (8'20") during the course of their career, this was not accompanied by a similar rise in the length of their finished films, largely due to the risks inherent in projecting longer reels using 1900s equipment. Unlike exposure in a camera, projection necessitated bringing the film into contact with a source of intense heat, itself produced by a reaction of volatile chemicals. Given that this typically took place in enclosed and densely populated spaces, exhibition was a lot more dangerous than camera use. The production of film base remained a largely manual process and the volume of stock sold remained relatively low throughout the 1900s. The introduction of band-casting machines enabling the 'industrial scale' manufacture of nitrate in Britain did not take place until 1912.[7]

After its manufacture, film base has the flexible and transparent properties needed to fulfil its mechanical function in a camera, printer or projector. But it cannot in itself record or reproduce a photographic image. That facility is provided by the photosensitive *emulsion*: a chemical compound coated on one side of the base. This undergoes a reaction when exposed to light in a camera or printer, after which it can then be turned into a permanent, visible image for viewing or subsequent duplication. This is done by immersing the exposed film in a series of chemical baths rendering this reaction visible (*developing*) and then desensitising the emulsion to any further exposure (*fixing*). This is known as *processing*. The two key characteristics of the photographic emulsion which could have had a significant impact on Mitchell and Kenyon are its *chromaticity* (which parts of the visible colour spectrum it is sensitised to) and *speed* (relative photosensitivity). As for the former, film emulsions in use during this period either recorded a black-and-white image when exposed to blue light only, or were *orthochromatic*, i.e. sensitised to blue and green light. *Panchromatic* film – which records red as well – did not become widely available until 1926.[8] The effect of this limited exposure range can clearly be seen in one form or another in almost all Mitchell and Kenyon titles. In M&K 291: *Whitsuntide Fair at Preston* (1906), for example, painted detail on the merry-go-round appears to have very little contrast in some places and a lot more in others, according to the extent to which the original colour matches the film's sensitivity. For the same reason, men's suits often appear totally black (i.e. details such as pin stripes are obliterated) and buildings in a street scene a uniform shade of grey.

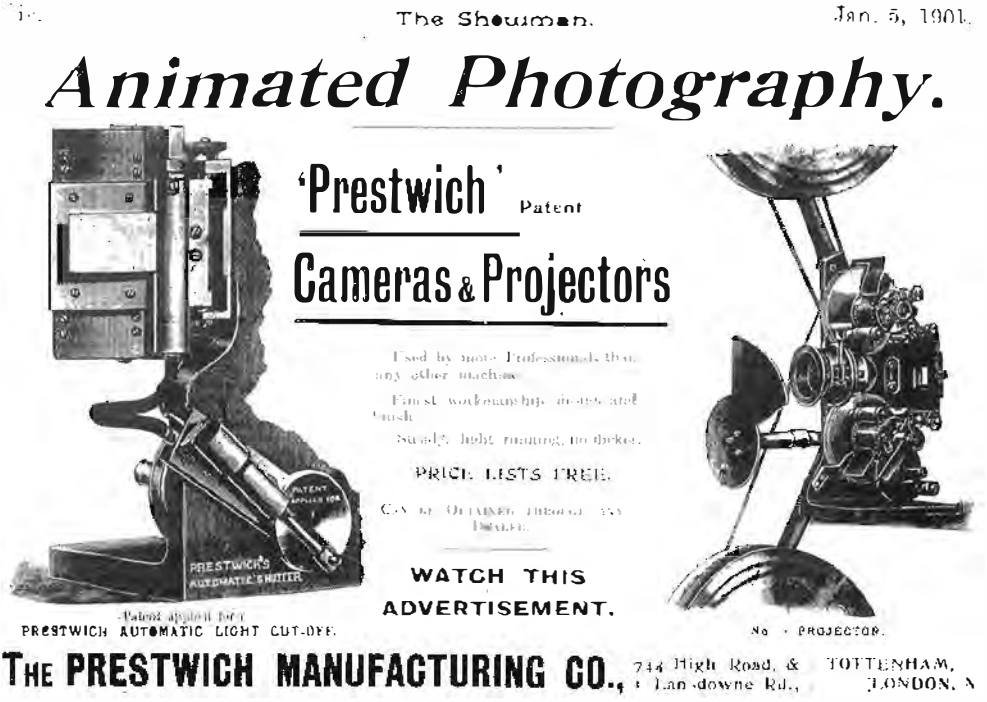
Surprisingly, speed was not as much of an issue as might be thought. In any case it is impossible to determine with any degree of accuracy the speed of film stocks which were typically used during the 1900s, using today's Exposure Index (EI) scale. As Barry Salt argues:

> The 'speed' of this film in our contemporary sense was largely immaterial, since it was developed by inspection to the correct density under a red safelight, just as is now done in still photography when making positive paper prints. ... What is important, as far as any possible visible effect in films is concerned, is the lens aperture that was used.[9]

In other words, the characteristics of the emulsion had far less impact on production practices in the Mitchell and Kenyon period than they did even a generation subsequently. The factor which impacted on them most was the camera, its capabilities and limitations.

THE PRESTWICH CAMERAS

As noted above, Mitchell and Kenyon did not follow the lead of Cecil Hepworth, the 'Brighton School' or the other British film pioneers in manufacturing their own equipment. The cameras used by Mitchell and Kenyon were purchased from the London-based firm of Prestwich. John Alfred Prestwich, formerly a stills photographer, made his first appearance in the film industry in 1896, when he was granted a patent with William Friese-Greene for a two-lens projector mechanism intended to minimise flicker.[10] The design was fundamentally flawed and no working model was ever built, but even at that stage Prestwich was gaining a reputation for the quality of his



A trade advertisement for Prestwich hardware that appeared in *The Showman*, 5 January 1901.

engineering. Barnes suggests that, 'the woolly thinking behind the apparatus is obviously Friese-Greene's, whilst the accomplished technical application is due to Prestwich.' He concludes that Prestwich 'was an engineer of outstanding ability who, during the next decade of cinema's history [1896–1906], constructed some of the best cinematographic apparatus of the period.'[11]

Prestwich produced four camera models in total, each of which offered additional functionality and a higher-quality mechanism than its predecessor. The final camera, Model 4, went on the market in 1898 and established itself at the forefront of British film production until the commercial introduction of the Pathé studio camera in 1903 and the Williamson camera in 1904. All consisted of bodies made from oak (as Souto notes, almost all ciné cameras had wooden bodies until the late 1910s),[12] but as the range progressed their film capacities increased, the film transport mechanisms became more accurate and new features were introduced. Prestwich's earliest camera, Model 1, had a seventy-foot film capacity and could only be loaded and unloaded in a darkroom. The position of the shutter blade on its shaft could be altered relative to the aperture, meaning that exposure time was adjustable (though, of course, the speed at which the mechanism was cranked also affected the exposure length). The intermittent mechanism (i.e. the mechanism which, while being continuously turned, enables a film frame to be held stationary during exposure and then advanced) used an epicyclical sprocket wheel, unlike the subsequent Prestwich cameras. The epicyclical intermittent mechanism pulls the entire sprocket drum downwards, thereby advancing the film. The seventy-foot rolls were placed 'raw' inside the body, meaning that the camera could not be loaded or unloaded in daylight.

A subsequent model, known simply as the 'Prestwich Cinecamera', introduced refinements. A much larger body, over twice the size of Model 1, incorporated two independent lightproof wooden containers, or 'magazines', which encased a feed and take-up spool with a film capacity of 300 feet. Not only could almost five minutes now be shot before reloading, but the reloading itself could be done in daylight, simply by replacing the magazine with one containing unexposed film. The epicyclical intermittent was replaced by a 'rack and pinion' claw-type mechanism. This advances the film by means of a claw which is inserted through one perforation on either side of the stock, pushes it downwards by a length equivalent to four perforations (i.e. one frame), retracts, and during exposure returns to its starting position. This does not introduce the extreme mechanical vibrations associated with epicyclical mechanisms, resulting in vastly improved vertical stability in the projected picture. Another advantage is that the perforations are only engaged by the intermittent mechanism when the film is actually in motion (rather than continuously, as in an epicyclical intermittent), thereby causing less wear and damage to perforations.

The Prestwich Cinecamera also featured a 'through the lens' viewfinder, a primitive antecedent to the reflex viewfinders found in cameras today. This was literally a hollow tube running throughout the horizontal length of the case, enabling the operator to see directly through the lens making the exposure. As unexposed film is opaque, it could only be used when the camera was not loaded, and certainly not during shooting. This probably accounts for many of the earlier Mitchell and Kenyon films containing little or no camera movement: the subject was framed using the viewfinder, then the film threaded and the scene shot. It may also explain numerous examples of misframing in the films taken from moving vehicles, e.g. in film M&K 215: *A Trip to North Wales on the St Elvies* (1902), where, despite the use of a short, panning shot on the boat deck, the subject is never satisfactorily framed. Two other additional features in the Cinecamera are worth mentioning: a mounting assembly enabling lenses to be easily interchanged and a footage counter, the Prestwich was 'one of the first [cameras] to be so equipped',[13] showing the operator how much film was left before reloading was necessary.

The final camera produced by Prestwich, and the one probably used to shoot most of the extant films, was Model 4, first marketed in 1898. This featured the magazine system of loading, only this time the magazines were mounted externally, making the camera body itself more compact and enabling it to be operated without a tripod if smaller magazines were used. Model 4 was arguably the earliest camera ever designed which used external magazines: it certainly predated the first mass-manufactured example, the Pathé studio camera, by five years. The maximum magazine size available now held 500 feet, allowing over eight minutes of continuous filming. Barnes notes that 'in camera and projector design there was a move towards larger film capacity' during 1898,[14] but there is little evidence to suggest that this resulted in significantly longer finished films being shown – the lack of a coherent system of continuity editing and the nitrate health and safety issues saw to that.

Apart from generally increased flexibility of use and minor refinements to the film transport and intermittent mechanisms, the main development impacting on Mitchell and Kenyon's production was the addition of a separate 'rangefinder' viewfinder.

In many of the Mitchell and Kenyon films, extended and elaborate camera movements (tracks and pans) can be seen, though slight misframings still sometimes result. These would certainly indicate the use of Model 4 for two reasons. Firstly, the absence of a viewfinder giving at least some indication of the image being exposed through the taking lens would have made such shots virtually impossible. Secondly, slight misframings can sometimes be seen, which become more pronounced

M&K 422: *Lord Robert's Visit to Manchester* (1901), 10 October 1901. The Prestwich 4 in action. In a later sequence from this film, Cecil Hepworth can be seen manoeuvring a camera into position.

the closer the action is to the camera. This is likely to have been caused by the parallax error resulting from the viewfinder's lens being separate to that of the taking lens. A typical example can be found in film M&K 119: *Sunderland v. Leicester Fosse* (1907). The further away the action on the football field takes place, the more accurately the camera pans to follow it. But as the game moves closer to the camera the parallax is magnified, resulting in an increasing degree of misframing. Incidentally, Mitchell and Kenyon possibly owned more than one Model 4. In M&K 422: *Lord Robert's Visit to Manchester* (1901), a cameraman can be seen positioning a Prestwich Model 4 in the foreground of a shot, preparing to film the unveiling ceremony of a statue.

As Barry Salt has argued, the capabilities and limitations of the lenses available were a major influence on camera technique in this period. The comparatively large fixed apertures (by today's standards), typically around f4.5, enabled shooting to take place in both bright and subdued daylight, though depth of field was limited. The Prestwich Cinecamera and Model 4 were designed to have easily interchangeable lenses. The lens barrel itself was mounted on a steel plate which slid into a wooden bracket on the front of the camera. The bracket was mounted on hinges and could be opened to allow access for cleaning and shutter adjustments. Salt notes that lenses with a fixed focal distance of 50mm to 75mm were typical around the turn of the century, though longer 'telephoto' lenses of 100mm to 150mm 'were occasionally used in actuality filming.'[15] Lenses with a variable focus distance (known now as 'zoom' lenses) were not

M&K 680: *Hollow Drift Children's Procession* (1902). Note the relatively straight angle at which the couple in the foreground are looking into the camera relative to the point at which the procession disappears into the foreground, indicating the use of a long prime focal distance lens.

developed until the 1930s. Terming them 'telescopic' lenses, Mitchell and Kenyon appear to have used long lenses as a selling-point, as a surviving advertisement makes clear.

Mitchell and Kenyon used their 'telescopic' lens to greatest effect in crowd and street scenes, probably with the intention of magnifying their subjects to enable easy recognition when the film was projected. One striking example can be found in M&K 680: *Hollow Drift Children's Procession* (1902), in which the angle of the procession disappearing into the foreground shows clearly that a lens of well over 100mm must have been used to take the shot.

EDITING

The technique of cutting and joining individual lengths of film to form a single roll was discovered and perfected almost as soon as film itself was invented. The method which W. K. L. Dickson recalled using during his early film experiments with Thomas Edison involved 'a clamp with steady pins to fit the punch holes, to use in joining the films with a thin paste of the base dissolved in amyl acetate which, I suppose, is still [in 1933] commonly used.'[16] This is now known as cement splicing, and involves the use of a chemical compound which dissolves a thin layer of base on two facing surfaces, which are then pressed together under considerable pressure to form an adhesive seal. It remained the sole method of joining film until the late 1960s. In fact, Dickson's clamp was relatively sophisticated even compared to common practice two decades later: as late as the 1920s, the routine method of producing splices in studios, laboratories and projection rooms was still by hand using a razor blade, without any mechanisation.

Cement joins in the surviving Mitchell and Kenyon elements would suggest that they did it frequently and by hand, though many of these joins were made to form short lengths of unexposed stock into a longer roll for exposure, rather than to edit the processed film for presentation. One case in point is a section of M&K 735: *Congregations Leaving St Hilda's Church* (1902), the first fifty-seven seconds of which consists of a continuous, static shot taken from opposite the church. The second half of the film includes a number of negative joins during a continuous shot (i.e. not on a cut), suggesting that lengths of stock had been joined before exposure.

The use of editing as a deliberate narrative device as distinct from a technical exigency – i.e. juxtaposing images in order to convey a deliberate message to the viewer – developed and evolved gradually during the 1900s and 1910s. Individual, edited films of more than a few minutes in length did not start to emerge until the late 1900s, though the systematic use of creative editing becomes more and more apparent in the Mitchell and Kenyon Collection as the decade progresses. The greater proportion of films from the 1900–2 period consists either of long, continuous shots, with the only edits being either 'jump cuts' (i.e. when cranking was stopped and resumed after a time delay without moving the camera – several examples can be seen in the second half of the Middlesbrough church film) or when two or three 'scenes' were joined to form a finished film. A typical example of the latter can be found in M&K 219: *A Trip to North Wales on the St Elvies* (1902), which consists of three shots taken from a boat, showing the shoreline. The breaks were presumably to reload the camera.

By the middle of the decade, Mitchell and Kenyon's editing had become a lot more sophisticated. The football films are among the most polished examples, possibly because their subject matter – fast-moving action happening within a predefined, enclosed space – lent itself especially well to the use of camera movement and sequential cutting to illustrate the progression of play. A convincing demonstration of this can be found in M&K 136–8: *England v. Ireland at Manchester* (1905) which, it could be argued, even attempts a rudimentary version of 'classical' continuity editing, which emerged in the late 1910s. In one sequence we see the England goalkeeper from a reverse

angle, anticipating a shot. The film then cuts to an approaching Irish striker (suggesting that two cameras were used, as the lens used for the second shot appears to be longer), followed by a further cut to the converging English defenders. Remarkably, this sequence includes cuts on action and obeys the 180-degree rule, though this could be accidental.

PROCESSING AND DUPLICATION

The services provided by a film laboratory are essentially twofold: to process exposed film and to produce duplicate copies for cinema exhibition. Nowadays various control mechanisms exist to ensure the quality and consistency of these procedures, e.g. sensitometry, chemical analysis of the developers and fixers and accurate control of exposure in printing. None of these existed in the 1900s. In fact, most of this work was carried out by the film-makers themselves, although we do not know whether Mitchell and Kenyon did this or outsourced it. One writer noted that, even as late as 1930, 'very little was known of the laws of nature which govern the making and processing of cine film.' He continues:

> Processes in these early days were essentially unstable and the causes of fluctuations in activity were unknown. This situation gave rise to many 'old wives' tales', some of which were so firmly held as to constitute, in later days, a real brake on progress.[17]

This impression is supported by the findings of the archivist John Reed, who, when restoring a feature film from 1918, noted evidence of careless film handling and 'poor processing consistency' in surviving elements.[18] Film processing was typically done using the 'rack and tank' method. Working under a red safelight, technicians would wind the exposed orthochromatic stock onto a large cylindrical rack which would then be mounted above an open tank containing the developer. The film would be periodically immersed in the tank as the rack was rotated, which would continue until the developed image was visible under the safelight. The rack would then be moved to a tank containing the fixer, after which the processed film was dried and unwound. Systematic control of the composition and temperature of the chemicals (both variables affecting the processing time) was simply non-existent during the 1900s (automated developing machines were not commonplace until the 1930s). Film-makers of Mitchell and Kenyon's generation, therefore, had little control over subtleties of contrast and density. Indeed, it is likely that the new Mitchell and Kenyon preservation elements and viewing copies enable us to see a *higher*-quality image than original audiences would have done.

Printing–duplication by exposing an image of the processed film onto new stock – was also a primitive operation. In the very early days, cameras doubled as printers. Prestwich Model 1 at Bradford has slit holes in the top and bottom of the case, to enable an exposed and processed element to be passed through the mechanism in contact with raw stock. Although purpose-built printers began to be marketed during the mid-1900s, it is unlikely that the Mitchell and Kenyon films were duplicated for exhibition using anything more sophisticated. It would certainly have been impossible to carry out any of the image enhancement which is now possible at the printing stage.

PROJECTION

Projection technology during the Mitchell and Kenyon period typically consisted of a mechanism attached to the same light source used to project lantern slides. The key difference from the light used in today's projectors was that it was produced chemically rather than electrically, by means of a flame from a cylinder of hydrogen reacting with a stick of lime (i.e. limelight). Unlike in exposure

or printing, this generated intense, sustained heat. This placed significant demands on the projector's intermittent mechanism. Although, as Salt notes, projectors of the period generally used the same sorts of intermittent mechanisms as found in cameras from the period,[19] they tended to fail from heat exposure. Another point to bear in mind was that during the 1900s, film exhibition was generally itinerant. Purpose-built cinemas were the exception rather than the norm, so projector components had to be portable. This combination of the combustibility of nitrate, the volatility of the chemicals used to generate limelight, the fragility of early intermittent mechanisms and the need for portability imposed restrictions: screenings tended to be short, the picture relatively dim by today's standards, and the audience size small. All this was to change with the evolution of the 'Maltese cross' intermittent mechanism in the 1910s, the emergence of carbon arc (electric) illumination and the gradual move from itinerant exhibition to purpose-built venues (encouraged, in Britain, by specific health and safety legislation), but in the period Mitchell and Kenyon were operating, this was all yet to come.

CONCLUSION

From the evidence in the newly discovered films, it appears that Mitchell and Kenyon successfully exploited the rapidly expanding possibilities of the technology at their disposal, yet also had to work within its limitations. As far as the evolution of British moving image technology is concerned, the discovery of this Collection hasn't necessarily forced a re-evaluation of Rachael Low's contention that Mitchell and Kenyon 'made a solid contribution to the considerable British output of the time, but do not seem to have exerted any influence on the development of cinema technique.'[20] On the one hand, they purchased what was probably the most technically advanced model of camera on sale at the time, and used it to its full potential. They also took advantage of the wide lens apertures and 'telescopic' focal distances available in the commercial marketing of their films. They may also have been slightly ahead of their time in their use of editing. On the other hand, they were clearly constrained by the health and safety risks then inherent in film exhibition, hit-and-miss laboratory procedures and the absence of a comprehensive 'language' of film editing which would have enabled them to play a more interpretative role toward their subjects. Furthermore, there is no evidence that they sought to take any active steps to break free from these constraints. It would be overly negative to conclude that technology was a 'real brake on progress' for Mitchell and Kenyon. Rather, their career is an illustration of what was then the state of the art, warts and all.

NOTES

1. John Barnes, *Filming the Boer War* (London: Bishopsgate Press, 1992), p. 8.
2. Despite the inherently dangerous nature of its main raw material the film industry in Britain was not subject to any legislative regulation until the Cinematograph Act of 1909.
3. Cecil M. Hepworth, *Animated Photography: The ABC of the Cinematograph* (London: Hazell, Watson & Viney Ltd, 1897); *Came the Dawn: Memoirs of a Film Pioneer* (London: Phoenix House, 1951).
4. Earl Thiesen, 'The History of Nitrocellulose as a Film Base', *Journal of the Society of Motion Picture Engineers*, vol. 20 (1933), pp. 259–62.
5. John Barnes, *The Beginnings of the Cinema in England* (Newton Abbot: David and Charles, 1976), pp. 66–70.
6. H. Mark Gosser, 'The *Bazar de la Charité* Fire: The Reality, the Aftermath, the Telling', *Film History*, vol. 10, no. 1 (1998), pp. 70–89.
7. R. J. Hercock and G. A. Jones, *Silver by the Ton: A History of Ilford Ltd., 1879–1979* (Maidenhead: McGraw Hill, 1979), p. 51.

8. C. E. Kenneth Mees, 'History of Professional Black-and-White Motion Picture Film', *Journal of the Society of Motion Picture Engineers*, vol. 63 (1954); reproduced in Raymond Fielding (ed.), *A Technological History of Motion Pictures and Television* (Berkeley: University of California Press, 1967), p. 125.
9. Barry Salt, *Film Style and Technology: History and Analysis* (2nd edn, London: Starword, 1992), p. 31.
10. Barnes, *The Beginnings of the Cinema*, p. 184.
11. Ibid.
12. H. Mario Raimono Souto, *The Technique of the Motion Picture Camera* (4th edn, London: Focal Press, 1982), p. 20.
13. Brian Coe, *The History of Movie Photography* (London: Ash and Grant, 1981), p. 82. This book contains an illustration (p. 80) which is captioned as a Cinecamera; but an identical model held by the National Museum of Photography, Film and Television (NMPFT) (K3273) is catalogued as a Model 4. As a description of the Model 4 in Barnes (1992) corresponds with Bradford's camera, it would seem safe to assume that the caption in Coe is a mistake.
14. Barnes, *Filming the Boer War*, p. 110.
15. Salt, *Film Style and Technology*, p. 33.
16. W. K. L. Dickson, 'A Brief History of the Kinetograph, the Kinetoscope and the Kineto-phonograph', *Journal of the Society of Motion Picture Engineers*, vol. 21 (1933), reprinted in Fielding, *A Technological History*, pp. 11–12.
17. F. P. Gloyns, 'Processing over Fifty Years: The Work of the Film Laboratories', *The British Kinematograph Sound and Television Society Journal*, vol. 61, no. 1 (January 1981), p. 34.
18. John Reed and Gwenan Owen, 'Uncanning the Uncanny', in David Berry and Simon Horrocks (eds), *David Lloyd George: The Movie Mystery* (Cardiff: University of Wales Press, 1998), p. 87.
19. Salt, *Film Style and Technology*, p. 33.
20. Rachael Low and Roger Manvell, *The History of the British Film, 1896–1906* (London: Allen and Unwin, 1948), p. 23.