TRAVELLING MATTES

Since the earliest days of the motion picture industry, technicians have sought a practical way in which to combine a shot of an actor, photographed on the sound stage, with a background scene, photographed elsewhere. Such a process would provide superior sound recording conditions for the simulation of exterior scenes. It would allow for the convenient and economical incorporation of visual detail which had been recorded in distant locales. It would provide for the photography of hazardous action with relative safety. It would give us the means with which to manufacture an infinite variety of unlikely or fantastic composites.

Over the years, two systems have been developed to allow for just such an effect. The first is background projection. The other is the travelling matte (Fig. 99).

Matte shots of several varieties have already been described. None of these allows the performer to move out of his own acting area, however; the moment he attempts to do so, he disappears. Mention has also been made of the "superimposition" of foreground action over background scenes through double-exposure and double printing. Such techniques produce a "phantom" effect, however, in which background detail can be seen through the body of the actor.

An entirely different process must be used to "jigsaw" the moving figure of the actor into the background image and to produce a convincing composite. What is obviously required is a type of matte which changes in position, size, and configuration from frame to frame—a "travelling matte," whose silhouette conforms exactly to the shape and movements of the actor, allowing him to move anywhere within the picture (Fig. 100).

Two entirely different kinds of travelling matte processes are available to produce this kind of composite. The first is a self-matting technique which is applicable only to black-and-white photography. The second—suitable for either black-and-white or colour—is an optical printing process which employs strips of motion picture film, bearing photographic silhouettes which alternately obscure and reveal foreground and background images during successive printing operation.

The Dunning-Pomeroy self-matting process

In the late 1920's, a technique was introduced in the Hollywood film industry by which actors could be photographed on the sound stage, and their images simultaneously combined with background action previously photographed elsewhere. The system was developed first by C. Dodge Dunning, and later by Roy J. Pomeroy, and was widely employed until the perfection of background projection.

The technique required the use of a production camera with a high-quality intermittent movement which was capable of taking two strips of film in bi-pack. Into this camera was loaded a bleached and orange-dyed master positive of the background scene, in contact with a panchromatic negative raw stock. Light from the acting area in front of the camera passed through the base and emulsion of the dyed master positive and struck the negative raw stock behind it. Only the bleached emulsion of the master positive was dyed; that is, the shadow areas were heavily coloured, whereas the highlight areas were completely clear.

The actor was positioned before the camera and was illuminated with orange-filtered light. Behind the actor, a blank screen was erected which was illuminated only by blue light (Fig. 101). In those areas of the master positive which were struck by orange light reflected from the actor's face and costume, the light passed almost equally through both the dyed and clear portions of the master positive, and a solid, conventional image of the actor was recorded on the panchromatic emulsion. On the other hand, in those areas which surrounded the actor, the blue light reflected from the screen provided illumination which to which the background detail of the master positive through to the dupe negative, the orange dye absorbing blue light in the shadow portions and transmitting it in the clear highlight areas. Inasmuch as the actor's body obscured the screen directly behind him, the blue light reflected from the screen could not reach those portions of the master positive on which the actor's figure was imaged. Since the blue light was continuously obscured and revealed by the actor's body as he moved across the frame, the performer served as his own matte.
Fig. 99. Typical travelling-matte composites. Here, an actress performing on the sound-stage in front of a window frame is combined with an exterior winter scene. (National Film Board of Canada.)

A sky background is added to an actor's close-up which has been photographed on stage. (National Film Board of Canada.)

Seagulls and sky detail composited with a sound-stage set.

A shrinking-man effect for a TV commercial. The diminishing figure of the performer is composited with the full-scale scene by travelling-matte techniques. (Film Opticals Inc.)

Background printer mask for the previous shot. (National Film Board of Canada.)

A TV commercial in which the coffee appears to over-fill the cup without spilling. Travelling-mattes were used to combine separate shots of (a) a coffee cup, (b) black liquid poured into a clear glass cylinder and (c) steam and highlight effects. (Film Opticals Inc.)
Fig. 100. Travelling-matte techniques allow for photography of actors and background detail at different times. The actor is photographed with techniques which produce a travelling matte of his figure.

A background printing mask, or counter-matte, is prepared through step-contrast printing.

During composite optical printing, the separate foreground and background images are combined. This particular shot is a complicated one, involving miniatures, a static matte, a partially-completed full-scale set, a foreground actor and a travelling matte. (National Film Board of Canada.)

Describing such a process is complicated enough; its execution was infinitely more involved. Excessively high densities in the shadow areas of the master positives had to be avoided lest they produce a “phantom” superimposition of the actor’s image. The bleaching and dyeing of the master positive was a complicated and tedious process, careful determination of hue and saturation being essential. Inasmuch as the two strips of film ran in bi-pack, there was no practical way in which directors and cameramen could judge what the finished composite would look like, and be assured that the placement, perspective, and composition of the two components was as it should be. Finally, there was no provision for correcting the final composite, short of developing the dupe negative on the spot, examining it, and re-shooting the entire scene.

With the introduction and perfection of background projection, the Dunning-Pomeroy process fell into disuse and finally became obsolete. Nonetheless, the principle by which it operated is still of interest today. Suitably modified and simplified, the process becomes feasible for certain types of low-budget film production. One such modification was introduced by Pomeroy in the late 1920’s, which combined the principle of the Dunning process with that of the glass-shot. This technique allows for the combining of
foreground action with static background scenes on a single strip of black and white negative.

In practice, the master positive of the Dunning process is replaced by a fairly large photographic transparency which is mounted in front of the camera. The actor is positioned between the transparency and a background screen. The transparency has been bleached and dyed orange, the actor is illuminated with orange-filtered light, and the screen is illuminated with blue light. Assuming that short-focal length lenses and small apertures are employed in order to hold focus on both the actor and the transparency, a convincing composite results.

By moving the diapositive outside of the camera and changing its form to that of a glass-shot plate, a number of advantages are gained over the older system. First, the composite may be photographed with any conventional motion picture camera, inasmuch as bi-pack operation is no longer involved. Second, the photographic transparency is relatively convenient and inexpensive to prepare. Third, so long as the camera and transparency are rigidly mounted, there is no possibility of registration weave between components of the composite—even if an inferior intermittent movement were employed both the foreground and background images would jiggle in synchronism with one another. Fourth, with the background plate positioned outside of the camera, it is now possible for the director and cameraman to view and compose the complete composite by simply sighting with the “through-the-lens” viewfinder. Finally, by temporarily substituting a Polaroid-Land camera for the motion picture equipment, test photographs of the composite can be quickly produced as an aid in balancing foreground and background lighting. This process has much to recommend it to low-budget producers, although a great deal of experimentation is required before consistently good results can be expected.

**The travelling matte principle**

Despite their ingeniousness, both the original Dunning-Pomeroy system and Pomeroy’s later modification display a number of obvious limitations. The first is unacceptably awkward, the second does not allow for a moving background. Both are limited to black-and-white cinematography, and neither allows for convenient correction of the composite once the foreground action has been photographed.

All of these limitations may be overcome through the use of “male” and “female” travelling mattes and counter-mattes—strips of film bearing opaque images which are run in bi-pack with foreground and background master positives during optical or contact printing.

Let us assume that we already have a travelling matte and a counter-matte in hand, both of which match foreground action photographed on the sound stage. Whatever means we may use to produce it, the travelling matte consists of an opaque photographic silver image recorded against a clear field, on motion-picture film which is identical in width and perforations to the film on which the foreground actor has been photographed. The shape of the opaque mask conforms exactly to the outline of the actor, from frame to frame (Fig. 102). The female counter-matte is identical in configuration, but its tones are reversed—the silhouette is clear against an opaque silver field (Fig. 102).

We will assume that we wish to combine the shot of our performer with an exterior background, photographed elsewhere. A master positive of the background scene is inserted into the projector of the optical printer in contact with the matte, which is opaque in the area of the actor and clear in the surround. The projector and process camera are set running, and the background detail which appears around the actor’s matte is printed on to the dupe negative during first exposure (see page 146).

The dupe negative is re-wound to start position, and the master positive of the background is now replaced with that of the actor’s performance on the sound stage. The matte used during first exposure is replaced by its female counterpart, which is clear in the area of the actor’s figure and opaque in the surround. A second exposure is now made, in which the actor’s image is printed on to the dupe negative, thus “jig sawing” the two components together on to the composite. Assuming many things—that the matte and counter-matte match one another properly, that neither matte has “bled” excessively during its preparation, that registration-pin positions have been kept consistent in all stages of the operation, that exposure and contrast of the two images have been properly balanced, and so forth—then a convincing composite results (Fig. 102).

**Hand-drawn travelling mattes**

As the reader has probably gathered, the optical printing of travelling mattes is a complicated business, requiring the highest precision tools and techniques, consistently applied throughout the operation. Even more complicated are the techniques by which travelling mattes are originally recorded.
Hand-drawn animation provides what is both the most versatile and the most tedious method for the production of a travelling matte. The technique is commonly employed for the addition of animated background detail to live action scenes—birds in flight, waves, flickering lights, reflections, movement in crowds, and so forth.

In practice, the master positive of the scene to which action is to be added is inserted into the intermittent movement of either a process camera or a matte-shot projector, and the image of a single frame is projected, rotoscope fashion, on to a matte-board. An animation artist plots the action to be added (e.g., birds flying across the sky) by referring to the projected image of the live action scene on the matte-board. A series of drawings of the birds are produced,
appropriately animated for the desired effect. These are transferred with paints to transparent animation cels.

Transferring to film

With the process camera still mounted in the same position as was used for projection of the master positive, the series of animated paintings are now photographed on an appropriate raw stock—black-and-white or colour as the case may be. Each of the separate cels is photographed against a black card, so as to later dispense with the need for a female matte. With the animated art-work photographed, the travelling matte may now be produced on film by either one of two methods.

First, the outline of each of the animation-cel paintings is traced on to punched animation paper and then transferred, in register, to another set of animation cels, on which the outline of the animated action is inked in solid. This set of matte paintings is then photographed on to high-contrast duplicating stock in the same sequence as prevailed during the photography of the animated art-work, thus producing a travelling matte on film which matches the original drawings.

A female matte will not be required during composite printing, inasmuch as the original painted cels were photographed against a black card, and are thus “self-matted.”

The second method assumes, as is usually the case, that the original animation cel paintings are opaque. Then, we may dispense altogether with the tedious tracing process just described. Following the original photography of the animated painting, the cels are re-photographed on high-contrast positive stock. This time, the cels are illuminated from behind, rather than from the front. Since the paints are opaque, light cannot pass through the drawings and a clear outline of the action results on the high-contrast dupe. Since the cels are transparent in those areas surrounding the animated painting, light passes through the clear sections and is recorded as an opaque silver image on the high-contrast dupe negative.

Once the travelling matte has been photographed, the final composite is made in the optical printer. First, the master positive of the background is copied in bi-pack with the travelling matte. In this operation, the live-action image which appears around the animated art-work is printed to the dupe negative. The dupe is re-wound to start position, and, during the second exposure, the master positive of the self-matting animated art-work is printed.

Fig. 103. Use of a hand-painted matte to allow envelopment of actors by falling debris in the background plate. Two figures move past a burning hotel building. The building is, of course, a miniature.
Falling-debris techniques

Hand-drawn mattes are also employed for intricate composites in which falling masonry or other objects are required to fall behind, on to, and in front of an actor. In such cases, the falling debris and the actor are photographed on separate pieces of film. (Alternatively, if sufficiently skilled artists are available, the falling objects can be drawn and animated, of course.) The shot of masonry is rotoscoped and a set of matte tracings is prepared which reveals only those parts of the falling object which are appropriate to the scene. The tracings are transferred to cels, the cels are photographed to produce a travelling matte, and the composite is printed in conventional fashion. In the event that some of the debris is required to fall behind the actor, the image of the actor can be rotoscoped over the matte drawings during their preparation, thus allowing the artist to conform the matte to the shape of the actor’s body, from frame to frame. In the final composite, the image of the falling masonry will be progressively obscured by the matte, but as if by the actor’s body (Fig. 103). Alteration of the matte’s shape will also be required if the falling objects are expected to crumble or break as they strike portions of the set which are recorded on the background master positive. Should a counter-matte be required for final printing, this can be produced by simply step-printing the matte in contact with a strip of high-contrast positive.

As would be expected, considerable planning is necessary in such work to match perspective, motion-parallax, and size relationships between both of the live action components. The work is quite involved and requires considerable talent and experience for its proper execution.
Photographically-produced travelling-mattes

As we have seen, the hand-drawn travelling matte provides the only method of securing certain complicated effects, as well as the cheapest and most convenient method for wipes and “insert” mattes. For more conventional work, however, in which actors and other foreground objects are to be combined with background action, the hand-drawn matte is not practical. The cost of projecting and tracing an actor’s movements on to paper and transferring the matte images to eels would be exorbitantly expensive for sequences of any length. Instead, a variety of different techniques have been developed which allow for the photographic production of a travelling matte, either at the time that the foreground is photographed, or during subsequent duplication. These are described next.

Single-film systems

The black-backing process

As early as the 1920's, technicians were producing travelling mattes for black-and-white composites by first photographing their actors in front of a dead-black backing. The negative of the actor was fully exposed so as to produce a fairly dense image of the performer against a clear surround. After development, the negative was step-printed on to a high-contrast duplicating stock, which, in turn, was successively re-printed until sufficient contrast had been built up to produce a travelling matte in which the silver image of the actor was opaque against a clear background.

Providing a black backing was used for the original photography, a counter-matte was not required—the actor’s master positive was self-matting. In some cases, however, a white backing was employed, which required slight underexposure of the actor’s image and subsequent production of a counter-matte. Sometimes, in an attempt to reduce the number of duplications, the first high-contrast dupe was over-developed, or intensified with dyes.

For many years, this was the only practical travelling-matte system available. Unfortunately, the effect was not very convincing on the screen. Over-development, intensification, and multiple duplications of the mattes caused “bleeding” or spreading of the matte image. When the composite was made, this resulted in a visible matte-line or “halo” around the actor.

The process could be used with colour stocks, also, but the results were even less impressive than in black-and-white.

Colour-separation (“blue backing”) systems

A far better travelling-matte effect can be produced by employing a negative colour emulsion for the original photography, and capitalizing upon the film’s ability to record different colours which are intentionally produced in foreground and background areas during original photography.

There are two methods. In the first the actor is posed in front of a deep blue backing. In some cases, a painted flat is used which is illuminated from the front.* In other cases, a dye-impregnated translucent screen is used which is illuminated from the rear.

The actor is lighted conventionally with white light, and photographed on a colour negative stock. The colour negative which results is then step-printed in contact with a black-and-white master positive, which records only the blue component of the scene. The result is a black-and-white colour separation positive in which the background area is clear (Fig. 106).

The colour negative is again printed to a black-and-white master

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* For such purposes, a special blue paint, manufactured by the Kreiger Color and Chemical Company of Hollywood, is widely used. The paint is manufactured as a blue powder (M-107-1) which is mixed with a plastic binder (Q-50-1 Kreigrocine Binder). After being mixed, it is applied like any water-base paint, and dries out to a dull matte finish.
positive, this time recording only the red components of the scene. The colour-separation positive which results is black in the background area. This positive is then step-printed to a high-contrast dupe, producing a negative image of the actor against a clear field (Fig. 106C).

Finally, the blue-filtered positive and the red-filtered dupe negative are optically printed in bi-pack on to a high-contrast black-and-white stock, producing a travelling matte which is clear in the area of the actor and opaque in the surround (Fig. 106D). A counter-matte may now be step-printed from the matte (Fig. 106E).

The completed male and female travelling mattes, together with foreground and background master positives (Figs. 106G and 106F) are combined through bi-pack optical printing to produce either a colour or black-and-white composite (Fig. 106H).

The description is simplified, in that it does not describe intermediate printing steps, from colour-separation positives, that are often necessary to build up density and contrast in the male and female mattes.

The system is widely employed today and gives fairly good results when properly conducted. If precision and consistency in operations are lacking, however, a matte line results which is just as obnoxious in colour as it is in black-and-white. The matte line will assume whatever colour is used for the sound-stage backing. Actually, either red or blue could be used for satisfactory separation; however, it is easier to separate blue out of the actor's flesh tones than red. Also, if a blue matte line results, it will be far more likely than red to merge into the sky and other areas of the background scene.

Care must be taken to avoid the presence of deep blue colours in the actor's costume, lest they become transparent on the composite, allowing the background scene to be viewed through portions of the performer's body. Peculiar fringing effects also occur when cigarette smoke, transparent objects, reflections, blurred objects and fine mesh materials appear in the foreground.

The second method uses colour emulsions in an entirely different way to produce black-and-white composites. The actor is again posed in front of a blue-backing but he is illuminated with orange or yellow-filtered light, as in the case of the old Dunning process. Naturally, the resulting colour balance looks peculiar to the eye, but
as it is to be used to produce a black-and-white composite, this does not matter.

A negative colour stock is used for the original photography. The original colour negative is printed to a black-and-white positive, with colour-separation filters which pass the yellow-illuminated foreground, but hold back the blue background. This produces a black-and-white master positive which is self-matting.

The same colour negative is now printed to a black-and-white stock with colour-separation filters which pass the blue background but hold back the yellow-lit foreground. The result is a travelling matte which is clear in the area of the actor but black in the surround. A high-contrast counter-matte is printed from this, producing a clear surround and an opaque foreground image. This counter-matte is used with the background master positive during final composite printing.

Both of these single-film processes offer many advantages. They are relatively inexpensive. Conventional production cameras are employed for the original photography. The lighting equipment is standard and the colour-separation lighting is hardly more critical than for conventional work. Finally, once the original photography is completed, the film can be turned over to a special effects laboratory for step-printing of the travelling mattes, and bi-pack optical printing of the composite.

Under ideal conditions, the quality of composite in both systems is rather good; however, there are inherent limitations in all of the single-film processes described. First, since both male and female masks are made from the same colour negative, the effect is to render any transparent object in the foreground which is interposed against the blue backing as part of the opacity of the travelling matte, and, hence, as invisible in the final composite. This is particularly true of windows, glassware, smoke, and reflections. Semi-transparent materials, such as mesh or hair acquire a bluish fringe, as do solid objects which are out-of-focus or blurred through rapid movement.

Second, since there is no way in which blue light can be filtered out of the image which is recorded from the foreground, without also altering the record of the background screen, it is essential that primary blue colours be eliminated from costumes and props.

Third, the production of male and female travelling mattes requires several duplication steps, all of which contribute to image bleed and registration error.