PART one

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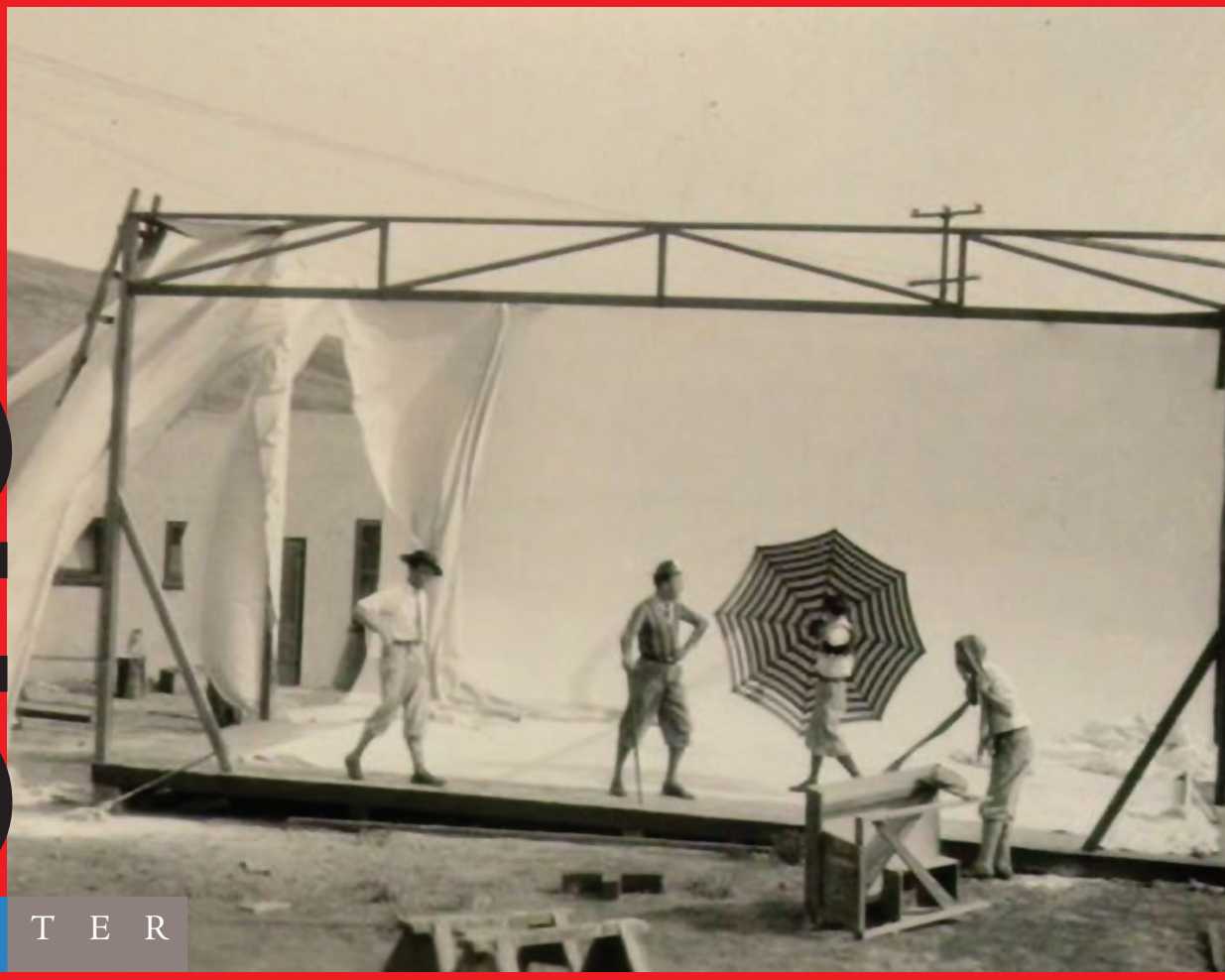
Exploring the Matting Process

Before you can understand *how* to shoot and composite green screen, you first need to learn *why* you're doing it. This may seem obvious: you have a certain effect you're trying to achieve or a series of shots that can't be done on location or at the same time. But to achieve good results from your project and save yourself time, money, and frustration, you need to understand what all your options are *before* you dive into a project. When you have an understanding of how green screen is done on all levels you'll have the ability to make the right decision for just about any project you hope to take on.

one

CHAPTER



Mattes and Compositing Defined

Since the beginning of motion *pictures, filmmakers have strived to create a world of fantasy by combining live action and visual effects of some kind. Whether it was Walt Disney creating the early* Alice Comedies *with cartoons inked over film footage in the 1920s or Ray Harryhausen combining stop-motion miniatures with live footage for* King Kong *in 1933, the quest to bring the worlds of reality and fantasy together continues to evolve. With computer technology pushing the envelope more every year, filmmakers are constantly attempting to outdo their predecessors with more realism and fantastic visual effects.*

Often misrepresented as chroma keying (which is a process relegated to a video switcher that turns off a specific color value in a video channel), the matting or traveling matte process uses a sophisticated series of elements that allow you to make complex extractions and composites. Although the industry may still refer to a matte as a key or keying, it's rarely suggested that an actual chroma key be used unless it's a crude and simple video production. With software and hardware matting and compositing available today, you'll seldom use such archaic technology.

In this opening chapter, I'll share the history of compositing and matte-making techniques so you'll better understand where this technology came from and why it's still important today.

The Road to the Modern-Day Traveling Matte

Let's start with the earliest compositing techniques. They were developed by Frank Williams, who used a black-backing matting process, which he patented in 1918. The process required the foreground actor to be evenly lit in front of a black background and then copied to high-contrast films, back and forth, until a clear background and a black silhouette were all that was left on the film. Using a contact print with the silhouette matte film and the intended background footage together, a composite could be created. This process was used in many of the action silent films and continued to be used through the 1930s for the series of *The Invisible Man* features.

The Early Days

In 1933, John P. Fulton used this technique in one of Universal's most timeless and memorable stories, H.G. Wells' *The Invisible Man*. Actor Claude Rains wore black velvet under his clothing and gauze bandages and was shot against a black background, and the composited shots were cleverly created to sell the illusion (see Figure 1.1). It was such a success that several sequels were created in the years following the original; they used the same process, even though more sophisticated techniques had been developed.

Figure 1.1 *In 1933, John P. Fulton of Universal used effects for* The Invisible Man *that awed audiences for generations as being technologically far ahead of their time.*

Walt Disney set out in the 1920s to do a series of cartoons called simply the *Alice Comedies*. These were short films that used footage of a live actress shot against a white background. The film was run through an animation camera a second time to expose the animated characters and backgrounds (see Figure 1.2). Some of the scenes were done frame by frame from a series of stills to get closer interaction with the live actress and the animated characters.

Walt wanted to do something more than just add cartoons to an existing film, as Max Fleischer had done in some earlier films (although Walt invented the rotoscope process along with Max's brother Dave). Disney wanted to put the live actress into an imaginary world, and he created a feature-length film called *Alice's Wonderland*, which was never picked up by a studio. His *Alice Comedies* continued, with various actresses playing the Alice role in these silent films.

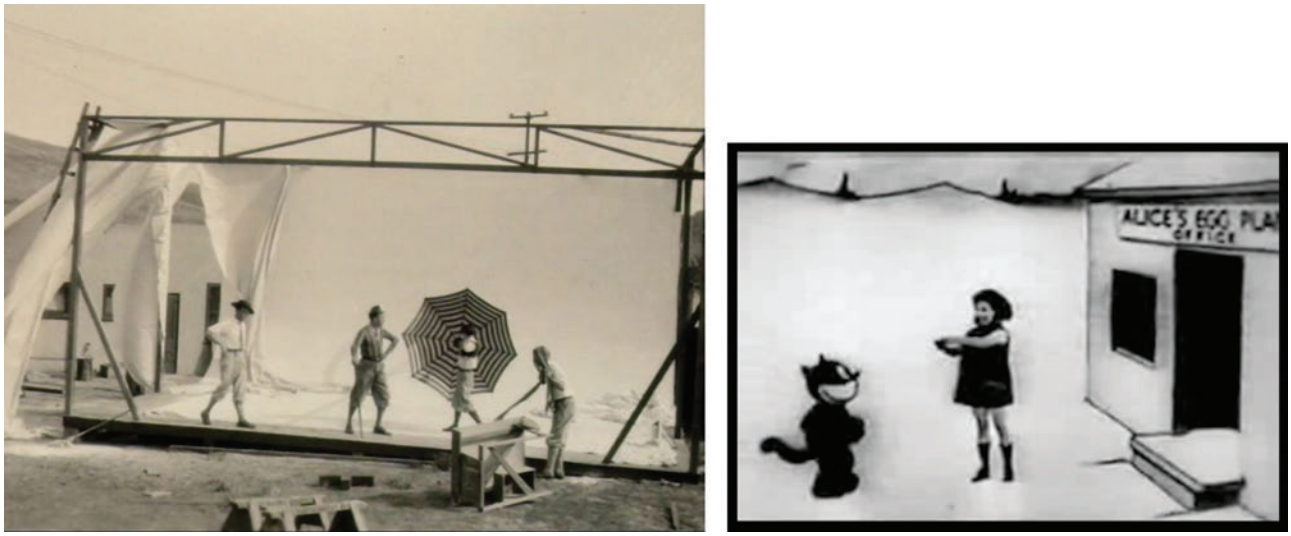


Figure 1.2 *The first Disney composites combined live film footage with cartoon characters and backgrounds.*

Walt's top animator working at the Disney studios at the time was Ub Iwerks, who helped solve issues with the multiplane animation cameras to achieve better lighting exposure for the Alice cartoons. Ub was also responsible for helping Walt develop characters such as Oswald the Rabbit and what would eventually become the icon for the Disney empire, Mickey Mouse (see Figure 1.3). He and Disney parted ways for a time due to a dispute over a third-party contract, and Ub ventured out on his own.

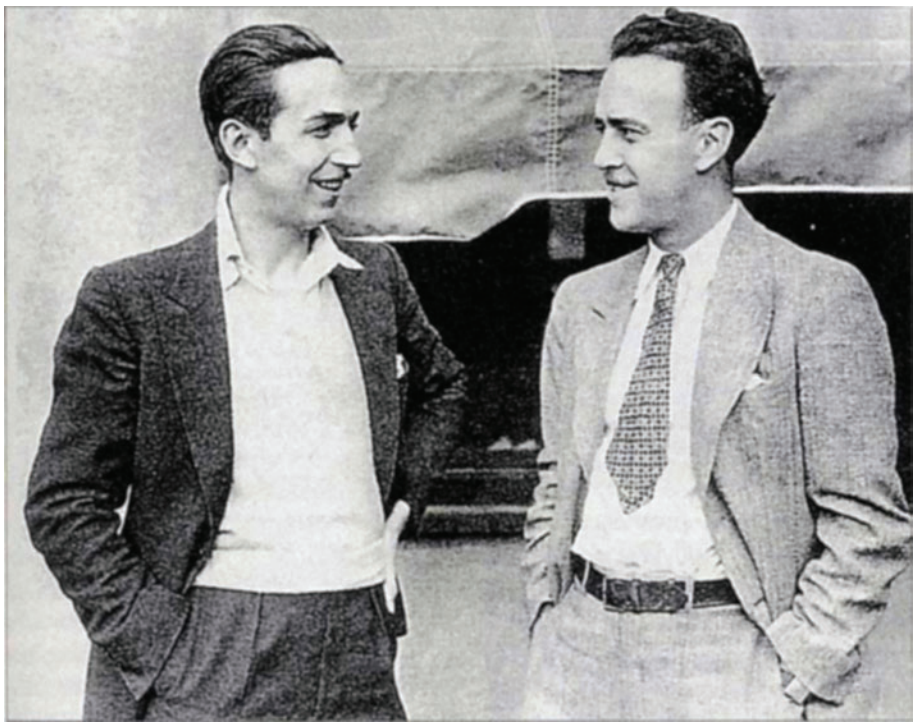


Figure 1.3 *Walt Disney and Ub Iwerks in the early days*

As shown in the documentary *Brazzle Dazzle Effects* on Disney's *Pete's Dragon: High Flying Edition* DVD (`http://disneydvd.disney.go.com/petes-dragon.html`), Ub returned to Disney in 1940 and remained until the end of his career, working in Disney's film technologies processing lab.

In 1944, Disney and Ub developed new ways of mixing animation and live action in color with the feature film *The Three Caballeros*. This fantastic production used several techniques, including clear animation cells composited onto live film footage, rear-screen projection of animation behind live actors and dancers, and a color removal/transfer process. This process wasn't quite as sophisticated as what was to come: it used a dark background that, when duplicated onto black and white negative film, could hold a luminance matte of the actor from the color film; a crude extraction could then be made. Using the optical printers at the time, this footage was combined with animation cells and color overlays to create some fantastic effects never before seen. Several other Disney productions were accomplished with this process, including *Song of the South* and *Fun & Fancy Free*, as well as a number of Disney's television specials.

One of the true pioneers of the optical printer was Linwood Dunn, who joined RKO Pictures in 1929. Dunn worked on developing the first commercial production model of the optical printer, which was used by the armed forces during WWII; he won an Academy Technical Award in 1944 for his design. During his time working at RKO, he created a double-exposure matte process for the musical film *Flying Down to Rio*, which was an effect that was ahead of its time for 1933 (see Figure 1.4). In this film, many of the location scenes were performed and shot in front of a rear-projection screen.

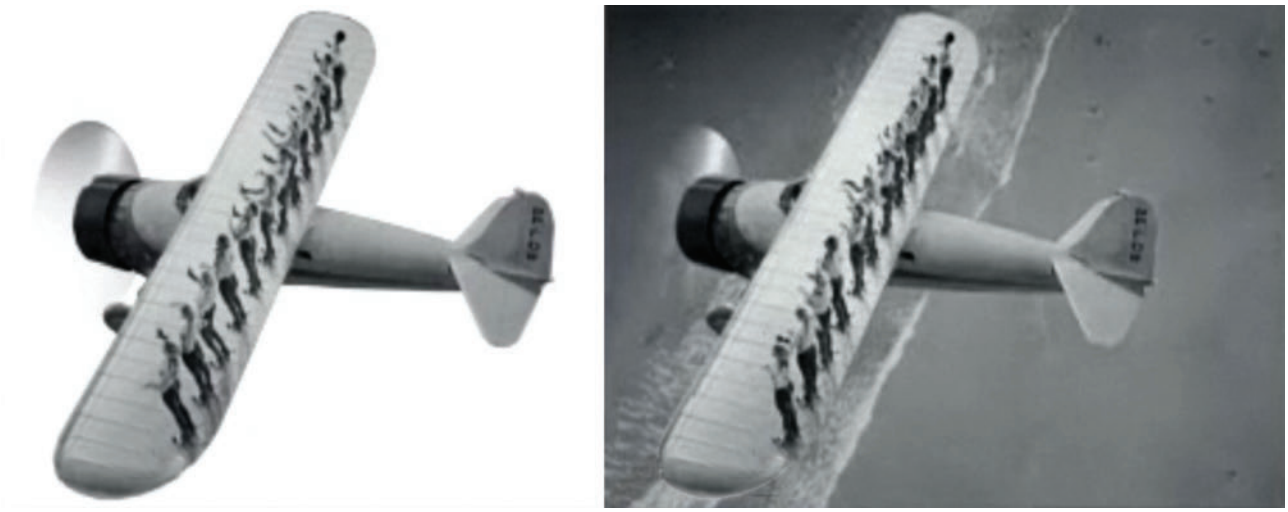


Figure 1.4 *The matte process using the optical printer on the 1933 musical comedy* Flying Down to Rio

The Traveling Matte Is Introduced

Petro Vlahos perfected the traveling matte system while working at the Motion Picture Research Council. This process originally used sodium vapor lighting on a set with the actors well in front of it. Petro's system was different from that of the British, who were forced to use didymium filters on all the lamps (which cost them two stops of light) plus a sodium absorption filter on the camera (resulting in another lost stop of light). This system was cumbersome and costly and produced results that were inferior to Petro's process.

Petro's system involved the use of a multicoated prism in a large Technicolor camera that split off the sodium light from the color film and directed the difference to the black and white film to create the traveling matte. He borrowed sodium vapor streetlights from the Department of Water & Power to light his scene and test his prism and camera process (see Figure 1.5).

Figure 1.5 *Sodium vapor street lights cast a yellow light in a narrow bandwidth*

Interestingly, Petro developed his process and patented the technology at the same time the British developed their system, without either entity knowing about the other's developments (see Figure 1.6). Keep in mind that this was well before technology and information were as rapidly globally accessible as they are today.

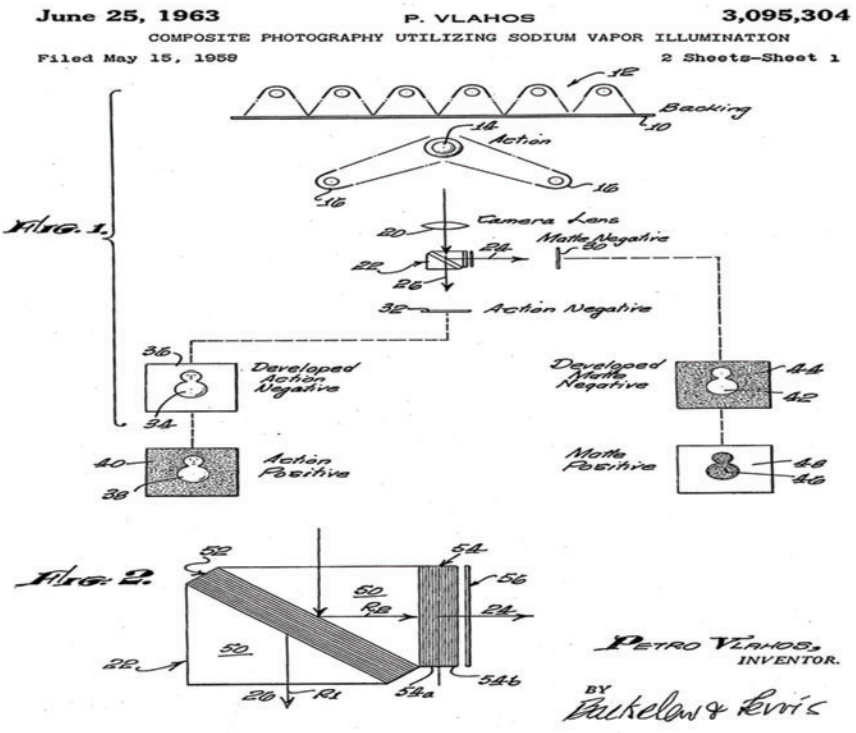


Figure 1.6 *Petro Vlahos' patent for the sodium vapor compositing process*

Upon learning of the British attempts at a sodium vapor lighting system's development, Petro made a trip to England and met with Ub Iwerks of Disney, who bought Petro's multi-coated prism from him in 1959 and started producing films for Disney using this technology. Ub then went on to perfect the camera used to shoot the traveling matte shots for several Disney feature films.

When I interviewed Petro Vlahos recently (Figure 1.7), he stated that even though Ub has been mistakenly credited with inventing this process in several instances, and has even received awards for the technology, Ub "took no part in the development, invention, or testing of the system which includes the multi-coated prism, but he did use it and made it popular in several films."

However, Ub Iwerks did perfect the production process using Petro's multi-coated prism in a three-strip Technicolor camera, which was dubbed "Traveling Matte Camera #1." In Figure 1.8, Ub is shown with the camera and the front is opened to reveal the prism, of which only one is to be reported to ever exist—the original that he originally bought from Petro Vlahos.

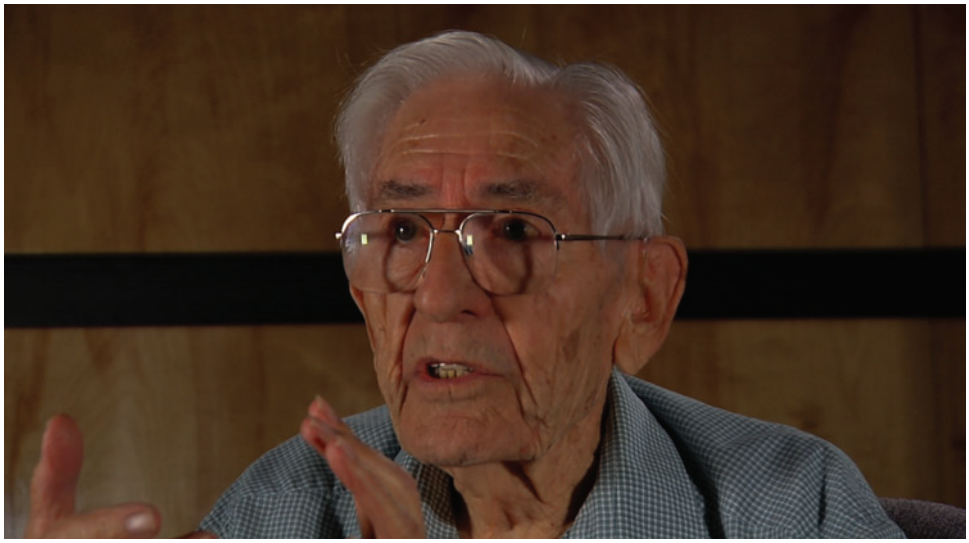


Figure 1.7 *Petro Vlahos at age 93 when I interviewed him*

Some of the earlier Disney films that Iwerks was responsible for, using this process, were *The Absent-Minded Professor*, *The Parent Trap*, *Mary Poppins,* and *Pete's Dragon*. Alfred Hitchcock borrowed Iwerks from Disney to supervise the special effects in his 1963 production of *The Birds*.

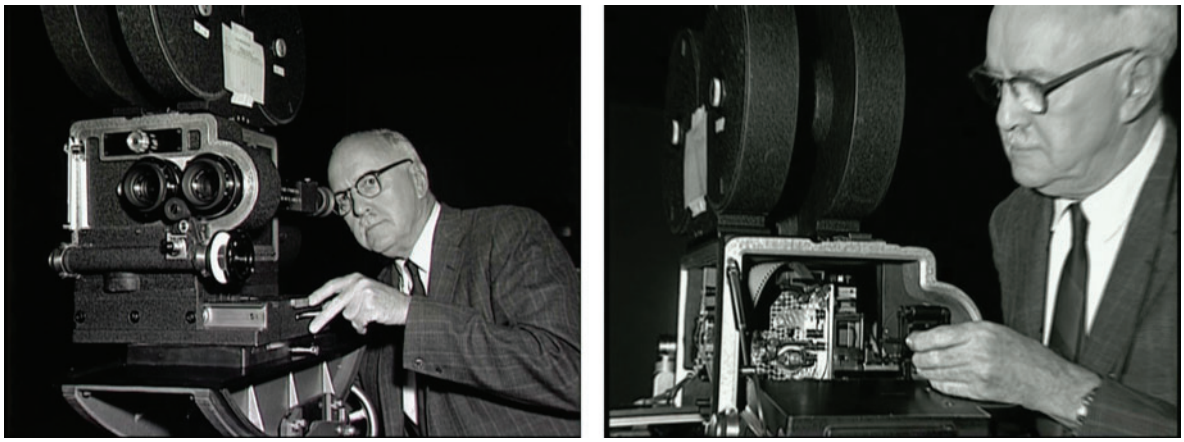


Figure 1.8 *Ub Iwerks with the modified Technicolor camera and Petro Vlahos' multi-coated prism*

Other notable pioneers of the compositing world who used early versions of the traveling matte process were Larry Butler for the 1940 Technicolor feature *The Thief of Bagdad* (SIC) and Arthur Widmere for *The Old Man and the Sea* (1958); see Figure 1.9. Widmere and others tried using ultraviolet lighting to create mattes, with acceptable, but still limited results.

Figure 1.9 *Composited scenes from* The Thief of Bagdad *and* The Old Man and the Sea

But it wasn't until Petro Vlahos was challenged by MGM during the production of *Ben-Hur* that things really started to develop. MGM was shooting *Ben-Hur* in 65mm (then printed on 70mm), so the sodium vapor system Petro had developed wouldn't work—it was designed for 35mm Technicolor cameras.

Vlahos knew about the blue screen process others had been using with limited results (watch *The Ten Commandments* to see some of the major issues for reference); things like hair, smoke, motion blur, and transparency couldn't be properly matted and left a blue glow in these areas. He knew there was a select band in the color spectrum where blue could be split off with good results. He developed and refined the technology and patented the technique known as the Color Difference Traveling Matte System (see Figure 1.10). He won an Academy Technology Award in 1964 for this technology, which made the shooting and compositing of *Ben Hur* possible. All subsequent blue screen and green screen technology has been based on Vlahos's invention.

Vlahos holds several patents for his work in the motion picture industry area over the years, including a matte metering system, a camera flicker metering system, a camera crane motion-control system, a high-grain screen for outdoor drive-in theaters (for which he won a technical Oscar in 1957), a safe pyrotechnics discharge system, a daylight lighting system (which was used in *Ben-Hur*), and a fake blood for filmmaking that was made of tiny red glass beads and cellulose wallpaper paste that wouldn't stain expensive costumes. He has won several awards for his technical achievements, including Oscars, Emmys, and more, and has altered the course of motion picture history through his many accomplishments.

In 1976, Vlahos founded the Ultimatte Corporation (`www.ultimatte.com`) with a colleague, Bill Gottshalk (cousin of Panavision founder Robert Gottshalk), to create the electronic color difference traveling matte system, commonly known as the Ultimatte. Patro was joined by his son Paul Vlahos, and Ultimatte has led the industry in digital keying and compositing. Their technology in live broadcast keying hardware remains the de facto standard today and is also licensed by their largest competitor, Grass Valley, for use in its hardware systems. Ultimatte's software matte system remains superior to most on the market today.

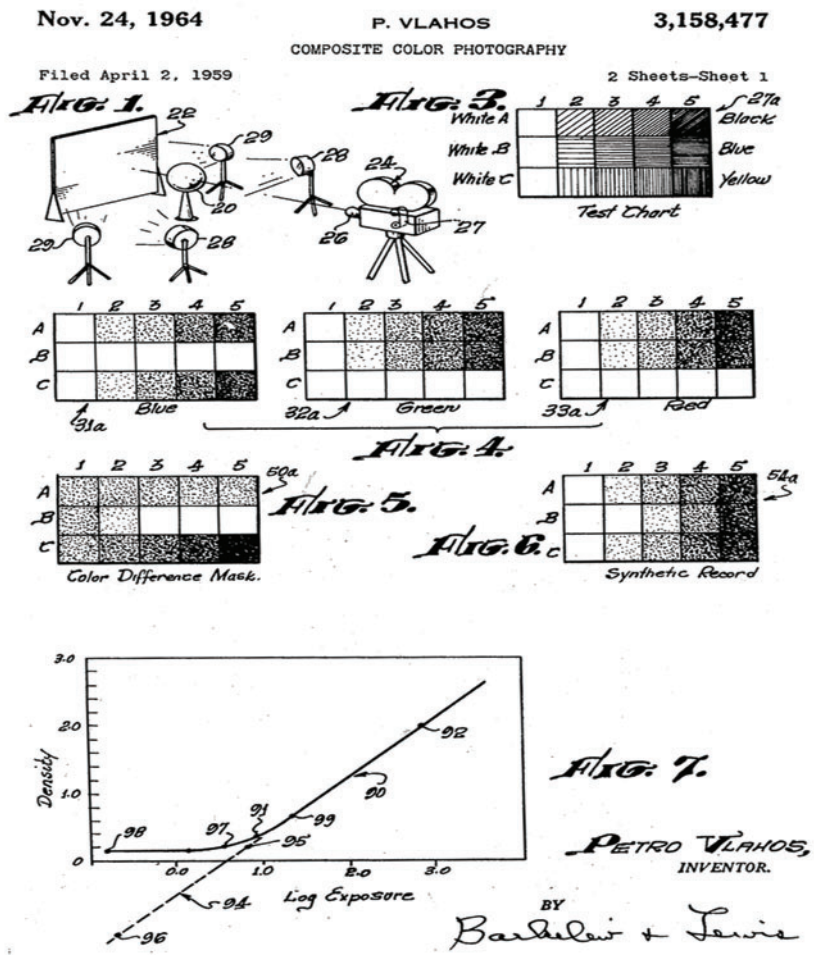


Figure 1.10 *Petro Vlahos' patent for the Color Difference Traveling Matte System*

Ultimatte has a sister company called iMatte (`www.imatte.com`), run by Paul Vlahos, which develops new technologies for live and video conference presentations and advanced camera technology for mobile devices. Paul has been instrumental in the development of much of the technology at Ultimatte over the years, holds several patents of his own, and has received awards for his accomplishments.

Ultimatte has been used extensively in broadcast television production since the late 70s. One of the original shows that used it was Carl Sagan's *Cosmos* series for PBS. The composited footage was ahead of its time, which raised the bar for production quality of Dr. Sagan's series. You can find several examples of *Cosmos* on YouTube.

Many variations of this basic traveling matte technology have been explored over the years, as I'll cover in this book. Different ways to light and shoot the screens have been explored, including front projection, rear projection, interior and exterior lighting, film, and hardware and digital compositing—each has made its place in special effects history.

How the Sodium Vapor Traveling Matte Process Works

The term *traveling matte* simply means a matte that travels with motion picture images from frame to frame. A *fixed matte* stays constant throughout a sequence, as is done with basic garbage matting and the traditional hand-painted matte paintings on glass that the camera shoots through, to the static scene behind the glass.

As illustrated in the historical documentary produced by Les Perkins, *Brazzle Dazzle Effects* on the *Pete's Dragon* DVD, the sodium vapor traveling matte process uses sodium light to produce a contrasting matte when exposed through a prism in the camera and onto black and white film. Contrary to popular belief, the sodium system (often mistakenly referred to as a "yellow screen") doesn't have a yellow background; rather, it consists of a white painted background that the sodium lights bounce off and back into the camera. This specific yellow sodium light that has a color temperature of about 1300°F (700°C) splits off to generate the matte on the black and white film stock; but because of its narrow spectral bandwidth, it doesn't affect the rest of the footage on the color film that is exposed. The color film records this portion of the scene as a dark bronze color, since the prism splits off the narrow bandwidth of the yellow sodium vapor light.

www.disneydvd.disney.go.com/petes-dragon.html

There are two film carriers in the camera. The lens in front captures the image, a prism deflects the sodium light frequency off at an angle onto the black and white film, and the color information continues straight on through to the color film. In the example illustrated in Figure 1.11, the process that was used in many of the Disney features is shown. The original scene showing the sodium vapor lighting on the background. The color footage of the actors is captured along with the black and white matte footage, which is then processed and inverted to create a void in the background plate. This matte is then masked to incorporate the animated character with the background plate and the animated characters and rotoscoped shadows. The final result may be several duplications of film later.

You can see why this technique was time-consuming and was eventually abandoned for the newer blue screen process and, eventually, the digital compositing that we take for granted today.

Figure 1.11 *The sodium vapor traveling matte production sequence with animated characters*

How the Modern-Day Blue and Green Screen Traveling Matte Process Works

Today's hardware and software compositors can provide real-time results, extracting the background screen from an image and creating the matte without the need for duplication or processing film.

The blue or green screen production process is primarily made up of three elements: the foreground subject, the colored screen background, and the target background that the subject is composited into. Instead of a separate film stock processed at the same time as the original footage to create the traveling matte, the matte is generated from the background color on original film or digital video footage and composited digitally through hardware or a software application as shown in the diagram in Figure 1.12. Variations and combinations of this process are discussed throughout this book, but the process is basically the same using either hardware such as an Ultimatte or a computer software editing/compositing program.

Professional and amateur filmmakers alike can now shoot, extract, and composite scenes with ease, thanks to the technology available for every budget. The only limitation is your imagination and how much time you want to put into the planning, production, and post-production of your project.

Figure 1.12 *The green screen traveling matte production sequence*

You can read more about how today's studios and indie filmmakers are using this technology in their projects in Chapter 7. As shown in Figure 1.13, the production of HBO's *John Adams* involved a lot of compositing techniques that are much more advanced from the simple sodium vapor process that Petro invented.

Figure 1.13 *Shooting and compositing green screen on the set of the HBO miniseries* John Adams

Figure 1.13 *(continued)*

Where to Learn More?

Studios and Productions Mentioned in This Chapter

- **Disney's *Pete's Dragon* DVD**: www.disneydvd.disney.go.com/petes-dragon.html
- **Les Perkins**: www.lesismoreproductions.com
- **Universal Studios**: www.universalstudios.com
- **RKO Pictures**: www.rko.com
- **MGM**: www.mgm.com
- **Ultimatte Corporation**: www.ultimatte.com
- **iMatte**: www.imatte.com
- **HBO**: www.hbo.com

You can find a complete list of references and suggested continued reading/learning from this chapter in Appendix A.