Stop-motion animation began as a special effect that was essentially done in the camera. Before long, other processes were invented for creating further visual effects in post-production. These effects evolved to the point that differentiation would be needed between special effects and visual effects. Today, the term “special effects” is used for practical effects that are done on set or in front of the camera during production. “Visual effects,” on the other hand, are done entirely in post-production, and in some cases during the film era, the elements were simply prepared or created within the camera itself. The basic principles of many of these visual effects have remained the same, but the tools used to create them have certainly changed. What used to be done with a great sense of tedium on a single strip of film can now be done with a great sense of tedium in the computer. Today’s digital tools still provide challenges and require just as much patience and skill, and they can range from very basic to much more complex.

As filmmakers become more savvy and higher-end tools become more widely available for the average person making homemade stop-motion films, the creative possibilities open up a whole new world of potential. Some in the stop-motion community even believe that today’s digital compositing tools can be used to bring back the classic effects used in Ray Harryhausen’s films and are moving forward to bring that genre back to the modern era. When looking at the level that stop-motion and visual effects have reached by themselves, I think the potential behind this pursuit is pretty exciting. Harryhausen’s films have inspired an entire industry, so it makes sense to continue that sense of inspiration for future generations. The goal of any film should be to create inspiration, whether for a moral message, for a good story, or simply to create more films. Ultimately, the use of visual effects should not be done
simply for the sake of using them, but to allow for more creative control over the performance or look of a scene. The effects should become transparent to the audience and should not draw attention to themselves, but they should always serve the story. This chapter will show some techniques that can be used to combine stop-motion animation with other elements, whether live action or digital.

**Film Compositing**

To better understand how visual effects are done today, it helps to understand a little bit about how they were done in the “old school,” before modern digital tools were available. For stop-motion, a good number of these effects came to fruition in the original *King Kong*, which brought together several different processes for marrying animation with live-action footage. One of the most basic compositing effects that can be done on film is a split-screen matte shot. It is so basic that I used it myself many years ago on my student film, *Snot Living*, at the University of Michigan, which I shot in 16mm. For a shot where my live actor, Brandon Moses, stared at the animated clay puppet in the same shot, I simply framed up my shot and attached a glass plate to the camera lens with poster putty. In the area where I wanted the puppet, I masked out that part of the frame with black paper on the glass, creating a matte (Figure 9.1). The black matted area would not be exposed on the film, but the rest of the frame would. In the area surrounding the matte, I shot Brandon in live action. Next, I had to rewind the film to the same frame where I started, cover up the rest of the frame with black paper, and remove the previous matte, essentially reversing it (Figure 9.2). Then, in this area, I shot my animation through another pass on
the same frames in the camera. After sending the film to the lab and getting it back, both exposed elements were blended together into the same frame (Figure 9.3). The risk in using this technique was that if something went wrong with either side of the matte, the whole shot would need to be redone.

![Figure 9.3](image)

Both sides of the matted areas appear combined in the final composite.

I used the same technique for another shot in the film, where Brandon gets hit in the head and three tiny versions of the clay puppet spin around his head (like in those old cartoons where little birds or stars would spin around a character’s head after a serious injury). In this case, the matted area where the animation happened was a tiny rectangular space near the top of the frame (Figures 9.4 to 9.6).

The extra trick with this shot was that because most of the frame was matted out, I was able to rig a large set in the same place that Brandon had been lying earlier. Because I wanted the puppets to look like they were spinning in mid-air, I placed them on a horizontal sheet of Plexiglas so that the background would show through. The Plexiglas was held up (precariously) by two footstools and a stack of phonebooks on each side to bring it up to the level of the matte window. This whole setup actually came crashing down in the middle of my animation, but luckily I was able to set it back up and place the puppets back where I thought they had been. Surprisingly, it worked, and I didn’t have to reshoot anything, which was a complete fluke and stroke of dumb luck. *(Snot Living* can now be found on YouTube by typing the title in the Search window.)
The limitation to the split-screen matte is that the live-action and animated elements in each half of the shot cannot cross the matte line. If they do, they will be cut off. For this reason, the effect can only be used for certain shots where the two elements don’t need to cross over each other. For shots where a stop-motion puppet needs to move across a live-action frame or interact with it, Hollywood movies have used rear projection, a technique in which a puppet would be animated in front of a movie screen projecting previously shot live-action footage one frame at a time. The puppet would be moved to match the
background, the camera took a frame, the rear projector advanced to the next frame, and the process repeated. For any moments of interaction, the puppet was simply positioned to match up to the live-action footage behind it. This was the basic premise of Ray Harryhausen’s Dynamation process, which would also be combined with matting out any foreground elements in front of the puppet and matting them back in through another camera pass. When you understand how they did this, it makes watching those old Harryhausen films that much more awesome.

In other situations, a *traveling matte* can be created. This technique requires more steps and passes of the film through the camera, often done through bi-packing two strips of film together to create the various composites. One of these methods, the Williams process (named after its inventor, Frank Williams), was used for some shots on *King Kong* and other films. To illustrate this process for black-and-white film, I put together a digital re-creation of a film matte using a miniature dinosaur and a photo of Vancouver. First, the stop-motion puppet could be shot against a neutral or black background (Figure 9.7). The actual film in the camera, however, would capture a negative image of what was on set, creating a negative puppet against a white background (Figure 9.8). This strip of negative film was printed against another strip of high-contrast film stock, which created a silhouette of the puppet and left the background transparent (Figure 9.9). A live-action background would be shot separately and developed into a positive print. This positive print was reprinted behind the high-contrast silhouetted image of the puppet (Figure 9.10) and showing through the transparent negative space around it. The result was a

![Figure 9.7](image1.png)  
*Figure 9.7*  
This is what the camera sees: a miniature puppet in front of a neutral dark background.  

![Figure 9.8](image2.png)  
*Figure 9.8*  
This negative image is what is actually captured on film inside the camera.
new negative of the live-action background with a transparent shape of the puppet cut out of it (Figure 9.11). This negative was then combined with the original negative of the puppet, which would fit exactly into the transparent shape (Figure 9.12) and then be developed into a new positive image of both elements (Figure 9.13).

**Figure 9.9**
The negative is reprinted onto a new strip of high-contrast film, leaving the background transparent around a silhouette of the puppet.

**Figure 9.10**
A positive print of the live-action background is printed behind the film with the transparent background and silhouette.

**Figure 9.11**
Now, there is a new negative with a transparent shape of the puppet cut out of it.

**Figure 9.12**
The original negative of the puppet is inserted into the transparent matte.
With color film, this process gets much more complicated because it essentially deals with using a blue screen as the neutral background, filtering the lens with the same color blue, and running more strips of film with alternating negative and positive images repeatedly through an optical printer. An optical printer is a combined movie projector and camera that can create composites in a similar manner to the in-camera processes, which is how special effects were done up to the digital revolution of the past 15 to 20 years. The tricky thing about these methods, other than having to think about alternating positive and negative images that are backwards, is the reliance on exact alignment of every element. If one thing goes wrong, an entire composite needs to be scrapped and repeated. Although these exact methods mostly have been phased out in today’s digital filmmaking era, it is fascinating to look back at how these cinema wizards brought classic images to the screen with what they had. These guys were true technical magicians, and their innovations can help us better understand and appreciate the tools available to us now. Everything we can do now comes from the logic behind these techniques.

**Figure 9.13**
The negative is developed into a positive print of both elements together, and now Vancouver is under attack by dinosaurs.
Digital Compositing

Today, we have a lot more freedom allotted by digital tools that can create seamless composites and work around many of the errors and setbacks that would occur from using film. They are essentially a combination of the foundations laid by the old-school film techniques and other developments in video technology that bridged the gap to computers. One common tool used in digital imaging today is the alpha channel, which essentially makes any part of an image transparent and allows another image layered behind it to show through. This is very much a digital extension of the transparent negative image from a strip of film, and it can be created for the entire background around a subject or as any shape within an image where a transparent area is wanted. Many compositing software programs used today also have the capability of creating masks that will cut or matte out any part of an image to combine it with another. Also popular is the option of chroma keying out a blue- or green-screen background and replacing it with a live-action or digital background. This has been used for matte work on films and is also used in video production for weather reports, talk shows, and special effects.

Split-Screen and Masks

The split-screen and traveling matte processes have transitioned into the digital era using the same principles from film, but obviously with more flexibility and creative options for the filmmaker. To demonstrate some very simple techniques that can be done for compositing stop-motion with live action, I’m glad to present some contributions by Vancouver-based independent filmmaker Rich Johnson. I discovered Rich’s films online and became a big fan of his hilarious Web series *My Friend Barry* (http://www.myfriendbarry.com), which is about a character named Frank (played by Rich) and his little blue stop-motion friend Barry. Part of the charm of the series is its simplicity, including the subtle compositing effects that bring Barry into the live-action world. Frank’s dialogue is scripted but sometimes improvised, which allows for many possibilities for having the silent animated character Barry react to the action.

Many shots are done in a simple split-screen technique, where live action and stop-motion are shot as separate scenes and brought together into one shot. This can be done very easily in any nonlinear editing program by applying a mask with an alpha channel into one of the scenes and then layering them together in Premiere or After Effects. In this situation, the split-screen matte line still acts as a division where the two elements should not cross over each other (Figures 9.14 and 9.15).
Other shots require a little more work and planning in the compositing and layering to bring Barry into interaction with the live-action world. Here, Rich himself describes the steps he takes to accomplish this:

I start by locking the camera down and shoot the live-action video with markers so the actors know where Barry is going to be when looking at him or following him as he moves. I also make a rough note about how long things take and what new improv comes out of the shoot so that I know where I need Barry to move, react, and look. After the live-action video is done, I use a remote to capture frames of Barry moving around with a clean background behind him. I also take one or two frames of the clean backplate with no Barry or actors, in case I need it for any holes and to mask bad reflections or unwanted shadows.
For a shot in Episode 1 where Barry comes out from under the bed and rolls in front of Frank, three layers are needed to make this comp work:

1. Stop-motion layer with Barry animated and saved out as a high-res MOV file the same frame rate as my live-action plate. In this case, it was NTSC 29.97 (Figure 9.16).

2. Live-action video layer with Frank, shot using NTSC 29.97 frames per second, in standard definition (Figure 9.17).

3. Clean background plate in case it's needed (Figure 9.18).
I import and/or capture the stop-motion and video layers into my editing program in this same order, with stop-motion on top. I use a temporary “garbage matte” (drawing a rough matte around the general area where Barry is) on my stop-motion layer so that I can see the video layer underneath. If you can’t make a temp matte, another method is to reduce the transparency. The key is to be able to see both layers so that you can match them up for your final edit before compositing them together. This is the most important step, and you need to lock down the edit in this stage because the last thing you want to do is go back and make changes. It’s too much work to do that. Each layer is edited and timed out, the temp matte is removed, and stop-motion and video layers are exported as uncompressed files to my compositing software.

Then, I import the uncompressed files into compositing software the same way, with layers arranged top to bottom. I add a 2-pop* one second before and after each clip to help ensure that they are lined up.

[*Author’s note: A 2-pop is a sound tone one frame in duration that is typically placed two seconds before the exact start of a program for cueing purposes.]

Next, I mask out the stop-motion layer frame by frame as needed to reveal Frank in the video layer (Figures 9.19 and 9.20). For the mask, I only concentrate on the areas where Barry’s layer passes in front of Frank’s. The rest of the picture on both layers does not change from one to the other, so I don’t worry about perfecting the mask in those areas. I finesse the mask by feathering the edges by two pixels or so. That softens up the edges of the mask and blends nicely with the video layer, making for a seamless composite. Now Barry passes in front of Frank (Figure 9.21). It’s like magic!

Figure 9.19
Stop-motion layer being masked out.
(Courtesy of Rich Johnson.)

Figure 9.20
Masked out stop-motion layer with live-action layer behind it. (Courtesy of Rich Johnson.)
For another scene in Episode 2, where a live-action hand comes in to wipe Barry’s face, the same technique is used. The only difference is that it’s not Barry who is masked—it’s just his eyes. One mask for each eye means all reflection and shadows are real on the rest of his body, even in his eye sockets. I put on the actor’s coat and sweater and wiped Barry’s face with my own hand. I made sure that Barry’s eyes were closed when I did this, so in the video layer, Barry’s eyes are closed (Figure 9.22), and the only animation going on is his eyeballs (Figure 9.23). Sometimes Barry’s eyeballs were crooked, so I would grab the left eye, make a mask, duplicate it, flip it 180 degrees, and add it over the right eye. Now, I had two fixed eyes animating in sync. When done correctly, masks are very powerful for this type of work, and I use them for everything.

Sometimes, in production, I would choose to pose Barry in many different ways, animating his basic moves: looks right, looks left, looks up, looks down, blinks while turning, and blinks at camera. From that, I could make him do anything I wanted in the editing, and it also meant that I could improvise with Frank, which gave me tons of freedom in crafting the jokes and pacing of the show. In this case, I would only plan for his entrance or exit for the shot. Barry is made of Play Doh, which makes him tougher to animate and makes him look kind of lumpy and cracked, which is part of his charm. Sometimes, obstacles are good to have, and little mistakes can help shape the work into something new and original. As long as I stay true to that and don’t get too hung up on the details, the show’s overall character stays pretty consistent. Barry is an easy shape and has no mouth, so basic stop-motion with him worked perfectly for what I was trying to achieve and convey in my storytelling.
Blue/Green Screen

The technique of shooting stop-motion puppets against a neutral blue or green screen is pretty straightforward. If your intention is to combine stop-motion with a live-action shot, first shoot your live action separately (Figure 9.24), and then animate your stop-motion puppet on a miniature set with the screen behind it (Figure 9.25). In the computer, you can place the live action into another layer under the stop-motion sequence and remove (or key out) the blue or green background to reveal the live action underneath. The result will be both images composited together in the same frame (Figure 9.26).
Whether you use a green or blue screen depends on several different factors. Traditionally, blue was the best color for optical matte shots on film, and green became the preferred choice for video because of the nature of the media themselves. Today, with most films being shot with video or digital cameras, there are subjective and artistic in addition to the technical considerations. One factor is the colors present in the stop-motion puppet you are shooting. If your character is designed with many shades of green, a blue screen may be a better choice (and vice versa—using a green screen for a blue character). This separation of colors helps in the compositing process and avoids any color from the actual puppet being keyed out along with the background. The lighting may also have an impact on which screen to use; a blue screen may separate from the puppet better in warm light situations, and cold lighting may be better for a green screen. The screen itself can be purchased as a precolored posterboard (Figure 9.27), a fabric sheet, or a flat screen material. You can also buy paint (Rosco or a similar brand) in the specific key color and apply it to a flat sheet of board or foam core. With either method, the background should be lit evenly or illuminated from behind to allow for a clean wash of color and no shadows, which makes it easier to key out the color later.

One of the challenges of shooting with a blue or green screen is the complete removal of the screen’s color from around the animated subject. Often, there may be issues with the green reflecting onto the puppet or remaining as a thin layer around the edges. With today’s digital tools, though, there are ways to deal with this. Removing the color from most of the frame around the subject
is the easiest part. Depending on the software, this is usually done by selecting the color (typically with an eye-dropper tool) and hitting a button or adjusting a tolerance slider to wipe it out of the frame. In After Effects, a plug-in called Keylight is commonly used, and Combustion uses a function called the Diamond Keyer for the general removal of the green (Figures 9.28 and 9.29). Once most of the green is keyed out, there will often still be a thin

Figure 9.27
Set-up for stop-motion against a green screen.

Figure 9.28
Selecting the Diamond Keyer in Combustion.

Figure 9.29
Keying out all the green color in the shot with the Diamond Keyer.
rim of green around the edges of the subject (Figure 9.30). Some additional keying tools can be used for fine tuning the keying out of this remaining color. In Combustion, for example, these tools include the Discreet Keyer and suppressing the green color on the color map (Figure 9.31). To create further atmosphere once the background is comped in behind the puppet, a blur can be added to help create the illusion of a shallow depth of field (Figures 9.32 and 9.33). (Compositing and screen captures for Figures 9.28 to 9.33 courtesy of Shawn Tilling.)
Shooting any object or stop-motion puppet with a color behind it for keying also allows for simple resizing and moving of that object into any part of the screen for compositing with other elements. The background that is composited behind the keyed-out animation frames can be a still photograph, a painting, or any type of imagery. A particularly unique use of green-screen compositing was used on a short student film called *For Sock’s Sake*, made by animator Carlo Vogele at CalArts. The film uses real clothing, like pants, socks, and shirts, as a cast of characters who go on a journey to save a runaway sock. Carlo shot real clothes on a flat green screen with a digital still camera pointing down from above (Figure 9.34). To move the clothes, he placed magnets inside them and moved matching magnets underneath the green panel, which allowed...
them to be moved without breaking the continuity of the fabric’s folds and wrinkles. The backgrounds were drawn in Photoshop with photo collage and digital drawing, and the animated clothes were composited into them with After Effects (Figure 9.35). The film can be seen on Carlo’s blog (http://carlovogele.blogspot.com).

Figure 9.35
Compositing effects demonstrated for the film For Sock’s Sake. (Courtesy of Carlo Vogele.)
Front Light/Back Light

Another compositing method for stop-motion that harkens back to an old film technique is a checkerboard matte (or front light/back light compositing). The general idea behind it is to take a frame of the puppet against a black or neutral gray background, referred to as a “beauty shot.” In this frame, the puppet is lit from the front only, with the light shielded from reflecting onto the background (Figure 9.36). Using a black card or curtain may help shield or absorb the lighting, or using “barn doors” on the light fixture. Next, the same frame is shot with a wash of light reflected onto a white card behind the puppet to create a silhouette image of it (Figure 9.37). The puppet can then be moved into the next position and the process repeated. This creates an extra step of taking each frame twice—one as a front-lit beauty shot and once as a back-lit silhouette, which serves as a transparent matte for compositing with a background. In the compositing process of layering these images together for each frame of the animation, the background is on the bottom layer. On top of the background is the back-lit silhouette matte, which provides an opaque silhouette image of the puppet over the background, and the negative space around it is transparent, so the background shows through. On top of this matte, the beauty shot image is placed over the exact silhouette, which its negative space also made transparent, resulting in a clean composite of all elements (Figure 9.38).

Although it needs twice as many frames and an extra repetitive step to execute during shooting, this method is essentially an alternative to a green screen. It avoids the issues of the green color reflecting onto the puppet or appearing as a rim around it, and in many cases it provides a cleaner, softer
edge around the puppet for compositing. Obviously, during the animation, the lighting setup for both sets of frames, as well as the camera, must be locked down tightly so that all of the images line up exactly. It is common for the back-lit silhouette images of the puppet to still have some highlights spilling into the edges and to have visible features within the silhouette. In many cases, these frames will need to have the brightness and contrast cranked up to create a crisper matte that is completely black and white. In some cases, there may also need to be the option of rig removal in the frames if your puppet is defying gravity in some way.

When this method is used on film, the single strip of film consists of alternating black-and-white images—hence, the term “checkerboard matte.” It also means that the animation, when played back at speed, is twice as slow and flashes quickly with black-and-white frames. The alternate frames are separated and put back together in the optical printer. Shooting digitally with frame-grabbing software, the alternate silhouette frames can be hidden during the animation process and exported separately into another folder. Some software programs, like Dragon, can also separate the alternate frames into subfolders while you shoot the animation. Either way, at the end of the shoot, you want your beauty shot and silhouette frames separated and organized into different directories.

Many different software programs, such as Photoshop or TVPaint, can be used to composite the different layers together in each frame as long as you can create transparencies for the negative space around the puppet and adjust the contrast and brightness. Independent animator Nick Hilligoss has his own method for compositing front-lit/back-lit images together using LightWave 3D. His foreground animation elements are captured as their beauty shots.
(Figure 9.39) and back-lit silhouettes (Figure 9.40). Each image sequence is separated, with the beauty shots applied to a rectangular flat object’s surface in LightWave as a color image map and the back-lit sequence as a transparency map. In this environment, black is solid, white is fully transparent, and shades of gray are partly transparent, so if there are any see-through objects or motion blur in the animation, they will also show up. Directly behind this rectangular object, with the beauty shots and mattes, is another flat object with the background applied to it (Figure 9.40). Both the background and puppet screen objects are exported together from the same camera view to create the final composite (Figure 9.41).

**Figure 9.39**
Beauty shot from the Ray Harryhausen Tribute promo short for *Stop Motion Magazine* by Nick Hilligoss. (Courtesy of Nick Hilligoss.)

**Figure 9.40**
Back-lit shot of the same frame. (Courtesy of Nick Hilligoss.)

**Figure 9.41**
Composite in LightWave with Surface Editor and Transparency windows open, angled to show both background and foreground elements. (Courtesy of Nick Hilligoss.)
Further tutorial details for front light and back light compositing can be found on the YouTube channels for Nick Hilligoss (http://www.youtube.com/user/StopmoNick) and Ron Cole (http://www.youtube.com/user/animatorIsomer), as well as further tips searchable through Stop Motion Animation (http://www.stopmotionanimation.com).

**Advanced Compositing for *Ava***

In Chapter 4, “Digital Cinematography,” I included some information that was shared with me about a moving camera shot from Lucas Wareing’s student film *Ava*, made at Emily Carr University of Art + Design. The camera move itself starts by pointing up at the ceiling of the film set and then begins tilting down and moving forward through the set. The camera moves through a bunch of real foliage and eventually ends in front of the monster, Charlie, who is sleeping between two cliff facades built as part of the stop-motion set. Meanwhile, there is the effect of a moving sun being animated behind to create a real lighting change throughout the whole set. The background behind the set was a plain white backdrop instead of a green or blue screen. This was done deliberately to better match the lighting throughout the scene and to avoid worrying about blue or green reflections spilling into the set. The original footage from this particular shot in the film (Figure 9.43) went through a complex process of compositing afterward in post-production. The visual effects for this shot would involve a digitally created matte painting of a night sky from...
which the camera would tilt down, eventually revealing a sunrise in the far background behind the stop-motion set, including an animated sun that followed the path of the lighting change created physically on set (Figure 9.44). Lucas and his compositor, Henrique Moser, shared with me some of the steps involved to complete this shot.

**Figure 9.43**
Still of original footage from *Ava*, directed by Lucas Wareing. (Courtesy of Lucas Wareing.)

**Figure 9.44**
Still of final composited footage from *Ava*. (Courtesy of Lucas Wareing and Henrique Moser.)
The first step was to use a steadiness plug-in to minimize some of the camera shakes that resulted from the physical stop-motion camera move. Next, the camera move was tracked to create a virtual 3D version of the movement of the camera on the physical set. This was done using PFTrack, a software program used for match-moving 3D elements to live-action plates with exact precision. The shot starts with the camera’s position extended past the beginning of the stop-motion camera move, pointing up at the matte painting. The virtual camera tilts downward across the sky portion of the painting and eventually merges with the tracked version of the physical camera moving through the set.

The matte painting itself, originally done in Photoshop, had its various middle-ground and background elements of mountains and clouds separated onto different layers (Figure 9.45). These split-up layers of the painting were projected onto separate cards in the 3D environment to create a parallax effect as the camera moved through the set. This basically means that there is a change of perspective in the background elements that creates more depth and simulates how it would look in a 3D space, as opposed to just one static background element that stays the same through the whole shot. In the 3D environment, there was one camera that tilted upward and moved down to match the physical camera move and another camera that was locked down and acted as a projector for the various foreground and background elements in the virtual set (Figure 9.46).

Figure 9.45
3D environment with some background elements for the sky. (Courtesy of Lucas Wareing and Henrique Moser.)

The plants and various bits of foliage were keyed out through a combination of various keying techniques to extract mattes from them. Also, in front of the virtual 3D version of the camera move, certain elements that existed in physical space on the stop-motion set were projected onto 3D cards in the exact places they appeared within the set. Certain things like the branches, plants, and cliffs would go through various stages of movement and overlap with each
other as the camera moved past them, so on certain frames, sections of these set pieces had to be matted out and projected to all match together. Many things in the set needed to be painted out, including the black disc that was animated throughout the set to line up with the moving sunlight and cover it up. The projection of mattes onto the 3D cards helped in the particular frames where the disc passed in front of the cliff, for example. To cover up the disc, a section of the cliff from another frame could be matted out and placed in the space it needed to be (Figure 9.47). The color grading would also need to be manipulated to blend in with the rest of the shot since the light changes throughout the whole scene.
In addition to the basic process of compositing and removing the various elements from the original footage so that the compositied background could show through, other subtle effects were added to enhance the atmosphere. One example was to enhance and exaggerate the highlights created by the sunlight at the end of the shot. This was done by keying out the bright highlights in the frame itself (Figure 9.48) and then separating the foreground and background into an alpha channel matte (Figure 9.49). The highlight shapes were blurred and given a warmer color tone, which could then be layered over the original shot to exaggerate the highlights, making them brighter and softer in the rim of light along Charlie’s body and next to his shadow on the ground (Figure 9.50).

**Figure 9.48**
Highlights created by the lighting in the frame are keyed out. (Courtesy of Lucas Wareing and Henrique Moser.)

**Figure 9.49**
The background is separated from the foreground. (Courtesy of Lucas Wareing and Henrique Moser.)

**Figure 9.50**
The keyed highlights are manipulated and then layered over the original footage. (Courtesy of Lucas Wareing and Henrique Moser.)
Many other effects and subtle details were executed within the advanced production method of completing this shot, all coming together to bring to the audience a beautiful and unique approach to the art of stop-motion filmmaking. Check out the movie called Ava Footage.mov on the CD to see the original footage from the stop-motion set and breakdowns created by Henrique Moser of a few steps taken to create the final shot.

**Effects**

Computer software and tools allow for all kinds of live-action or CG effects to be composited into stop-motion to embellish shots or add any elements needed to tell the story. Effects such as smoke, water, fire, explosions, or gun-muzzle flashes can be downloaded or purchased as QuickTime files through various websites or service companies. These effects will typically be shot against a black background that is prekeyed with an alpha channel. This way, if you simply drag them into a timeline in Premiere or After Effects, they can easily be laid on top of any other movie file, with the background being automatically transparent. In many cases, they will then need to be repositioned and modified to line up and match with your scene.

This effect was used for my two-character dialogue scene that is featured in Chapter 7, “Character Animation,” and watchable on the accompanying CD. Searching through various movie files of fireballs, I found one that was suitable to use for the effect of the monster shooting fire out of her mouth. The movie file itself had the fireball shooting upward in the middle of the frame, so it would obviously need to be rotated and repositioned to shoot diagonally off the right of the screen. This was all done in After Effects and lined up to match the monster’s mouth at the proper frame in the animation. Initially, the edge of the fireball was a flat line based on the bottom frame of the movie (Figure 9.51), so the shape was modified using a mask (Figure 9.52). The mask could change shape and essentially be animated in every frame to get the proper shape for the overall effect (Figure 9.53). Two copies of the same fireball movie were ultimately mapped over each other, rotated, and blended to give all edges of the fireball some variety and texture. (Compositing and screen grabs for the fireball effect in Figures 9.51 to 9.53 courtesy of Gautam Modkar.)
Figure 9.51
The first few frames of the fireball movie file, composited and rotated to position with the puppet's mouth.

Figure 9.52
A rough mask drawn in for where the fireball will be in the frame.
Online resources where you can find effects to composite into your own stop-motion films include:

- www.stopmotionmagazine.com (under Free Stuff)
- www.videocopilot.net
- www.detonationfilms.com

In addition to compositing in live-action or CG elements that are pre-photographed, it is possible to simply draw stylized effects right over your animation frames, such as lightning bolts, laser blasts, or anything that fits your scene. This can be done easily in newer versions of stop-motion software programs or externally in Photoshop. It can also be done using TVPaint, which is a software program used primarily for drawing 2D digital animation within the program itself. It can also be used for shooting stop-motion very effectively, and all of the drawing tools that come with it can be executed right on top of the stop-motion images. You can easily add hand-drawn effects, smear your stop-motion images, paint over them, blend the edges of seams on your puppet, and do a variety of other creative tricks.
Rig and Shadow Removal

Making a puppet fly is a trick that has employed several different methods over the years. Often, the puppets would be flown on invisible strings, stuck to a plate of glass, or suspended by a rod holding them up from behind where the camera would not see it. These methods can still be used today, but in most cases, a rig is simply placed visibly into the frame to hold up the puppet and is digitally erased out of each frame of the animation afterward. This makes the animation process go much more quickly because you don’t have to worry about concealing any tools that are suspending the puppet. In post-production, it can become tedious and time consuming, but this also depends on the length of the shot and how many frames need the rig removed.

One of the most straightforward ways to remove a rig from your stop-motion frames is simply to have a clean background plate prepared in addition to your animation frames. If you are shooting on any kind of set, shoot some frames of an empty set without the puppets in it and set those frames aside to use as a clean background plate in post. In the animation I did for the Thunderbean Stop-Motion Marvels! DVD, there were several frames of an empty stage at the beginning, and the entire scene was shot with a white limbo background. This made it pretty easy to select a background plate, and I would open this in Photoshop along with each of my animation frames (Figure 9.54). The next

Figure 9.54
Clean background plate and animation frame are both opened in Photoshop.
step is to paste the animation frame as a separate layer over the clean background plate (Figure 9.55). Then, with the animation layer selected, the Eraser tool is used to simply erase the rig out of the frame, and the clean background plate will show through (Figure 9.56). It is best to make the brush size smaller and to use a hard edge for delicately erasing the rig at the edge of the puppet itself. Then, you can make the brush a bit larger for quicker removal of the rest of the rig. Once it is all erased, each frame is complete, with the puppet suspended in air (Figure 9.57), and they can be flattened to go back into the animation sequence.

Figure 9.55
The animation frame is pasted as a layer on top of the background plate.

Figure 9.56
The rig is erased from the animation layer, showing the background plate underneath.

Figure 9.57
Completed frame with rig completely removed.
Some of the trickier frames to work with on the Thunderbean project were those where the shadow of the rig needed to be removed but the shadow of the bean remained in the frame. Because the shadow was a little fuzzy, it was difficult to tell exactly where the edge of the bean’s shadow was. In the last few slow-in frames, it was also difficult to keep the shadow from jittering. To help soften the effect of the shadow’s edge, I used a feathered Eraser tool instead of a hard-edged one and played around with the edge in the various frames until I got it to look right (Figure 9.58).

Figure 9.58
A larger feathered eraser brush is used to erase the rig’s shadow.

Removing a rig from a stop-motion scene is now a built-in tool in some newer versions of certain frame-grabbing software programs, which helps avoid doing it in another program like Photoshop. Alternatively, a rig can also be removed using masks and alpha channels in After Effects. Another alternative to using one still frame as a background plate for rig removal is to shoot a series of frames of the clean background plate and place them into another layer under the animation with the rig in it. The rig can be masked out, and underneath will be an actual movie sequence of the clean background plate. The advantage to this approach is that if there are any lighting changes or pixel fluctuations in the scene, there won’t be any noticeable difference between the animation frames and the frozen background image under them. The background plate has a danger of standing out as a still image because of the lack of noise that would be present in the sequential animation frames.

Being able to erase or mask out parts of an image in stop-motion also comes in handy for fixing mistakes that occur on set while shooting. One mistake that can occur in the middle of a stop-motion shoot is the animator’s shadow
flashing into the frame. Ideally, you should be standing in exactly the same spot each time you capture a frame, with your shadow completely free of the camera frame. In the heat of the moment while animating, though, it is common to forget this and have certain frames where your shadow creeps into the shot. Unfortunately, this happened to me a few times while shooting my two-character dialogue scene. However, using After Effects, these problem frames were identified and noted as to how much of the frame had a shadow flash into it. A mask was created from some held frames that didn’t have a shadow flashing into them (Figure 9.59), and this mask could be composited over the problem frames (Figure 9.60). The edges of the mask were feathered slightly to help blend them into the scene, and then all of the shadow flashes were gone. (Compositing and screen grabs for the masks in Figures 9.59 and 9.60 courtesy of Gautam Modkar.)

**Figure 9.59**
A mask is created from a clean frame with no shadows intruding into it.

**Figure 9.60**
The mask is composited over any frames that had a shadow intruding into them.

### Motion Blur

Motion blur is a favored technique of stop-motion animators for replicating the smooth movement of live action in their work. Part of the reason that older stop-motion films always had a jerky quality to the movement was that every frame was always in focus. An even bigger part of the jerkiness, however, was the distance between frames and poor registration of the positions
in relation to the speed of the movement. If the distance between two positions on a fast movement (a sword swooping through the air, for example) was too far apart, a strobing effect would occur because the eye was not able to fill in the gap between those two very clear images. If that same fast motion occurred over just a few frames captured in live action, it is likely that some of the frames would be blurred if studied frame by frame. In Chapter 4, “Digital Cinematography,” I went over a few techniques for achieving motion blur on the actual stop-motion set. In this chapter, I will present a few examples of ways to get motion blur into your animation in post-production.

One really interesting method for creating an illusion of motion blur was relayed to me by Ron Cole. I noticed his work on In the Fall of Gravity had a very smooth, ethereal quality to it, so I asked him if he used any particular motion blur technique. He told me about a relatively simple method he used that was actually borrowed from an old film technique. The effect is one of blending the frames to suggest a kind of look that isn’t really there as a blur but makes the animation feel much smoother. Ron created at least three copies of each animation scene; he then removed the first frame from the first copy, the first two frames from the second copy, and left the third as-is. These copies were layered together in QuickTime Pro, and the opacity was altered in each of the layers. That way, each frame showed three images overlapped, with the one in the center the most visible and the before-and-after frames very transparent (Figure 9.61). This gives the illusion that one frame at a time is fading in and out, and the various degrees of opacity could be adjusted, depending

Figure 9.61
Illustration of a frame-blending motion blur effect applied to a scene from In the Fall of Gravity. (Courtesy of Ron Cole.)
on the speed and quality of the animation. The multiple exposures of images typically shows up more on a fast movement, but for slow movements, it can create a much more subtle motion blur effect. This same effect can be done easily in After Effects, TVPaint, or any other package that allows you to layer copies of the same sequence over each other and adjust the opacity.

For a more realistic motion blur applied to certain frames or every frame of an animation sequence, there are tools and plug-ins like ReelSmart Motion Blur for After Effects, which will do the job nicely if you have the budget for it. Other simple techniques can involve using Photoshop to add an overall blur to an entire still image, using a blur effect like Gaussian blur and adjusting how extreme you want it. Another Photoshop tool that I have used for creating blurred frames is the Smudge tool, which can just be dragged by hand over any part of the puppet where you want to the motion to blur, like in a fast snappy action, for example (Figure 9.62) Whatever technique you use, the important thing to realize is that an effective blur should follow the object’s path of action. If you are blurring an arm moving upward in a sharp movement, try to smear that arm so that the blur is trailing downward in the opposite direction, with a smaller amount of smearing in the direction the arm is going.

Many of these effects for green screen, rig removal, masking, and motion blur, as well as other innovative techniques for stop-motion, are demonstrated beautifully together by Patrick Boivin in some of his YouTube videos that break down the process of his entertaining short films. Visit his YouTube page (http://www.youtube.com/user/PatrickBoivin) and, within the Stop-Motion Animation playlist, check out the “Making of” videos for Bboy Joker, Jazz with a General Problem, and Black Ox Skateboard. The process is described in a very entertaining way, and the shorts themselves are fantastic to watch.
Eye Compositing Effects for *Madame Tutli-Putli*

*Madame Tutli-Putli* (Figure 9.63) is an Academy Award–nominated short film from 2007 that was directed by Chris Lavis and Maciek Szczerbowski for the National Film Board of Canada. The film told the story of a young woman who takes a suspenseful journey aboard a train at night, using atmospheric lighting and intensely detailed puppet animation. The film amazed audiences worldwide, not only because of its cinematic resonance and story, but also because of a particular effect in the eyes of the puppets. The eyes were actually made up of video footage of real human eyes, which were painstakingly composited onto the faces of the puppets. The effect and technique for compositing the real eyes into the stop-motion frames were conceived and executed by artist Jason Walker over a period of four years from concept to the final result. The innovation behind this technique has certainly advanced the art of stop-motion animation to a whole new level in terms of performance and technical mastery.

I asked Jason Walker himself to share the process of his technique for *Madame Tutli-Putli* and how the project got started:

Around the year 2000, I had started playing around with computer animation and been able to get to know the film’s directors, Chris and Maciek, who were primarily doing illustration and animation at that time. I became their post-production artist on various projects, including a commercial we did for the Drive-Inn Channel in Toronto, where they had animated a stop-motion mouse. I ended up tracking and positioning a singing mouth onto the puppet, which did have eyes, but only a tracking dot where his mouth was. I tried a technique of having the puppet move only in two major positions and tracking a 2D shape onto a 3D shape, but looking like it was turning along with it. It was all set to the beat of music, and it worked really well.
Later, we found ourselves having a meeting to discuss a project for the National Film Board and what we could do. This was around the time that Peter Jackson’s *Lord of the Rings* had come out, and everyone was amazed by the effects for Gollum, so we joked that we needed to create a “poor man’s Gollum” for our film. I had an idea that had been in my head for a long time, since I was about 14 years old. When I was a school kid, we had a project where we had to make a papier-mâché head around a balloon and then pop the balloon to create a mask. I had the idea that instead of painting flesh tones and eyes on it, I would paste a collage of magazine clippings on it for skin and the facial features. When it came to the eyes, I found a *Vogue* magazine cover and glued the eyes onto the mask. Then, I had a thought that if I were to create an animation of this mask with these photographs stuck onto it, every time I moved the head, I would need to find a different set of eyes that were set at a different angle. This idea from my childhood came back to me at that meeting with Chris and Maciek—to shoot live-action eyes and composite them onto a puppet.

I asked Chris and Maciek to shoot some simple moves of a test puppet with blank eyes and did a test with filmed footage of actress Laurie Maher. Three basic steps were required to try to make it work: film the actress, track the puppet, and stabilize the footage of the eyes to stick onto the puppet face. Luckily, after about a month of working on it in my spare time, the test worked (Figure 9.64).

The directors were blown away by it, but I told them if they take this farther, they needed to make sure the puppet didn’t move around very much. I went away, and they got approval from the National Film Board to make the film. Coming back a month later, I saw their footage of all this puppet movement, with flashing lights and shadows from the moving train scenes. I started thinking, “I hope my method will work for this!”
Based on the timing and movement of the puppet animation, on the live-action set, we worked together to simulate the light flashes and direct Laurie to mimic the head movements. She had make-up and tracking markers applied to her face for matching to the puppet, and she was told exactly how to move her head and directed on the acting and emotion of her eyes (Figure 9.65). I tried to keep her on track with the correct movements and orchestrated the lighting, and there was no room for error as scenes became more complicated.

When I had the final eye take, I would bring it into the computer and try anything to make it work. I had created a timeline chart in After Effects and nicknamed it the “Wunderbar” (Figure 9.66). Once I had been given the puppet footage, I would analyze what was a head move and what was a camera move and indicate each on this timeline as a different color. This way, I could see a separation between what was a move and what wasn’t. Also, for moments when she would encounter a light or a shadow, the Wunderbar would record what kind of light it was and how long it lasted.

On the stop-motion set, there were tracking dots for the eyes built onto the face of the puppet. You would think that would be helpful for all the stabilization, but the dots were only used to track the puppet so that I could adhere a mask layer to the face. I had the eye layer separate from a layer of masks that cut the eye out (Figure 9.67).

However, when it came time to place the eye footage onto the puppet, there was no way to do it except by hand. That was the most intricate part; the computer helps you organize your layers, cut masks, and feather the edges, but the computer has no idea what an eye is, and it has no idea of the subtlety of a human eye in the area of a human face. When it comes to visual effects, it’s on one level to make it flawless, but the other level is to make your brain convinced in a way that you don’t have to think about. A bad composite is when a scene seems to
look right, but the brain tells you it doesn’t. When it comes to human eyes, there
is absolutely no room for error. When placing the eye onto the puppet in After
Effects, if the eye was off by even a fraction of a pixel, it wouldn’t work.

So I developed a system where for every frame, I would need to zoom all the
way in, use the arrow keys to move the eye up and down, and then zoom out
and see if there was any independent movement. This also had to be done for
scale and rotation of every frame. Often, I would zoom in, move it over one
pixel, and then zoom out, and it would be too far over. Then I wondered, “How
can that be, if it’s only a pixel? How can I move it less than a pixel?” It started
to become insanity at this point, but my solution was this: Let’s say my eye was
in the right place on frame 10, and I move it over one pixel for frame 11, but it
was too far. What I would do is put a point there, but then drag that point over
to frame 12 so that frame 11 was right in the middle. To explain this further,
let’s say you were on one side of a fence and you could only jump to the other
side of the fence, but you wanted to be on the fence. You would build a wall so
that when you jump over the fence, you would hit the wall before you could
land on the other side, but at least you would land on the fence. That was the only way to make the eyes convincing, and the toughest part was this method of sub-pixel positioning so that it always looked like it was on the puppet.

Another point to make is that this technique has sometimes been described as simply adding live-action eyes to puppets, so people think it’s not animation. This is partly correct, in that they are real eyes, but it’s not merely live action. When I paint portraits of children, they don’t sit still very long, so I shoot video of them, and afterward I can search until I get that one instance of the child’s face that is right for the painting. The same technique applied here, where I would film the eyes and the actress going slower than the puppet, matching accuracy of the movements, but not timing of the movement. Often, I would film the actress moving at least six times, take these separate takes, and join the eyes together. I would bring in these sequences, which would add up to many hundreds of frames, but inside the scene of the puppet there might be only 100 frames.

Then, it was a matter of selectively going through each frame of the eyes, using the time-remapping feature of After Effects, and sliding through the frames one at a time until you find the one frame that works for that frame of puppet. Essentially, it’s a reanimation of video stills—people may think it’s not animation, but it is! I have to animate the character that’s coming out of the eyes, and part of that is measuring how much she reacts to things by how many extra frames you have her looking there. You have the body language of the puppet and great performance of the actress, but there is also a third level where you can change the acting. Going back to *Lord of the Rings* again, it was noted that if the actor playing Gandalf didn’t look concerned enough, for example, they would use a subtle computer mesh to change his expression that much more.

I have ideas for some similar animation techniques I want to try with the entire face, but I will only do that with the right team of people. I often get approached to help other people with these kinds of techniques, and many people ask me if there is any new technology developed in the last three years that will help, like 3D scanning. None of that really helps because you still have to manually position a human eye one frame at a time onto the head, and only your brain will know if it looks right. Your computer is not going to understand human emotion—only your brain can do that. Seeing human eyes on a stop-motion puppet in *Madame Tutli-Putli* is something we’ve never seen before, and the effect of the film comes down to the fact that it looks like the eyes are there. Anything beyond that is a failure because it’s the eyes, and everyone in the world is an expert on this. If there is something wrong with the eyes, you know it right away. There is a quote where someone said, “If you don’t believe eyes hold the human soul, then take a picture of someone you love and stab it in the eyes with a pair of scissors. I bet you can’t do it.” That’s the power of eyes.

For more information on the film *Madame Tutli-Putli* itself, visit:
Jason Walker’s website: http://www.madametutliputli.com
Official NFB site for the film: http://films.nfb.ca/madame-tutli-putli/