Chapter 1
Introduction to Animation

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Animation is simply defined as the sequencing of a series of static images to generate the illusion of movement. Most people believe that actual drawings or creation of the individual images is the animation, when in actuality it is the arrangement of those static images that conveys the motion. To become an animator, it is often assumed that you need the ability to quickly design masterpiece after masterpiece. Although some semblance of artistic skill is a necessity for the job, the real key to becoming a great animator is in the comprehension of timing. You can have the most beautiful sequence of artwork, but if you do not know the basics of timing, your animation will fall flat. To understand how timing works, you really have to learn about the origins of animation.

When somebody says "animation," you probably immediately conjure up images of cartoon characters. But as I stated earlier, by definition animation is any sequence of images that creates the illusion of motion. We all know animation as a form of the visual arts, but in essence,

motion film is a type of animation. When you are watching any type of film, your brain subconsciously works overtime to make sure that you comprehend what is happening on the screen. We have known about this cerebral phenomenon, known as the *persistence of vision*, for many years. When you look at an object on a screen, your brain retains the image of that object a moment longer than it was actually present. But in that nanosecond, the next image pops onto the screen, allowing your brain to connect the two as a pattern in motion. This phenomenon is what makes film work.

A film reel is merely a series of still photographs that operates under the same principles as a child's flipbook. The film is projected onto a screen by running the static images sequentially through a lens with a powerful light beam. Strips of opaque celluloid separate the individual images. You obviously do not see the strips because the speed at which the film runs is too quick for your eye to detect individual strips. The motion on the screen is interpolated in your head as real because each image is ingrained into your brain for a fraction of a second longer than it appears. In a two-hour movie, the average person blinks more than 3,500 times. That's more than 50 minutes of darkness! Your brain automatically retains that previous image for longer than it was actually on the screen, so you're not missing any action. Modern films are projected at the rate of 24 frames per second. Therefore, for every second you are watching a film, the image of that split second has been "flipped" 24 times. On top of all this retina traffic, we believe in the principles of physics just by our conditioning as human beings here on planet Earth. Look at Figure 1.1 for an example.

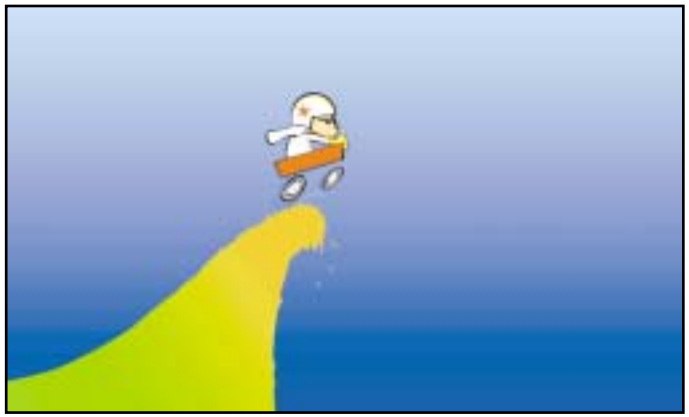

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Figure 1.1
What will happen when he rides off the cliff?

We naturally assume that when a character rides off a cliff, he will fall. We all grew up on Earth learning to deal with the forces of gravity. Just like you learned to walk, you learned to observe the forces around you. It was through that observation that you learned what to expect. If a character ran off a cliff and floated away, you would be caught off guard. You wouldn't go into cardiac arrest, but nonetheless the animator would be playing with your pre-conditioned expectations. Although small children might not understand that the plot points to a cartoon, they understand what falling down means, and that's why they laugh at that silly coyote every time. Artists in the past, such as Salvador Dali and Bill Barminski, took the idea of people's perception to new heights. Check out http://www.barminski.com/vodka1.html for an example of playing with one's expectations. Modern blockbuster films such as *The Matrix* and *Crouching Tiger, Hidden Dragon* had interesting stories, but they really shocked people on another level because of their ability to manipulate an audience's expectations using innovative camera moves and special effects. If you grew up in a zero-gravity world, maybe you would have fallen asleep during one of the fight scenes.

If you want to read more about the persistence of vision, Peter Roget's 1824 paper, "The Persistence of Vision with Regard to Moving Objects," is a great source of early nineteenth-century film fascination.

History of the Studio Process

The nineteenth century was full of incredible inventions, particularly for film. Entire books have been written on these inventions; for our purposes, we will hit the highlights. In the mid-1800s, two scientists, Dr. Simon Ritter von Stampfer and Dr. Joseph Plateau, independently stumbled upon an amazing

discovery. While von Stampfer was in Austria developing his Ritter phenakistiscope, Plateau was in Belgium inventing his stroboscope. Both were the first contraptions used to watch animation. William George Homer made a hybrid of the Plateau-Stampfer inventions in 1834. It became known as the *zoetrope*, and it relied on this most rudimentary principle of animation, the persistence of vision. The zoetrope, shown in Figure 1.2, is a cylindrical object with slits around the side. A strip of sequential drawings can be placed around the inside of the cylinder. When you spin the zoetrope and look through the slits on the outside, the flickering result is animation in its purest form.

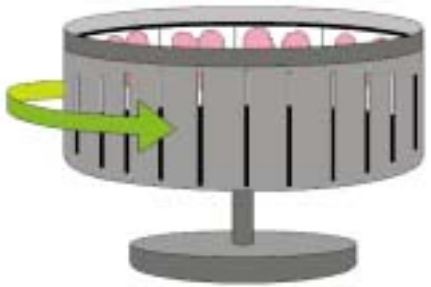

Figure 1.2
With a spin of the wheel, you can view a short animation through the side slits.

A few decades later, British photographer Eadweard Muybridge began his enormous contributions to the beginnings of what would soon be the booming industry of animation. Leland Stanford, then governor of California, had to settle a bet he had made with another politician. The governor surmised that as a horse galloped, at some point all four hooves left the ground. To prove himself correct, he hired San Francisco landscape photographer Eadweard Muybridge. When Stanford explained what he wanted, the eccentric photographer gasped. The idea was radical, and the technology to capture such speed had not been invented. Remember, to take one picture in the 1860s, you had to stay still for tens of seconds. Almost ten years and many experiments, arguments, and dollars later, the bet was settled. On June 19, 1878, Muybridge came to a racetrack in Palo Alto, California and set up a series of 24 cameras connected to tripwires. Each camera would rapidly fire off an exposure as the wires were broken by the passing horse. The resulting images recorded true stages of motion for the first time in history. Figure 1.3 will show you who won the bet.

Figure 1.3
Check out the third frame.

Muybridge proved that when a horse is in full gallop, at some point the animal is completely off the ground. Not only are all its feet off the ground, but its legs are tucked in underneath its body. For centuries, masterpieces had been painted showing galloping horses always with one foot on the ground. At this time in history, the idea that all four feet leave the ground seemed absolutely outrageous. Muybridge continued to photograph movements of all sorts of animals and people performing various actions. His photographic studies were turned into popular zoetrope strips during the late part of the century. Today animators still use Muybridge's work for reference. There are dozens of books available on his lifetime of work.

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Figure 1.4
Le train! Le train!

The jump from simple still images being flipped to a seamless sequence of images is credited to the Lumiére brothers of France. Although numerous inventions of decades past helped the Frenchmen, they began what is now known as modern film. On December 28, 1895, Louis and Auguste Lumiére sent people screaming from a Parisian theater when they filmed an oncoming train pulling into a station. While watching the *The Arrival of a Train at the Station*, many people in the audience, such as the man in Figure 1.4, thought the train was going to plow right through the seats. It seems funny to us now, but back then people had never seen anything like this.

James Stuart Blackton created the first animated film, entitled *Humorous Phases of Funny Faces*. Fascinated with special effects, Blackton featured an artist's real hands drawing the faces of a man and woman, which begin to interact with one another. He used chalk and cutouts to achieve his illusion of movement. The pivotal pioneer's 1906 short was very crude in terms of its animation, but he inspired others, such as Winsor McCay, Sidney Smith, and Gregory La Cava, to produce higher-end shorts using more refined techniques.

In particular, McCay would take the idea of combining live action with animation to a new level. In 1914, he amazed audiences with his short, *Gertie the Dinosaur*, in which he interacted on stage with the prehistoric beast. He decided to use a dinosaur so he could not be accused of tracing photographs. Another one of McCay's shorts, *Little Nemo*, required him to draw more than 4,000 drawings by hand. It was during the production of this short film that McCay figured out a way to register his drawings. In other words, he was the first person to align his drawings perfectly in sequential order using hash marks, thus preventing the jiggling that accompanied many early animated shorts. Nevertheless, animators were still drawing each frame of action over and over, including backgrounds and cycles.

A battle that still is being fought today in animation began to unfold in the early 1900s. It became time versus money. The laborious process was becoming too costly for many of the small fledging studios of the time. Imagine having to draw each frame, background, props, and characters together on one sheet of paper. To expedite this costly process, an animator by the name of Earl Hurd began to use celluloid sheets at the JR Bray Studios in 1913. This invention was the turning point in modern animation. Using these clear sheets, Hurd figured he could hold certain static elements while animating the characters on another layer. Hurd's cels, as they were called, allowed the animators to work on only the moving elements of the film. Backgrounds and props could be held underneath or over the primary action. This paved the way for what would become known as *overlays* and *underlays*. Try to imagine the impact on time and money that the use of cels would have on the industry. The gold rush in animation was beginning.

As the Depression trudged on, many studios began offering animated shorts before their features. A sense of escapism began to take hold, especially with the advent of synchronized sound in film. Part of being successful in any industry is being able to see down the road a few years. A young creative talent named Walt Disney looked beyond that point. His creation of a mouse, originally named Mortimer, would change the world. In 1928, his tiny studio of a dozen artists released a short film entitled *Steamboat Willie*, starring a mouse named Mickey. Disney figured out a way to sync up sound with his animation, and he sunk every last dollar into this endeavor. With nothing to lose, he gambled on the fact that his studio had something nobody else had—a cartoon with sound. Disney's incredible vision, mimicking the popular Buster Keaton shorts of the time and using sound in an innovative way, made *Steamboat Willie* a unique success. Walt Disney Studios was propelled to the forefront of animation.

Characters such as Donald Duck, Goofy, and Minnie Mouse would become household names in the years to come. Mickey dominated the theaters in the 1930s and 1940s; people would go to the movies to see whether "a Mickey" was playing. Warner Bros. Studios was soon in on the game, and in those years they created hundreds of classic zany shorts. Approaching animation with a different aesthetic look, the studio hired animation directors such as Chuck Jones, Bob Clampett, and Tex Avery. These men and their contemporaries would indelibly leave their mark on the world with such hilarious characters as Bugs Bunny, Daffy Duck, Droopy Dog, and Porky Pig.

The stylistic difference between Disney and Warner Bros. is important to note. While Disney cornered the market on the shorts with sentimental favorites such as Mickey and Minnie, other talents of the time went in the opposite direction. Tex Avery produced numerous cartoons that contained the element of

cuteness but had an underlying adult humor and wild action (especially in the shorts produced under him at MGM). Avery truly busted open the principles of animation and played with people's perceptions of physical reality.

As animation found a home in the theaters, numerous studios began to compete for commercial success into the 1950s. Although we all grew up watching these six-minute shorts of Bugs and Daffy, the knowledge of their demise is not common. In those days the major studios produced these shorts, which were shown preceding features in the movie theaters. As we marched into the 1950s, household names such as Tom and Jerry began to establish themselves. But as their popularity grew, so did their cost. Disney began venturing into feature films, producing classics such as *Snow White* and *Bambi*, while other studios continued to make shorts. These six-minute gems came with staggering price tags because of the quality of animation back then. While the backgrounds and props were being held on cels, the characters were still being redrawn over and over. The character animation was so smooth and dynamic that it required each animator to laboriously craft hundreds and hundreds of beautiful drawings. By 1955, the cost of a six-minute Tom and Jerry short was more than $50,000! That's without any voices—high even for today's standards. Studios were buckling under the pressure of a new invention called *television*, and they deemed animation too expensive for it. And so it was decided that animation was on its way out. Remember, in those days nobody had heard of a rerun.

By 1957, the last of the big studios had closed the doors of its animation division. MGM had no choice but to follow Disney and Warner Bros.' leads and close down their animation division. By 1960, most animators in Hollywood found themselves out of work or picking up brief work on animated commercials. It took two animation directors coming from MGM, William Hanna and Joseph Barbera, to not only save the genre but also to reinvent it. Hanna and Barbera knew they could harness their skills to create a cheaper system of animation by utilizing their talent pool. The two men invented the limited animation system, which was based on reusing animation, utilizing strong staging, and creating simple gags. Their first production, entitled *The Ruff & Ready Show*, was a half-hour show that cost $2,800 to produce. They changed the perception of how animation had to look, feel, and move. Fifty years later, the same principles would become the principles of Web animation. By economizing the artwork, Hanna-Barbera dramatically drove down the cost of production and were able to bring thousands of artists back to their drawing boards. Hanna-Barbera would become known as the "General Motors of animation" for the twentieth century. (By the way, the pair decided on the order of their famous studio name based on the results of a coin flip!)

In the 1980s, while feature film animation experienced another renaissance period by marrying traditional techniques with dazzling computer technology, television animation suffered. Many studios were turned over to business conglomerates who were looking for cheaper ways to produce Saturday morning cartoons. Legendary animators-turned-producers were pushed out of the studios to make way for business school graduates. The bottom line became the priority to the corporations. Overseas studios, particularly in Asia, began to take outsourced work from American studios for the lowest dollar. Many animators here in the United States found themselves out of work, and the quality of television animation suffered tremendously. Sadly, the trend has continued today. While offering corporations a more economical solution, cheaper overseas labor forces have not been as skilled or savvy in using technologies such as Flash. At the turn of this century, not one animated television show was being fully produced domestically by any of the major Hollywood studios.

Feature animation has faired better in recent history. In the last ten years, computers have brought feature animation into a digital age. The computer has become an incredible tool for studios such as Pixar. While many studios have taken to 3D programs such as Maya, the animators who work with complex creatures, such as Shrek, possess all the knowledge of their predecessors and then some. Although computers have made life easier for animators in terms of time saved, the principles of movement are more important now than ever. The computer animator who does not understand and appreciate animation from the past will create lifeless work. The people who devoted their lives to this genre and to understanding how to create that illusion of movement live on through today's modern exemplary work.