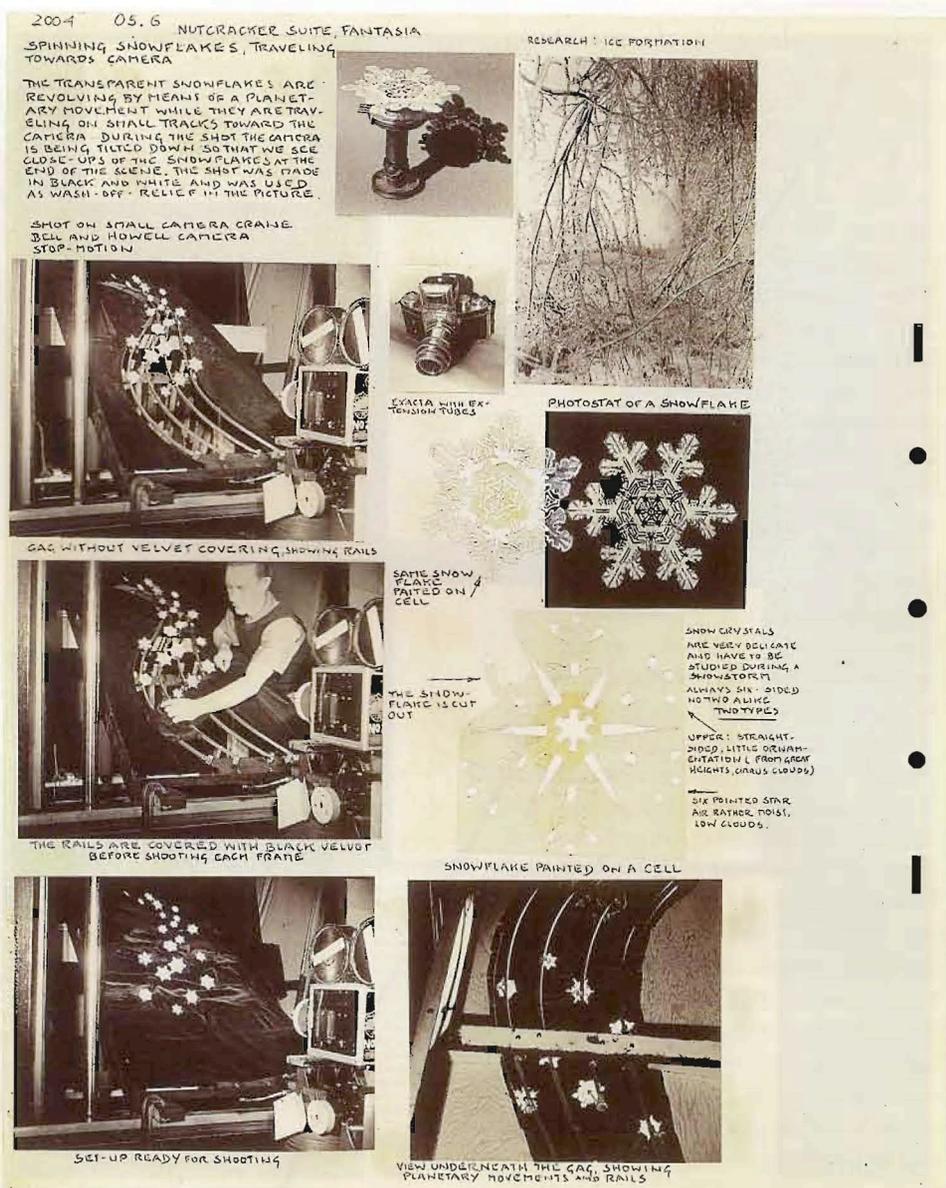


# Secrets of Disney's Visual Effects: The Schultheis Notebooks

By John Canemaker

*How the spectacular imagery of classics like Fantasia and Pinocchio was achieved has always been something of a mystery. But now we have some answers, thanks to the discovery of a trove of detailed notes made by one of the Disney wizards.*



1, 2. One of Herman Schultheis's notebooks reveals how a delicate ballet of Snowflake Fairies in the "Nutcracker Suite" section of *Fantasia* was actually created with the help of hidden steel mechanical gears and wheels. 3-5. Drawings of ghosts reflected in distortion mirrors and pieces of tin were photographed frame-by-frame in tedious round-the-clock camera sessions in order to make the dead rise in *Fantasia*'s eerie "Night on Bald Mountain" section.

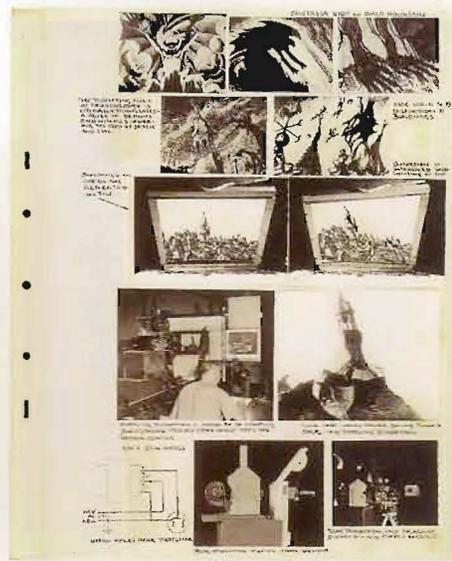


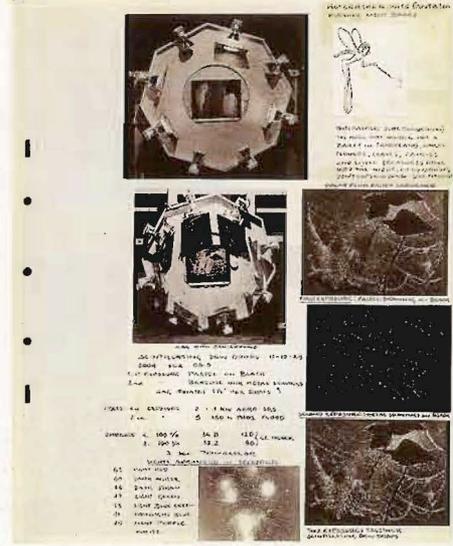
In *King Kong* (1933), the giant gorilla climbing the Empire State Building was really an 18", metal-jointed, fur-covered puppet animated frame-by-frame on a model set of New York City. The tornado in *The Wizard of Oz* (1939) was a 35' muslin wind sock and the wicked witch "melted" by riding an elevator through a trapdoor. A computer-controlled movie camera, used for the first time in *Star Wars* (1977), made possible precise and complex multiple movements of miniature spaceships and planets.

Through the years, the "secrets" of movie special effects have been well-documented. Numerous books and oral histories tell about the tools, methods, and processes of the long line of cinema wizards who created (and continue to create) movie magic. Even Georges Méliès (1861–1938), pioneer and grand master of trick films, left drawings and notes that reveal the mechanical and optical devices he employed in films such as *The Merry Frolics of Satan* (1906).

But there is a gap in "how did they do that?" movie-making knowledge with regard to the golden age of Disney animation of the late 1930s. This may seem surprising considering the large amount of research and writing through the years about Disney character animation. But the believability of the drawings in classic films like *Snow White and the Seven Dwarfs* (1937), *Pinocchio* (1940), and *Fantasia* (1940) was greatly enhanced by special effects created with optical and mechanical devices, and very little in any significant detail has been written about that.

Some books make passing mention of the "multiplane camera," "wash-off cels," "distortion glass," and "multiple camera passes and mattes" in the attempt to describe how some of Disney's most spectacular and intriguing imagery was made, but these vague references leave more questions than answers. How, for example, in *Fantasia* (a film that is virtually a special effects showcase), did diaphanous, distorted spirits rise from the dead in the "Bald Mountain" sequence? How were huge cosmic galaxies made to whirl and volcanic lava to flow so convincingly from the newborn Earth in the "Rite of Spring" sequence? In "The Nutcracker Suite," how were tiny, realistic snowflakes made to dance, and how was the then-new Technicolor film stock controlled and blended like a painter's palette for the colored shadows of the orchestra in the dream-like "Toccata and Fugue" section? In *Pinocchio*, how was a European village brought to life in an amazingly dimensional and complex single "take"? Or Jiminy Cricket's memorable 3-D hop





6.



7.



8.

through town toward Geppetto's workshop? Little is known about the workings of a now-defunct department at the Disney Studio blandly called the "Process Lab," where the above effects and many others were created. A small, unglamorous area staffed with inventive craftsmen (read "wizards") who could whip up cinematic fantasy worlds on order, it was (as magician's habitats go) similar to other Hollywood studio special effects departments: a workaday place of "personal craftsmanship . . . [consisting] of individuals creating effects unaided and with the simplest of tools."\*

The Process Lab gamely took on the pictorial challenges that arose daily in the increasingly ambitious pictures Walt Disney was producing. Solutions were improvised, constructions to support the effects were made and then destroyed as soon as a new problem arose. If notes and plans regarding the work were written down 60-some years ago, they have not survived; few photos and no oral histories document the inventions. And so the secrets of the Process Lab wizards died with them.

Or so it was thought. Recently, in an empty house on Hyperion Avenue in Hollywood—coincidentally the same street on which the Disney Studio and its Process Lab were located in the '30s—an exciting discovery was made. Four notebooks were found containing extraordinary details about *exactly* how a number of striking visual effects for Disney's earliest (and arguably greatest) feature films were created.

PRINT is publishing here for the first time examples from one particularly impressive notebook that deals mainly with the creation of *Fantasia* and *Pinocchio* (and, to a lesser degree, *Dumbo* [1941] and *The Reluctant Dragon* [1941]). The notebook's 180 pages, each measuring 16 1/2" long and 13 1/2" wide, are filled with drawings, cels, samples of color nitrate film frames, and dozens of snapshots of Process Lab technicians in action. Illustrations are augmented by a neat hand-written text that offers precise and often densely-detailed technical information. The page layout is a cogent balance of text and diverse pictorial material—an artistic design in and of itself. To animation scholars and fans, the notebook offers a rare and precious record of movie-making in a bygone era, and enhances our knowledge about the creation of milestones in animation history. The excitement over the find is a toon equivalent of the recent cave art discovery near Avignon, or a lost Leonardo codex come to light.

The books were compiled by one Herman

Schultheis, who worked in the Disney Process Lab from February 28, 1938, through June 1, 1940, and in the Special Effects Camera Department from December 21, 1940, through January 24, 1941. "Schultheis was apparently a compulsive individual fascinated with all things technical," says the discoverer of the notebooks, Howard Lowery, owner of the Howard Lowery Gallery in Burbank, California, which specializes in the sale of animation art. "He kept records, brought his own camera to work, and photographed workaday scenes."

Little is known about Schultheis. "A small bio he prepared mentions he was knowledgeable in many fields, with a great deal of experience in music and photography," says Lowery. Many of his snapshots of effects setups appear in the *Fantasia/Pinocchio* notebook, and at the top of certain pages is an excerpt of music for the section illustrated. "Schultheis was apparently a global traveler or explorer with a personal archive of 23,000 photos from most countries in the world," Lowery continues. "We found photos of him in a pith helmet in Central America. He may have been killed there by poachers perhaps, criminals, or unfriendly natives in 1954."

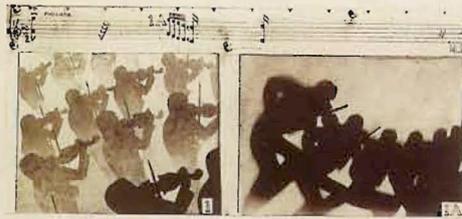
Schultheis's wife, according to Lowery, lived in a house he designed and built north of the Silverlake district in Los Angeles, on Hyperion. The couple had no children, and when Mrs. Schultheis died in the early 1990s, she willed the house to a local nursing order affiliated with the Catholic Church. "The contents were sold to raise money for the order," relates Lowery. When a number of Disney children's books from the late 1930s personally autographed by Walt Disney for Herman Schultheis were found, the church fund-raisers called Lowery, who "went to the empty house to look over the contents. The books were the first items I purchased, and then as we looked further into the house, other things turned up. We opened drawers, tore apart a bed built into a wall, and that's where the notebooks were found in a hollow space."

Schultheis's notebooks reveal both the simple and complex solutions found to solve visual problems. One fascinating page shows the ingenious way a lovely section of *Fantasia* was created (Fig. 1). In the finale of "The Nutcracker Suite," dozens of balletic fairies twirl toward the camera wearing naturalistic snowflake "tutus." Using today's computer technology, a snowflake's rigid shape, intricate patterns, and complex design (no two alike) and the dynamic perspective of numerous figures floating from the distance into

\*From *Hollywood: Legend and Reality*, edited by Michael Webb (Little Brown and Co. Boston, 1986), p. 170.



TRAVELING MATTE SHOTS



EFFECT OF TRAVELING MATTES, BRUSHED OVER TECHNICOLOR NEGATIVE BY THE CAMERA TO OBTAIN VARIOUS COLORS AND INTENSITIES IN SHADOWS OF MUSICIANS OVER A REDUCED S.G.



PHOT MULTI EXPOS 100% EACH ROW



#1

COLOR

BACKGROUND: RED AT TOP BLENDING TO LIGHT YELLOW AT BOTTOM GRADUALLY EXHAUSTING TO LIGHT GREEN COLOR.

#1: LIGHT BLIND GREEN IN UPPER LEFT TO DARK BLUE IN LOWER RIGHT

#2: DARK SHADOWS UNTIL THEY REACH RIGHT SIDE OF SCREEN WHERE THEY CHANGE TO DARK BLUE LAST 2 FEET ALL SHADOWS FADE OUT LEAVING WHITE S.G.



#2



1st EXPOS. BACKGROUND COLOR COMPOSITE HIGH CONTRAST MATTE OF #1 + #2 IN BLACK ON A WHITE FIELD IN SHADOWS OF MUSICIANS TO EXHAUSTION IN FRONT OF TRAVELING MATTE. NO SHADING S.G. WAS BRUSHED WITH .025 / FRAME GAIN. MAT. PAPER NO. 115. 2. TRAVELING MATTE WAS REMOVED + S.G. CROSS-DISPOSED IN NEGATIVE.

2nd EXPOS. COLOR ON #1 COMPOSITE MATTE WITH GRADUATED INTENSITY AT LOW CONTR. IN THE DIAGONAL ZONES OF PLAYERS + BLACK FIGURES OF #2.

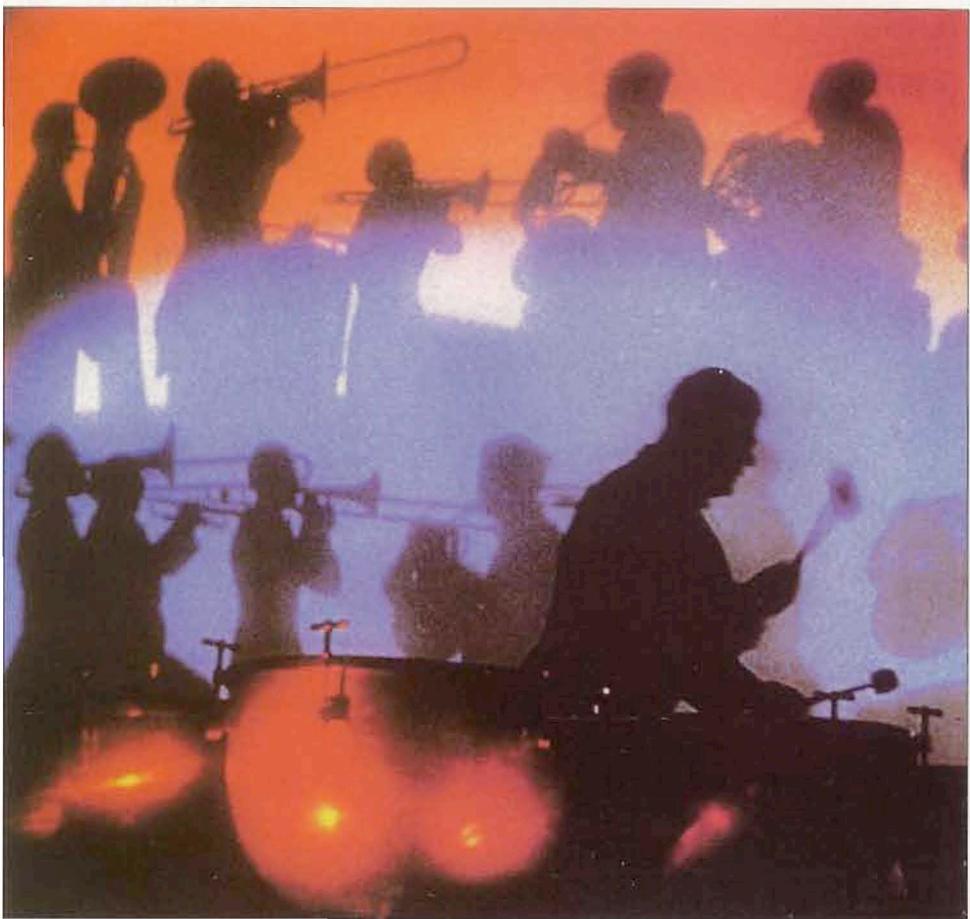
3rd EXPOS. COLOR #2 SINGLE-HIGH CONTRAST, FORMS MATTE OF #2.

ON JUNE 17, 1935 A COLOR TEST OF THE INTRODUCTION OF THE TOCATA WAS SHOT USING HALF AND FIFTEEN TRAVELING MATTES IN CONTACT WITH THE NEGATIVE FILM IN THE CAMERA, OVER VA RIOUS AIR BRUSHED BACKGROUNDS IN COLOR.



STRING SECTION OF ORCHESTRE

9.



6, 7. For another "Nutcracker Suite" sequence, the shimmering world of Dewdrop Fairies was born on a rotating wooden lightboard.  
8-10. Shultheis's restless camera recorded early storyboards for *Fantasia*'s "abstract" "Toccata and Fugue" section, and his notebooks contain detailed diagrams and technical information on the colorful live-action shadow play of the orchestra that (in the final film) precedes the "Toccata" animation.

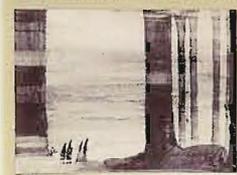
11. A circular construction made of wood containing multiple circular glass paintings of stars in the cosmos lent a dimensional quality to the birth of the universe in *Fantasia's* "Rite of Spring."

12, 13. For the finale of the "Ave Maria" section in *Fantasia*, a horizontal "multiplane" construction held glass paintings of clouds and trees as a camera "trucked" through frame-by-frame.

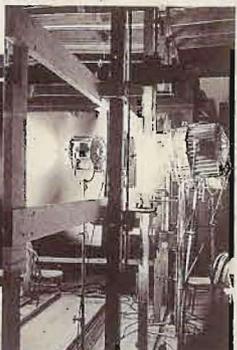
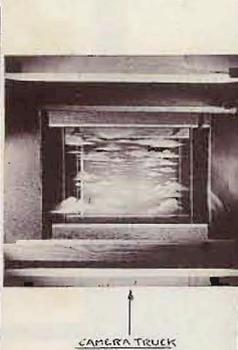
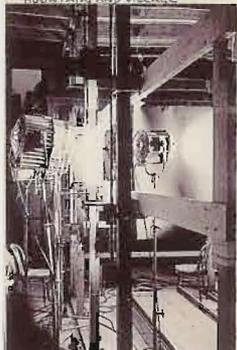


11.

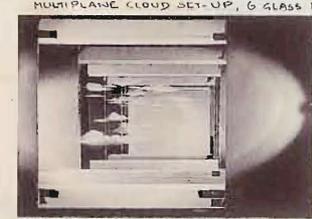
AVE MARIA FANTASIA



THE SACRED BEAUTY OF THE AVE MARIA PROVIDES AN EMOTIONAL RELIEF TO AUDIENCES TENSE FROM THE SHOCK OF THE "BALL ROOM" MUSIC AND ITS GRIM VISUALIZATION



CAMERA TRUCK



SHOT ON LARGEST MULTI-PLANE CAMERA  
 THE CLOUDS ARE AIRBRUSHED ON LARGE GLASS PLATES  
 WHILE THE CAMERA TRAVELS THRU THE CLOUDS, ONE GLASS LEVEL AFTER ANOTHER IS REMOVED TO COMPENSATE FOR THE RESULTING EXPOSURE CHANGE. CLEAR GLASS HAS TO BE ADDED IN FRONT OF CAMERA LENS.  
 NUMEROUS DISSOLVES WERE REQUIRED

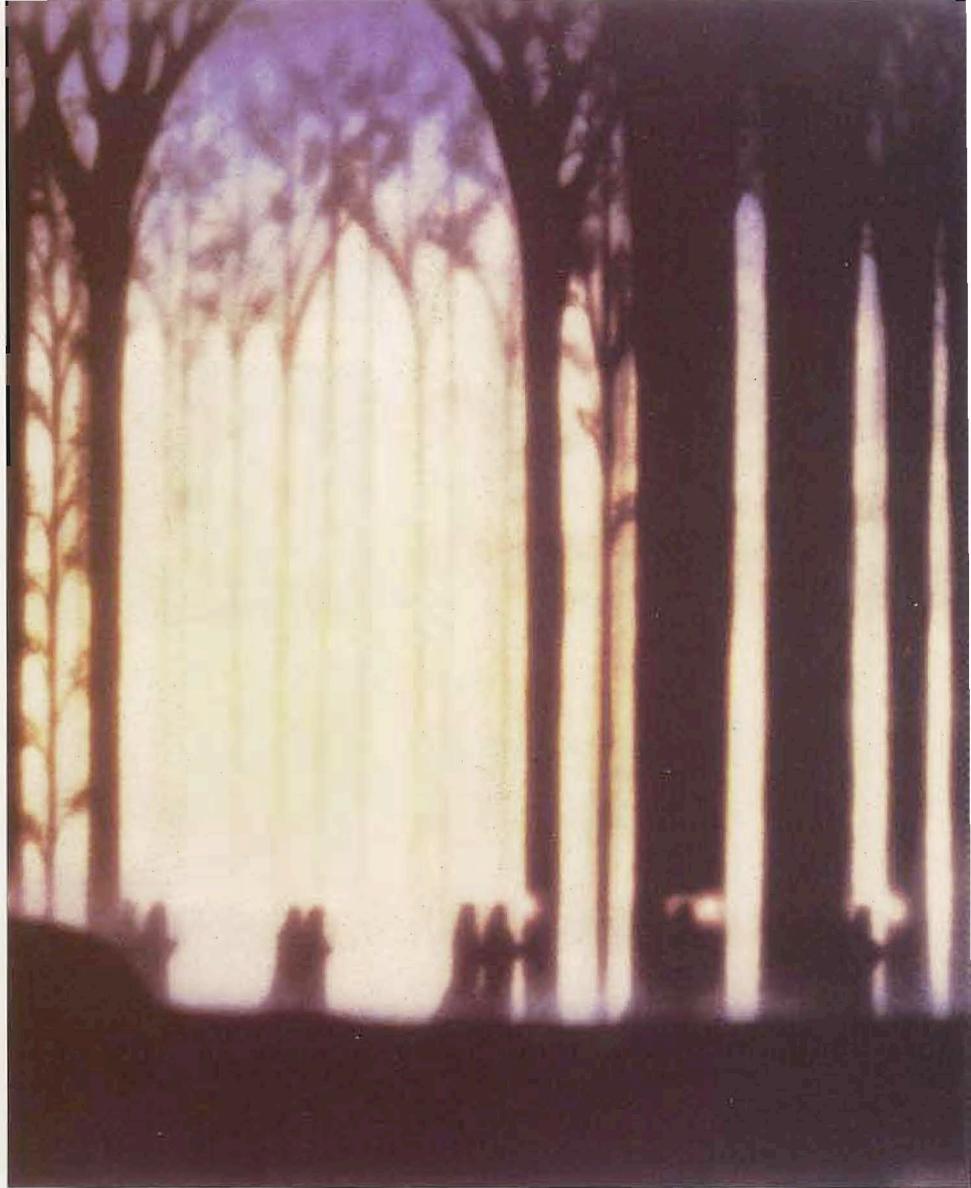
12

the foreground would be fairly easy to animate. In 1939, however, a couple of dozen photostats of real snowflakes were traced and painted onto cels. Then, each flake was cut out and individually mounted atop small rotary gears, which were positioned on four curving steel rails disguised with a cover of black velvet. Each turn of the flakes (representing the tutus) and their simultaneous journey down the rails was animated frame-by-frame in front of a stop-motion camera. The black-and-white film was used in two ways: It was transferred to sequential photostats, which the animators used as a guide to draw the spinning fairies who would wear the tutus; it was also transferred directly onto special "wash-off relief" cels. These special translucent sheets of celluloid had a "tooth" or texture allowing them to be drawn on with pastels and graphite pencils, mediums that cannot be used on normal cels. The translucence of the wash-offs could be chemically removed (washed off) and made transparent, except for the artwork. The wash-off cels were registered to cels holding drawings of the cartoon fairies and finally both were photographed in color. Thus did a meshing of gears and graphics become seamless visual poetry on the screen. Schultheis devotes a number of notebook pages to explaining how a pastel effect can be also be achieved using a photographic means: "Adlux" film.

Raising spooks from the dead in *Fantasia's* "Night on Bald Mountain" sequence was comparatively simple: Single drawings of a ghost (or a line-up of ghosts) were moved incrementally on a belt or drum as their reflection on a distortion mirror was photographed frame-by-frame (Fig. 3). In a related scene, buildings in a village are doubly distorted by the twisting of their reflection on a piece of tin frame-by-frame while shooting through a piece of rippled glass (Fig. 5).

Schultheis's photographs are the only pictures of several odd devices, such as a wooden rotating lightboard that was used for one scene in "Nutcracker Suite" (Fig. 6). Large, octagonal-shaped, and a modest example of the carpenter's craft, the lightboard held artwork in its center and an outside ring of eight lights. Glowing dewdrops from a fairy's wand, Schultheis demonstrates, were metal shavings illuminated on the board and shot against black; then, a second camera pass of the same film double-exposed drawings of the background and character.

Notebook photos are also the only existing record of early and revised versions of storyboards for the semi-abstract "Toccata and Fugue" sequence (Fig. 8). At the head of

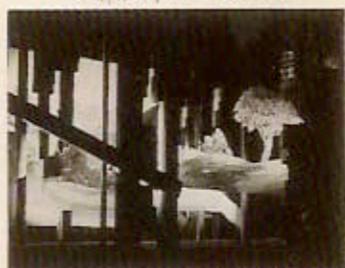




PRODUCTION SHOT IN  
TECHNICOLOR OF SPRING  
VILLAGE SCENE, MADE  
BY UNIVERSAL MULTI-  
PLANE CAMERA IN  
SPECIAL EFFECTS DEPT.



2nd, 3rd, 4th & 5th LEVEL



30th VIEW OF ABOVE SCENE



3rd, 4th & 5th LEVEL



ANIMATED CONTACT LEVEL 15'



LARGE 30th LEVEL



14.

another singular and beautifully composed page, Schultheis explains the intricate how's and why's of the colored shadows of the live-action orchestra that precede the "Toccata" animation section (Fig. 9). He discusses the "Effect of traveling mattes, bi-packed over Technicolor negative in the camera to obtain varying colors and intensities in shadows of musicians over a colored b.g. [background]." The page itself is an abstract artwork, its aging yellow hue setting off touches of color in the mostly gray and black-and-white panels that hold blow-ups of test footage, diagrams, musical staves, orderly hand-written text about color, exposure, and dates of experiments. A tiny slip case contains a souvenir clip of Technicolor film frames.

The multiplane camera, which was first used at Disney in 1937, offered an illusion of depth in animation. Schultheis shows that there were several versions of this device, such as the wooden rack that was cobbled together for the opening sequence of "Rite of Spring" (Fig. 11). In order to give the feeling that the camera was traveling through spiral nebulae and assorted galaxies in outer space, three large circular glasses were painted with small dots representing stars and cosmic dust. Attached to three separate racks spaced a couple of feet apart, the glass "cosmos" was turned frame-by-frame as the camera trucked forward, the space between each glass level giving a believable illusion of depth.

The notebook shows a similar horizontal multiplane set-up for the "Ave Maria" section's finale (Fig. 12). Airbrushed clouds on several small plates of glass were held by five

14, 15. Schultheis recorded the only pictures of the preparation and shooting of one of *Pinocchio's* most elaborate scenes: a prolonged multiplane camera pan from the top of a bell tower, down into and through village streets where school children run to morning school classes.

16. A complex night scene of *Pinocchio's* village, as seen through the lens of the multiplane camera.



wooden frames. "While the camera travels thru [sic] the clouds," explained Schultheis, "one glass level after another is removed. To compensate for the resulting exposure change, clear glass has to be added in front of camera lens."

Schultheis's most detailed exploration of the multiplane effect appears on several pages of the notebook and uses the only photos known to exist of the making of two scenes in *Pinocchio* that are among the most technically elaborate ever devised for animation. In one, Geppetto's village comes to life. Starting on a bell tower, the camera follows pigeons flying toward a road that leads to a village, where children come out of houses and run to school. The scene, which ends in front of Geppetto's door, only lasts a few seconds, but its complexity cost \$45,000, equivalent today to perhaps \$300,000 or more. It is often touted as an example of Walt Disney's striving for quality, no matter the price.

Schultheis's photos literally take us behind the scenes of this unique shoot (Figs. 14, 15). He shows everything, from the unloading of the five glass levels from a truck outside the Studio, to a view of the horizontal multiplane set-up from several angles; each level individually lighted and its effect; even the pencil and paper drawings attached to each level for a test run before the imagery was painted on glass. Another notebook page presents the preparatory multiplane set-up

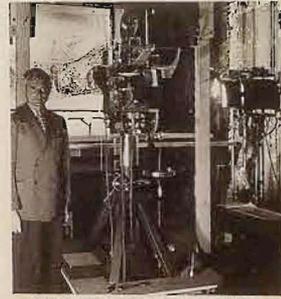
*Continued on page 118*

*John Canemaker's forthcoming book is Disney Inspirations—The Art and Lives of the Visual Development Artists, to be published by Hyperion Press in 1996.*

LONG TRUCK THRU VILLAGE SHOT ON LARGE CAMERA CRANE THIS IS A FIVE LEVEL SHOT THE CAMERA TRUCKS IN FROM A DISTANT SHOT, PASSES BUILDINGS, TREES, THE MAIN SQUARE OF THE VILLAGE, ENTERS AN ARCHWAY AND FOLLOWS A STREET TO GEPPETTO HOUSE



LIGHT ON ALL LEVELS



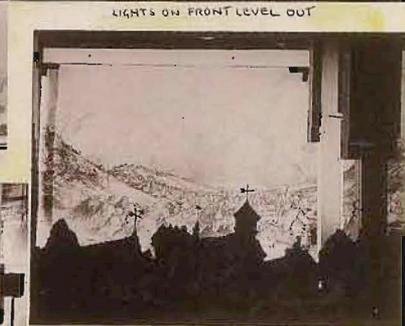
CAMERA SET UP FOR LONG SHOT



LIGHTS ON FRONT LEVEL OUT



FRONT (ANIMATION) LEVEL WITH MOVING BIRDS



LIGHTS ON TWO FRONT LEVELS OUT



SIDE VIEW SHOWING LEVELS



SIDE VIEW SHOWING LEVELS

WHILE THE CAMERA TRUCKS IN GLASS LEVEL AFTER GLASS LEVEL IS REMOVED AND ILLUMINATION CHANGE, THAT CAUSED IS COMPENSATED. THE FIRST TESTS WERE MADE WITH PAPER DRAWINGS IN PENCIL ON THE NEXT PAGE ARE SHOWN SOME PROGRESSIVE FRAMES OF THE SHOT



College of Art invariably use Caucasians in their designs. While traveling in China, I noticed the same tendency. The notion of what is beautiful and what is powerful globally needs to be challenged.

I sometimes show my students a powerful graphic image, one that was not done by a professional designer and went almost unnoticed at the time. The image, a black-and-white photograph, appeared in the New York Times during the early '70s. We see the head of the Statue of Liberty with an upside down American flag flying from her crown. Veterans and Scouts know this is a distress signal—all the more poignant because the accompanying story told how Viet Nam veterans had occupied the Statue of Liberty and hoisted the flag in protest to the war. Even my foreign students, too young to remember the event itself, get the message. Every time. America in trouble.

*Cross-Cultural Design* contains a few images almost that powerful. And so Henry Steiner and Ken Haas are to be commended for a step in the right direction. This book will surely be helpful to students and professionals alike who wish to increase their ability to communicate across cultures. —*Al Gowan*

## Disney's Secrets

*Continued from page 73*

and exposure chart for the well-known subjective camera angle of Jiminy Cricket's hop toward Geppetto's workshop, as seen in *Pinocchio's* opening.

In the introduction to the *Fantasia/Pinocchio* notebook, dated March 1939, Schultheis wrote, "It is my belief that the Special Effects will be one of the most important production departments in the Studio, and my engineering, photographic and musical knowledge can be used to the Studio's best advantage in this Department." But despite his self-promotion, Schultheis's tenure at Disney was brief, and his offer to sell the notebooks to the Studio for \$400 was rejected.

The books' current owner has no desire to sell them at this time. "My wish," says Howard Lowery, "is that they be published in facsimile form." A limited-edition art book using the best and most interesting pages from the Schultheis notebooks is an excellent idea and one hopes that a publisher will come along who agrees. As Lowery says, "It would not serve a broad audience, but there is a large number of people to whom filmmaking history is important and to whom *Fantasia* and *Pinocchio* are among the most important films ever made. I'm sure they would appreciate and treasure it."

## Piet Zwart's NKF Catalog

*Continued from page 97*

an important client for whom Zwart designed new product lines, notably modular kitchen components in 1937. This project had a tremendous impact on kitchen design.

During 1943–44, Zwart was under Nazi detention and kept apart from his wife and four children. After the war, he resumed his collaboration with Bruynzeel and produced new stamps for the PTT. Zwart died in Leidschendam on September 24, 1977, at age 92. His legacy is a profound influence on graphic design that spans the globe.

In 1937, Zwart explained his approach to typographic design: "The task of functional typography is to create a form of typographical design in harmony with the present age, a form free of traditional conventions and as animated as possible; it is to find a clear, well ordered means of visual expression which shall be decided by modern typographical problems and modern methods (e.g., phototype, techniques such as machine setting, typewriter script and photographic setting); it is to break with the spirit of handwork."<sup>6</sup> His designs for NKF including the catalog achieved a remarkable functional vitality and are a historically important expression of a dynamic age of change. About the NKF catalog, Zwart said, "What is the beauty of this kind of work? That it is a slice of life, and that it also is your whole life?"<sup>7</sup> Seldom has the viewpoint of designer as artist been so eloquently expressed.

### Notes

<sup>1</sup>Broos, Kees. *Piet Zwart*. The Hague: Gemeentemuseum, 1973. p. 46.

<sup>2</sup>Cohen, Arthur A. *Herbert Bayer and Piet Zwart: Masters of Design*. New York: Ex Libris, undated. p. 14.

<sup>3</sup>Jaffé, Dr. Hans L.C. "Piet Zwart: A Pioneer of Functional Typography." *Neue Grafik*, No. 10. Zurich, 1961. p. 6.

<sup>4</sup>Various sources cite 1926 and 1928–29 as the publication date. One says it was originally printed in 1926 and reissued in 1928.

<sup>5</sup>Zwart, Piet. *Keywords*. The Hague: Staatsdrukkerij Den Haag, 1966. p. 6.

<sup>6</sup>Jaffé, op. cit., p. 9.

<sup>7</sup>Broos, op. cit., p. 46.

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## Shaking It Up

*Continued from page 37*

tion techniques during his years at Leo Burnett only deepened his belief in the integrity of ideas above all else. "Now, when I am forced to ask myself questions like whether or not something needs a varnish on it, it just means that the project sucks, that I didn't do my work. If the idea is strong, you can usually print it very simply and it should stand up."

What's special about Sagmeister's work is also its humor, lack of inhibition, and freedom from the rules and pretensions that the profession tends to produce. Six-foot-three-inches tall, lean and lanky, with thick dark hair swept back from his face like that of a 19th-century romantic, a charming way of crisply pronouncing favorite words like *excellent*, and a friendly, informal manner, Sagmeister is a designer who does not take himself or his profession too seriously. He clearly delights in stirring up mischief, in poking fun, in producing small shocks. For example, a call-for-entries for Hong Kong's advertising club featured an illustration of four Chinese men bending over with their pants down to moon the viewer. The image caused such a stir that the award ceremony was indignantly boycotted by the advertising agency Dentsu, Young & Rubicam, and the poster was reproduced on the front page of the South China Morning Post.

Because Sagmeister's current success is fueled by a roster of international clients, much of his work is executed and delivered electronically. However, as a practical designer concerned with thinking before making, he never begins a project by designing on the computer. Moreover, he dismisses any link between quality and technology. "If there is more good or bad work out there now, it's not because of the computer. Quality-wise, it's had very little impact. The people who did fantastic work before by cutting out typefaces by hand will do fantastic work on the computer. And the people who did shit work before will do shit work on the computer. The only thing that changed was that people who couldn't do any work before now do—at least in their own minds—professional-looking work. I would still say it is shit, but the difference is that now you are not stuck with only Courier on your typewriter. You can elongate and squeeze. Every assistant has 150 typefaces on the computer. Nobody hires a designer to design some stupid little newsletter that you can have done in-house if you send somebody to take a Quark XPress course for \$400. That is pretty much what is