

STARLOG photo guidebook

SPECIAL^{Vol. 4} EFFECTS



Norman Jacobs and Kerry O'Quinn present

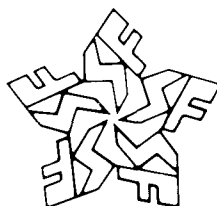
SPECIAL EFFECTS

Vol. 4

A STARLOG Photo Guidebook

By DAVID HUTCHISON

For STARLOG PRESS, INC.:
Art Director: W.R. Mohalley
Associate Art Director: Neil Holmes
Senior Designer: Denise Lewis
Art Staff: Georgia Kanelous
Marilyn Pierce
Production Manager: John Clayton
Proofreader: Leslie Stackel
Shawn Hodes



A STARLOG PRESS PUBLICATION

475 Park Avenue South
New York, NY 10016

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PREFACE

This fourth volume in STARLOG's Photo Guidebook series on special effects focuses on the use of modern technology in the production of fantasy films. Most promising is the large scale use of computer animation and scene simulation in Disney's *TRON* or the computer graphic effects in *Star Trek II*. These films point the way to the eventual elimination of model photography as we know it today in favor of computer simulation. As we go to press Digital Productions is using their CRAY super-computer to create spaceships and entire scenes for *The Last Starfighter*. While traditional modelmaking will not entirely disappear over the next decade, computers will push back the frontiers of the imagination—opening new worlds for fantasy filmmakers to explore. *Dragonslayer* and *E.T.* have introduced Go-Motion™, a new technique for animators that produces an illusion of life that is startlingly real. Henson's *The Dark Crystal* is a unique achievement in the art of puppetry. *Crystal* is in many ways the 2001 of the genre, many films will be measured against it for years to come.

For fans of the supernatural both *Raiders of the Lost Ark* and *Poltergeist* gave us visions of ghostly powers enough for a year of Halloweens. Careful integration of live camera techniques with animation and miniature photography went a long way to making the unreal, real.

But Disney's *Something Wicked This Way Comes*, a fantasy film with great promise and impeccable credentials, demonstrates that no amount of special effects gimmickery can save a film that is not working in the first place. Why a film goes wrong is almost as great a mystery as why a film goes right. Since filmmaking is the most intensely collaborative of all of the arts, it is difficult and unfair to lay the success or failure of a given project at any one door. Sometimes, though, a film is carried to successful completion by the energy and clear vision of a single artist—usually the director. His vision can inspire and unify an entire production team. And though the vision behind *S.W.T.W.C.* seems to have faltered somewhere along the way, the special effects story candidly reveals many of the problems facing the fantasy filmmaker.

David Hutchison
STARLOG Magazine

ACKNOWLEDGEMENT

This fourth volume of STARLOG's Photo Guidebook of Special Effects could not have been assembled without the generous assistance of the science-fiction/fantasy collectors and the special-effects artists themselves, many of whom took the time to lend photographs from their collections and take the time to tell the stories behind them. My personal thanks to: David Ayres; Michael Bonifer, Harrison Ellenshaw, Michael Fremer, Howard Green, Scott Santoro and Ron Tantin of Walt Disney Productions; Susan Trembley of Lucasfilm Ltd.; Richard Edlund, Paul Huston, Dennis Muren, Bruce Nicholson, Lorne Peterson, Ken Ralston, and Laurie Vermont of Industrial Light and Magic; Peter Kuran of Visual Concepts Engineering; Alvy Ray Smith of Sprockets; Lyle Conway, Jim Henson and Gary Kurtz.

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THE SIGHT AND SOUND OF FUTURE TECH

Human imagination harnesses the
power of computer technology to
bring dream worlds to life.

Michael Fremer, supervisor of music and sound effects for *TRON*, took time during the production of the Disney film to describe his department's application of micro computers (the Atari 800 and the Apple II Plus) and other more sophisticated equipment to sound and music editing. Early in the production, Fremer was quick to realize that the unique visual landscape offered by *TRON* was every bit as challenging for his department as for the animators, since special sounds would have to be created to fit the fantastic style of the computer and animation produced backgrounds and characters.

Research on *TRON*'s audio effects began in July 1981. "My first consideration was budget," Michael Fremer explains. "The studio gave us a budget which reflected what would be necessary for any ordinary film. But there was *nothing* ordinary or normal about *TRON*, so that put me in kind of a bind. All of our sounds had to be created from scratch rather than pulled from stock. We had to create aural effects for a newly-created electronic world, so we've had to in-

vent sounds for *everything*, from the footsteps on up."

While the right sound with the right visual can create a compelling sense of reality, the wrong sound can completely undermine that reality. In a pure fantasy situation like *TRON*, this distinction is crucial.

"I looked at my budget and began to look for ways to get the most out of it. Quite a large sum of money, about \$25,000, was devoted to transferring sound to 35mm mag for cutting. If I could take that sum and devote it to sound effects, I felt we could do a much better job." To avoid the time-consuming, expensive process of sound transfers and since the Disney transfer department was busy readying material for EPCOT and Tokyo Disneyland, Fremer was ready to try something new.

"Since my budget was not really big enough to handle the picture's demands, I tried to find alternative methods of doing my sound effects." Since *TRON* was a showcase of new technology, Fremer searched for methods which would sidestep all of the old technology of sound transfer which involves transferring effects to

Walt Disney's *TRON*, filmed in Super Panavision 70, is a fantasy of parallel worlds.

Facing page— Above: David Warner is the mastermind behind a massive theft of information.

Below: His alter-ego Sark is the most villainous being in an incredible computer and animation generated cosmos.





Even the music has orchestral and electronic parallels. Orchestral computer Jorge Calandrelli checks over the score with electronic composer Wendy Carlos.

35mm magnetic tape for cutting and dubbing.

"The first thing I did was to hire Frank Serafine, who had created many of the sounds for *Star Trek*," Fremer explains. "Frank immediately set about creating many sounds in his studio, sending them off to be transferred to 35mm mag and then to another department to be cut. But very soon, he suggested the possibility of working with the soundtrack on video. The idea was to have *TRON* videotaped and then synch-up a 16-track audiotape recorder with it. All of our sound effects could be edited directly on the 16-track recorder without ever going to 35mm mag. Further, there would be no physical cutting—all editing could be done electronically. Finally, we could take the 16-track master directly to the dubbing stage — no transfers, literally the second generation track right on the film.

"The idea really appealed to me. Not only because we would save an enormous amount of money by not hiring 20 editors to chop up sounds and tracks, but because there really

wasn't any other way to effectively handle the sound problem on *TRON*. Many of our sounds required the mixing of 20 or 30 tracks, which meant that we weren't really going to get to hear what things would sound like until we got to the mixing stage. So, this seemed to be the ideal solution.

"Certainly, *TRON* was going to blaze new trails in every other department; I thought we should, too. Frank seemed like the right person to hire. He had never done a whole picture before, so there was an element of risk, but we worked out a deal allowing good opportunities for both sides. Basically, we had the use of his studio for the whole period of time without paying by the hour. We set him up with space at Lion's Gate Studio and as we proceeded, we got more and more involved in this new technology. As it's set up now, we have one 16-track machine with our library of sound effects on it keyed to S.M.P.T.E. time code, which is a film industry standard. All of our sounds are logged through an Atari computer, which makes them very easy to call up.

"Let's say we are looking for a 'blast.' We type in 'blast' and the computer prints out a menu of all of our 'blast' sounds giving us the S.M.P.T.E. code number for each location on the tape. Also the printout lists the duration of each effect plus any comments that we noted at the time when we transferred the effects library to 16-track tape. So, we simply select the effect we want, push a button, program in the S.M.P.T.E. number and the tape runs right down to it and finds us our effect.

"Now, let's look at the old way of doing it. A guy has a library of sound effects up on the wall with 2,000 boxes of tape. He must climb up there, grab the tape, put it on the machine, run it down, listen to all of the cuts. . . . I mean it takes hours! Then, when he finds the effect he wants, he has to send it upstairs to the transfer room, where it's transferred to 35mm magnetic film. Ridiculous! Our way is instantaneous.

"Once we find the effect we want, we go back to the picture which is synched to a 16-track tape machine. We program the S.M.P.T.E. number where we want the effect to start and to stop, we push a button and the machine does all the rest. And it's just fabulous."

Frank Serafine used two multi-track tape machines to handle the sound effects of *TRON*. A 10-hour library of sound effects was recorded on a TEAC 16-track one-inch tape recorder, while an Ampex 16-track two-inch tape recorder was slaved to the master video-machine. The sound effects were transferred from the library machine to the video-synched tape recorder using S.M.P.T.E. time code for precise frame accuracy. Special video controller equipment allowed Fremer and Serafine to walk through the picture one frame at a time or to race through any sequence at high speed.

The Ampex two-inch master reel was then sent to Mike Lee and Bob Minkler at the Lion's Gate soundstage for final dubbing.

"We brought in a supervising sound effects editor [Gordon Ecker] to work with Frank, since Frank didn't have the experience of actually editing a film. Well, he looked at all this new technology and was not con-

vinced at all. But after just a couple of months, he began thinking about transferring *his* entire library of sounds to S.M.P.T.E. time-coded tape and as the weeks went on, his skepticism about editing electronically rapidly diminished," chuckles Fremer.

Hi-Tech Music

"As far as the music goes, I decided I wanted synthesizers," Fremer says. "But I didn't want one of these diddly kind of synthesizer tracks. My first choice was Wendy Carlos, but I didn't know if she had ever scored a film. I knew she had done music for film which was cut in, but this was a different situation.

"So, I contacted her and she had everything she needed to do it. I watched how she works and wondered if we could sync her the same way we were synching the sound effects. It was a question of what sort of equipment she was used to working on. Well, she loves her old 3M 16-track machine, won't part with it. It doesn't have a servomotor on it, so you can't run it as a slave to a video machine. Also she performs at half-speed. She writes the material, produces the sounds on tape at half-speed and then doubles the tape's speed for final playback. It's bizarre, but what gives her that great sound.

"So, I hunted around for a specialist in synching, who built a special system which slaved her video machine with her 16-track tape recorder and allowed both to run at half-speed. Now, she can lay down her basic track—she does one note at a time, she doesn't have a program synthesizer, she works with the old patching system—so if she spends hours and days doing the basic track without sync and then goes back and puts it on the picture and it doesn't sync, it's just a terrible waste of time. Now, she can lay down a basic rhythm track and run it back to see if she's in sync."

For protection, the Disney Studios also recorded a live orchestral score to hedge against the event that time wouldn't allow the completion of a synthesizer score. There were also Disney Studio personnel who believed that such a score would be "too

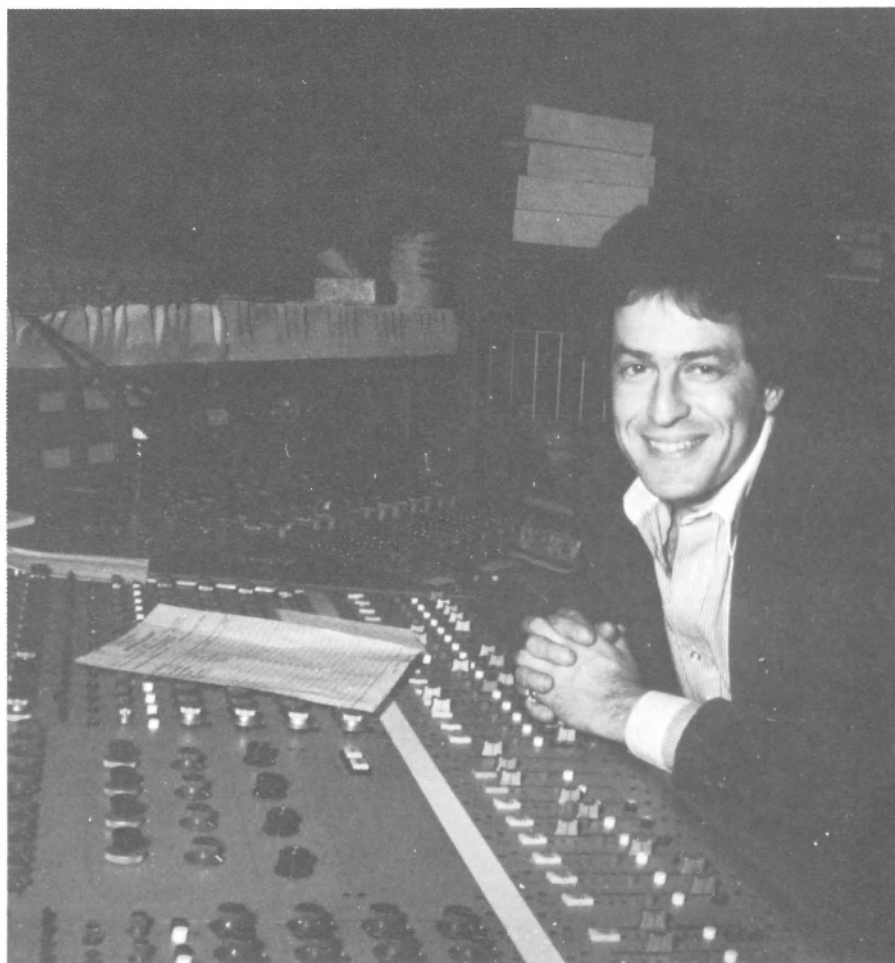
weird" for Disney audiences.

"Wendy was also responsible for developing her own computer click track program," reveals Fremer. "Normally, music editing works something like this: The composer decides where she wants her cues to be. For example, I would like this cue to start at this point in the film, which is usually notated in feet and frames. But we are using S.M.P.T.E. numbers, so Wendy marks where it is supposed to start and end. Then, she has to pick a tempo. The music editor must find a click track which will catch all the little pieces of action that she wants to catch in the scene.

"The music editor may say, for example, 'OK, I think a 17-click track will work'—which means 17 frames per click. (Forty frames per click is a slower tempo.) The music editor goes to a drawer and pulls out a big bag of loops with clicks on it at different rates. He puts these loops up against the picture on a moviola until he finds one which works—one which hits all of the marks that the composer has specified. This trial-and-error pro-

cess can go on for some time.

"Well, Wendy thought she could do better than that. She devised a computer program. Now, all she had to do is sit down at the computer, type in the S.M.P.T.E. number for the beginning of the cue, type in the S.M.P.T.E. number for the cue's end and how many places within that area she wants to catch with the clicks. Then, she presses a button and says, 'OK, I want a click track of about 40 and a tempo of about so and so.' In about two seconds, the computer comes up with a printout of all those cues that you want to hit, how close to the beat it comes and the percentage of error. If this isn't satisfactory, you can go back to the computer and say, 'OK, I'm willing to go plus or minus 10% on the click and I'm willing to move the cue's beginning and end so many frames.' Push another button and two seconds later, it prints out the percentage of error. Right away, you can see if you are better or worse. If you are better, you push another button and it will print out how many cues you are hitting."



Michael Fremer, supervisor of music and sound on *TRON*.



Sark (David Warner), who has decreed that peaceful programs be put to death on the video game grid, is backed by Master Control Program in *TRON*.

Programs for computer-generated click tracks have been created by a number of individuals in recent years. *Conan* made use of the system developed by Robert Randles called-Musync, which enabled composer Basil Poledouris to more easily re-edit his music when last-minute editing changes were made by director John Milius.

A Philosophy of Sound

Michael Fremer was eager to detail the process of sound effects development for *TRON*. "Let's take the motorcycle sequence as an example," he says. "The vehicles aren't really motorcycles, so we want something which sounds like an engine, but not exactly. So, you try a real engine first. We recorded some motorcycles and some cars, both at rest and in passbys. The sound was processed through various means to smooth it out or change it. Sounding them out is a little like painting—looking for just the right combination of colors.

"You have to think about the different qualities of the sound. What does the cycle sound like when it's up close and what does it sound like when it's far away? In the real world, when you listen to an automobile engine nearby, you'll hear the valves and certain parts of the engine. For *TRON*, we had to come up with our own electronic version.

"We have tanks in this electronic world. If you were close to a real tank, you would hear treads. These tanks don't have treads, so we used some sounds recorded over Pacific Telephone—hundreds of relays clicking. We dropped that in for the treads which you hear when you are close to the tanks. It suggests the sound of moving treads, but it's electronic and exactly right for the world we are creating. As you get further away from the tank, you don't hear the treads clicking, just the engine's roar.

"Our philosophy is to keep the sounds varied, to create a really unique identity for each sound and to try to find a real world analog for each device.

"The Recognizers which come swooping down are a little like helicopters. We took a basic helicopter sound and worked it through the synthesizer, adding a screaming animal or something—for a great combination of sound. Of course, you never want people to be able to tell just *what* you used in the combinations, but you still want them to respond subconsciously to the organic nature of the original sound."

Michael Fremer also had to deal with the various formats in which the film was released: mono, four-track Dolby optical, and six-track magnetic. "We did our pre-dubs for the six-track magnetic format and just folded the sound down for the other

formats," Fremer says. "You must keep in mind that, in most situations, the movie will play in mono sound, which is just dreadful. So, you have to keep little compromises in mind to allow for the bad situations. Dolby recommends that you mix through their four-track optical matrix and then, when you are finished, they can spread it out for the six-track release. I don't go along with that. I like to make the six-track version the best and then lose a little depth in the four-track optical version—you are going to lose it anyway. The mono sound just folds down into a single source.

"Originally, we were contemplating an eight-track release which would require a special interlocking sound system. We were going to have five discrete tracks behind the screen, a stereo surround, a special multiplex sub-woofer system and the MCP in the ceiling. But time worked against us.

"I anticipate having some difficulty on the dubbing stage. Normally, if you are working with 16-tracks, they are all on different dubbers, so if one effect is not in sync, you just unlock it and re-sync it. But we have all of ours married onto one Ampex 16-track two-inch tape recorder, so we can't do that. What you would have to do is transfer that one track to 35mm mag and start rock and rolling it into sync. I'm covering myself by putting all of our important effects on 35mm mag,

on call, at any time. So, if one of our tracks doesn't work, you just go back to the mag, roll it up on sync and we're all set.

"If they want to change the picture on us, cut a couple of feet out, so we are out of sync, then, in normal mode, we would have to go back and cut all the elements—all 20 or 30—and that would take half a day. But with our computer system, we just punch in the instructions: 'These 20 feet no longer exist.' The tape will run forever till it's back in sync."

Not only do computer systems for music editing ease the tedious work of mathematical calculation for the music editor and therefore, make life easier for the composer, but they have immediate applications for both foreign language dubbing and Foley-ing as well. In the future, more and more production tasks will be turned over to computers in an effort to make the whole process of filmmaking more efficient and less expensive—and as in *TRON*, more unusual and unearthly.

TRON is the first feature film to employ computer graphics on a large scale. And with the new machines come new jobs and job titles for moviemakers. One of the more interesting sounding credits to be found at the end of *TRON* is "Computer Image Choreographer." The two names listed are Bill Kroyer and Jerry Rees.

In May 1981, before *TRON* was completed, Bill Kroyer talked about his work while seated behind a Chromatics computer monitor at Disney studios. Kroyer joined the Disney Studios with *Pete's Dragon* and even animated a bit of *The Fox and the Hound*. So what's an animator doing sitting behind a computer terminal?

"I'm looking at a 'pencil test' for a sequence from *TRON* that is being sent over the phone lines from the computers at MAGI in Elmsford, N.Y.," came the easy reply. "It's my job or part of my job as computer image choreographer [C.I.C.]."

"Oh. And what is—"

"A computer image choreographer?" smiles Kroyer. "Well, it's certainly the first time that credit will appear on the motion picture screen, because this is the first time this process has ever appeared on the screen



Left to Right: *TRON* producer Donald Kushner, futuristic industrial designer Syd Mead and writer-director Steven Lisberger go over pre-production drawings and storyboards for *TRON*.

on this scale.

"Computer-generated imagery, what we call 'scene simulation' and which most people tend to call 'computer animation,' is really an up-and-coming fast-moving field. The basic idea is to generate pictures on the screen which are not drawn or painted by anyone, or built as models first. They are scenes that are completely constructed in the imaginary mind of the computer. Then, the computer reads out that imagery on a piece of film, which is processed, printed and projected as ordinary movie film.

"What Jerry and I do as computer image choreographers is to describe the imagery to the computer. We describe all of the geography and hardware. Basically, we use blueprints and maps that describe the 'physical reality' of a scene to the computer. Then, we describe the action or choreography of those objects and the computer puts it all together into a scene. You might say it 'visualizes' it. Then, the computer 'reads-out' that information onto movie film. Basically, we are creating a com-

puter image and then we are choreographing that image's actions. Hence, the name—computer image choreographers."

The *TRON* filmmakers are very excited by this new computer tool, since the images that are created are not tied down by the laws of reality. "The scenes we can visualize in our heads' make it to the screen almost completely intact. There are very few limitations. At the moment, the limitations are mostly technical according to the current state of the art and the amount of time and money that it takes to compute the complexity of the imagery desired. But once you adapt to working within your budget, you are pretty free to ask for just about any image you want and just about any kind of choreography you want. You can move the camera anywhere you want, there is no limitation; you can blow things up; you can move things at any speed; make 90-degree turns; you can have things completely disobey the laws of gravity or . . . anything. It's a great feeling of power," says Kroyer.

But the computers will not turn just



High-tech artist Peter Lloyd served as consultant and color stylist on *TRON*.

anyone into an artist of the future: first, the image must be in your own head. "You absolutely have to be able to visualize exactly what you want," Kroyer warns. "You are not dealing with any sort of hard artwork, or models or actors that you can look at and manipulate. . . you are not dealing with anything. You have to describe to the computer exactly what you want to see. The computer will only give you what you describe and not one single bit more. If you describe it wrong, you get it wrong. The better you can visualize what you want, the more completely you can create it."

The bulk of the picture's computer graphics are being generated by MAGI (Mathematical Applications Group, Inc.) of Elmsford, NY and Information International Inc. (also known as Triple-I or just III) of Culver City, CA. Digital Effects of New York is also supplying computerized effects for the film.

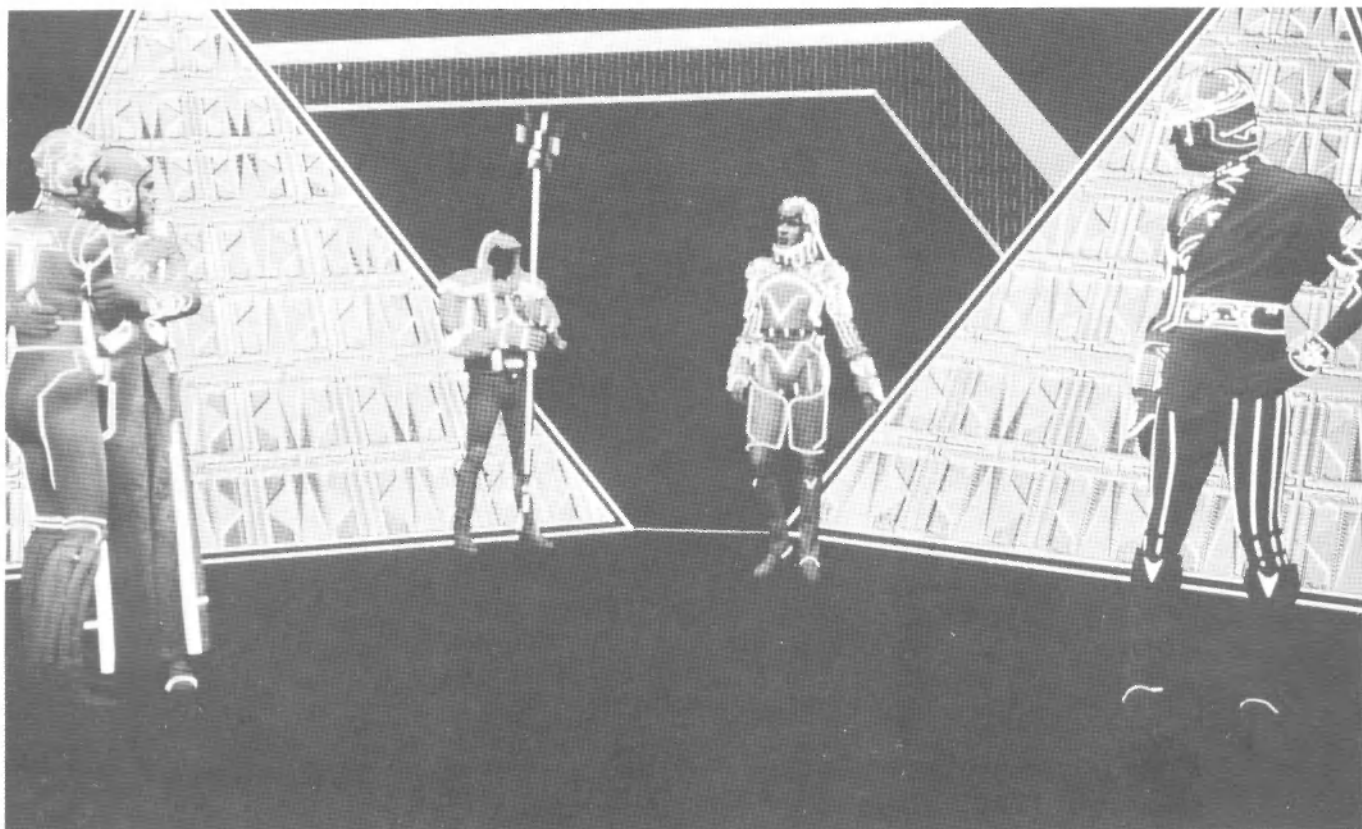
Talking to Computers

Each company has their own custom hardware and software systems which create imagery. MAGI's system is called Synthavision and Triple-I [A few months after

TRON's release, Triple-I sold their computer graphics unit.] uses a system called ASAS (Actor/Scriptor Animation System). It's not necessary for the computer image choreographer to be "conversant" with the different software systems nor is it practical, so the C.I.C. relays his instructions to the programmers at each of the respective companies. The programmers then translate the C.I.C.'s requests into the language used by each computer system.

Kroyer explains how the system works by demonstrating with the scene with which he is currently working.

"The scene coming from the MAGI computers at the moment is from the Clu sequence at the film's beginning. Clu blows up a Recognizer and the pieces smash into his tank, the tank veers out of control and smashes into a wall. One of the shots, for example, shows the tank's exterior being hit by debris from the Recognizer and being knocked off center. To plan a scene like this, we first describe to the programmer the scene length, we give him diagrams and blueprints of the canyon where the scene occurs and then we draw diagrams of the path of



The evil Sark (David Warner, center) and a guard imprison their foes, played by Jeff Bridges (far left), Barnard Hughes and Cindy Morgan (far right).

speed. The programmer already has a complete data base of the tank itself from the vehicle's blueprints and they are already in the computer. Then, we have to describe the angle and tilt of the tank in each frame of the shot; we have to describe when the debris hits and how the debris is falling, whether it is rotating or spinning and, well, basically we have to describe every last little thing that's in the scene. The programmer will have to know and understand all of this information so he can describe it in a numerical way to the computer.

"So, now he has a data base for the canyon, he has one for the tank, he describes the increments that the tank moves per frame, the degrees that it tilts and the degrees that it turns. He has to have a file for each piece of debris that falls. When the

debris hits the tank, there must be a certain type of flare . . . and that must be described.

"It's like painting with numbers. Everything has a number—even all the colors have numbers, all the glow factors are described by numbers. You can see that by typing in numbers, eventually anything in the scene, the color, the light, the light's direction, the direction and movement of the camera, the type of lens, etc. can be accurately specified. All of these things are given number codes; the computer understands these number codes and creates the scene. At MAGI, all of this information for a given scene is stored on a magnetic disk. Using the disk, the operator is able to change or modify any portion of the scene at will. When a scene is completely built up on the disk, the



Computer image choreographer Bill Kroyer at his terminal. Kroyer and Jerry Reese described the imagery to the computer, which in turn "reads it out" onto movie film. MAGI, Triple-I and Digital Effects generated the final images.



Jean "Moebius" Giraud goes over a "rough" for a computer display graphic shot in *TRON* with writer-director Steven Lisberger.



Villainous Sark (David Warner) will stop at nothing to protect his own interests in the world of *TRON*. The film combines computer-generated imagery with special techniques in live-action.

disk reads out the information into a low-resolution 'pencil test.'

"This is the way our computer pencil tests work," begins Kroyer. "The computer 'reads-out' the scene onto the screen of a high-res monitor. The screen is mounted inside a lightproof box. Pointing right down at the monitor screen is a 35mm camera. If you were to look at the screen during the filming, all you would see is one tiny dot of light moving. The tests are photographed in black and white and in a low-res mode. We don't need color and high resolution for a pencil test. It's quicker and cheaper in black and white low-res. All we are doing is looking at the timing and movement.

"Now, this scene with the tank started with the tank rocking up on one tread and then flopping down on the other tread when it gets hit by some debris. The first pencil test showed the tank raised up at one angle for the first four frames of the scene and then suddenly, it settled down on the other tread in three frames. I called the programmer at MAGI and explained that I didn't think that this looked like a natural reaction to gravity. The tread should start falling with the scene's first frame and accelerate according to the laws of gravity. So, what I am getting now is the pencil test. I will view this test and if there is anything else on it that needs correction or tweaking, as we call it, I'll call him back and he can compute the change in a matter of minutes. I can get two or three versions of this 29-frame scene before lunch today. The scene can be refined in just a matter of hours."

Computing the Scene

"If I can call the programmer back at lunch time today and say to him that the scene is now correct, he'll put that completed disk into the computer which will produce a high resolution color version of the scene in a few hours—that's what we call computing the scene," Kroyer explains. "When the scene is computed, it is transferred to tape for storage, the disk is erased and used to start a new scene. The tape becomes the permanent record of the scene. Eventually, that tape is fed into a machine that transfers the image onto high-resolution color movie film, VistaVision format. The resolution is expressed in lines and we are running at about 2,000 lines, which, I am told, is higher resolution than the film stock we are using. Some of our scenes contain over one million pixels (picture elements).

"When we get our film in VistaVision, we view it using a VistaVision projector. The film is rear-projected so we can stand right up to the screen to examine the quality of the image . . . and it's sharp."

For you hardware buffs, here is a rundown on some of the hardware used to create the images in *TRON*. MAGI operates with a Perkin Elmer System 3240 computer to make the calculations for each picture it generates. The system functions with two megabytes of MOS memory and two 80-megabyte disk drives, and talks to a Celco DFR 4000 computer, which is used to generate the pictures onto a monitor.

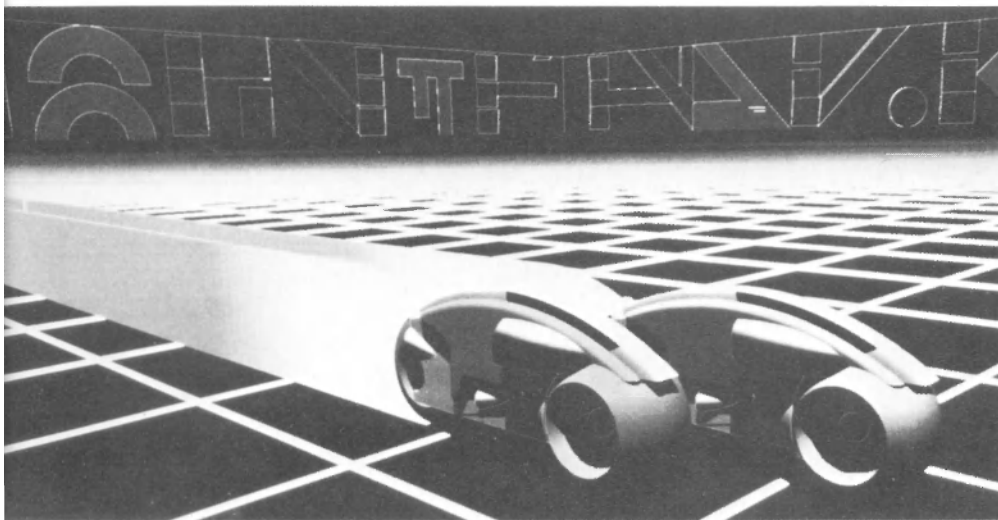
Triple-I's main computer is a custom-built one-of-a-kind which they call the Foonley F-1. The pictures are generated on a PFR recorder, which is manufactured by the company. Programmers use a 40-inch by 60-inch Taylos encoding tablet to plot the vector lines for the various images.

"MAGI and III have very different methods of creating scene simulations," says Kroyer. "MAGI uses a geometric system. They build their images out of solid geometry. They make objects by combining sets of geometric objects of shapes which are put together into whatever form they want. Of course, not only can they add geometric solids, but they can *subtract* solids as well. As a very simple example, if we wanted a wheel, we might start with a sphere and start chopping off parts of it to get down to the shape we needed.

"MAGI has created the lightcycles, the tanks, the Recognizers, etc. They constructed those objects by assembling a set of solid shapes. The entire object is constructed around a single center point. To animate the object, basically what we are doing is moving that center point and the constructed object moves along with it.

Triple-I's system is completely different. They use a vector graphic method to create objects. All of the objects are built by constructing a shell out of polygons, instead of creating a solid object using solid geometrics. Triple-I defines the points of a surface and they connect those points into a series of polygons. They have computer programs that smooth, shade and color the surface.

"Their method is much more suitable for complex organic shapes, because you don't really have to rely on the existence of regular geometry. You can define points in any fashion and create any sort of shape out of polygons. That's why they can do human faces, like the MCP (Master Control Program), or very organic-looking shapes like the Solar Sailer. Their system seems to be a bit more difficult to choreograph because they carry a much greater data base, so we tend to give Triple-I the simpler choreography, relying more on their visual beauty. MAGI tends to get the more difficult and complicated



Two "light cycles" race across the video game grid.

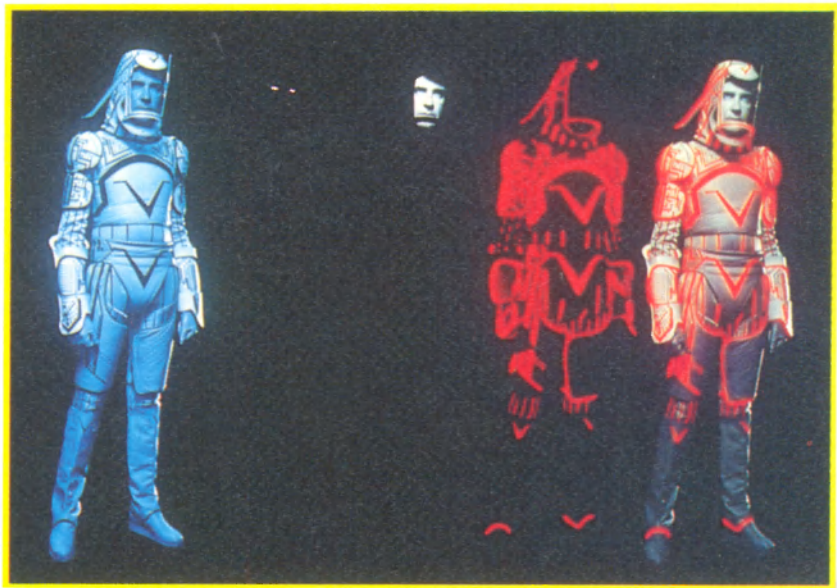
choreography, because their visuals tend to be a bit more simple. Both look beautiful and both companies do great choreography, so it's just a matter of emphasis."

Meet Bit

"Digital Effects in New York did an opening piece of a man forming out of energy and they also created a character called Bit. Bit is a little geometric object that flies around a bit like, well, Tinkerbell, I guess," laughs Kroyer. "Bit changes shape to express its mood. When it's angry or giving negative opinions, it becomes a brittle kind of pointy shape. When it's in a pretty good mood and answering in the affirmative, it goes down to more of a soft-shaded look. Bit is Flynn's mascot, in a way."

It takes quite a lot of computer power to work effectively in computer graphics. Some of Triple-I's graphics require 75,000,000 calculations to create one frame of computer animation. Multiply that by 1,240 frames needed to make one minute of film and the immensity of the task becomes apparent.

Four Hewlett-Packard 9826 computers are needed to calculate exposure control during the optical process which will give *TRON*'s fantasy setting its unique "electric" look. A Cinetron 1100B is used for camera moves on cranes and motion control when required.



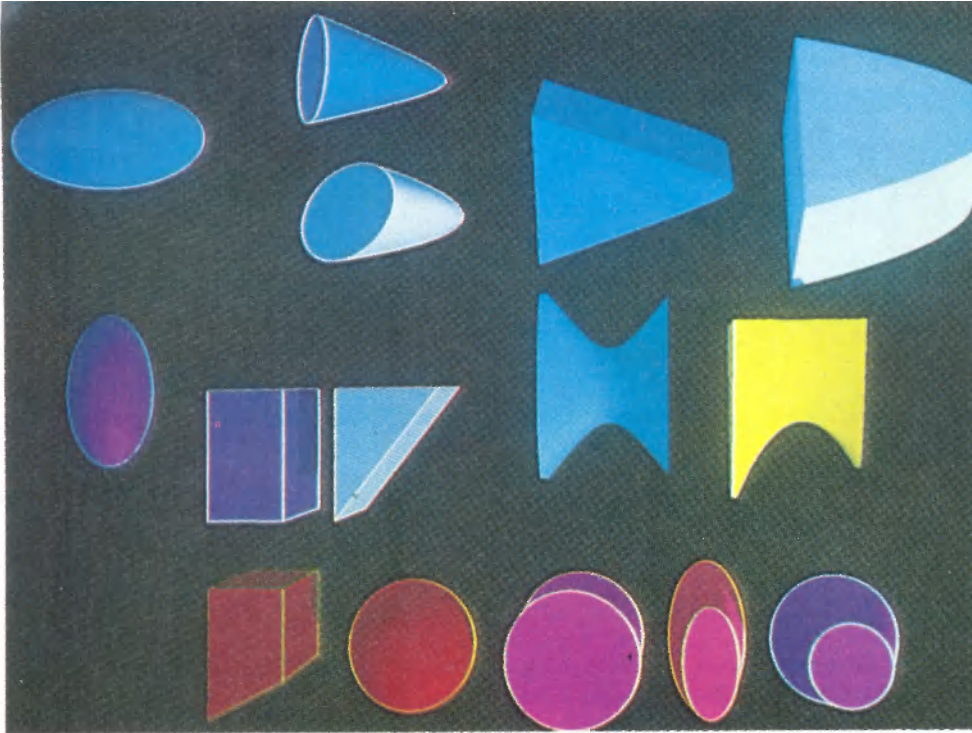
To create the various color and light intensities of the glowing video warriors, cel painters create hold-out mattes by blacking out individual portions of the figure at a time. This example of the villainous Sark indicates a total of four hold-out mattes, so designed for an equal number of camera passes. Each time a hold-out matte is painted to black-out certain portions of the figure, one or more other specific areas are clearly revealed for exposure, making graduations of light and color possible for the final electronic world character. **From left to right are:** Sark, as shot during production on a sound stage draped in black; the post-production elements: eye reveal, face reveal and circuitry reveal; and, finally, Sark as he appears in *TRON*. Such labor intensive post-production involved about 450 people and over 200,000 cels. Even before the film was finished the hand cel technique became obsolete; in the event of a *TRON II* an entirely different method requiring much less hand labor would be used.

The "electric" look is achieved using the "candy-apple" look developed by Richard Taylor and Richard Edlund while they were working for Bob Abel's company some years ago. Kroyer suggests that if there is ever a *TRON II*, this method of photo-rotoscoping and bottom lighting mattes to create the candy-apple look will be abandoned. In-

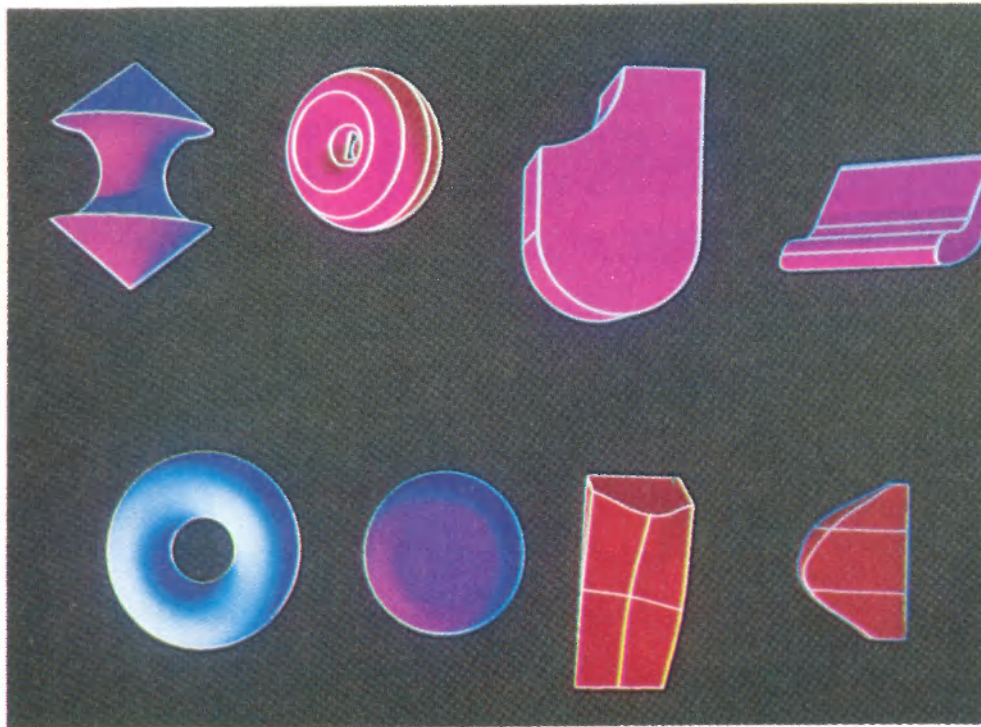
stead, the live-action footage will be completely digitized and manipulated *within* the computer itself. Once the film is digitized, it can be manipulated any way the artists imagine. The live action can be colored, distorted, combined with other objects and, of course, completely without "matte lines" since there are no "mattes." Even mohair or fur can be



Bruce Boxleitner as seen through the dome of his lightcycle.



Left and middle: MAGI builds their objects by assembling a library file of solid geometric shapes. Their Synthavision process has the capability to add and subtract these solids in order to create anything from lightcycles to tanks.

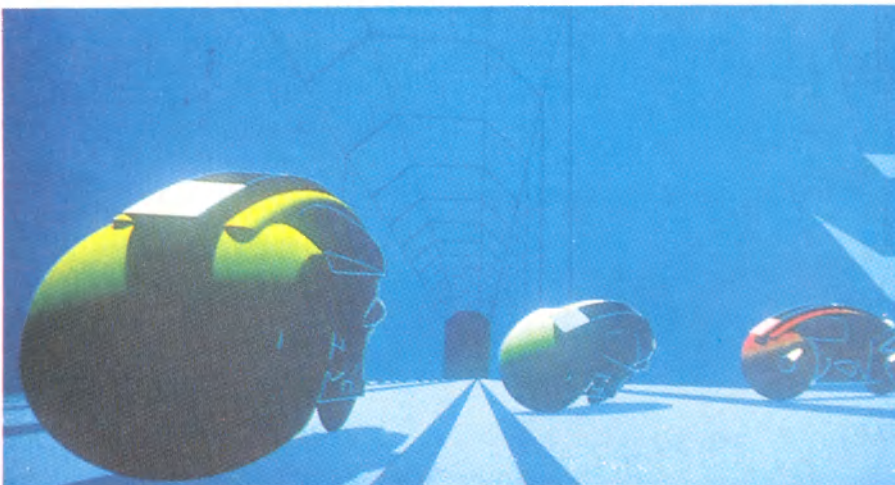


easily “matted.” Everything is combined inside the computer. The optical printer will be a museum relic, replaced by the digital printer.

But for the moment, *TRON* is pushing the technology of computer graphics along, even as the film is being made. “For example,” comments Kroyer, “in the early stages, we had problems with scenes looking flat—they just didn’t look like they had any depth. We asked the people at MAGI to create for us an artificial atmosphere in the scenes that would make things appear to be dimmer or less distinct as they receded in the distance.

“They came up with a program called ‘depth-cluing’ that automatically made the pixels dim out at a geometric rate from the point where the camera was supposed to be. This created the effect of an artificial atmosphere and added tremendous ‘depth’ to the scene. We came up with all sorts of little refinements that added interest and ‘reality’ to a scene: secondary light sources, different kinds of glows, diffusion programs. We kept asking Triple-I and MAGI for more tools to work with and they would go back to their desks and conceive programs necessary to meet our demands which were growing more and more complicated.

“Now, if you are going to ask me if I think computer animation will replace classic Disney animation, the answer is, ‘No.’ Computer animation will never replace the kind of character animation that made the Disney films great. What we are dealing with here is an entirely different kind of tool, it doesn’t *replace* anything. Computer animation opens up whole new areas for the artist; it’s another kind of tool, a new brush. The scenes we created on computer could not have been done by any other method. It would have taken 100 animators 10 years to do



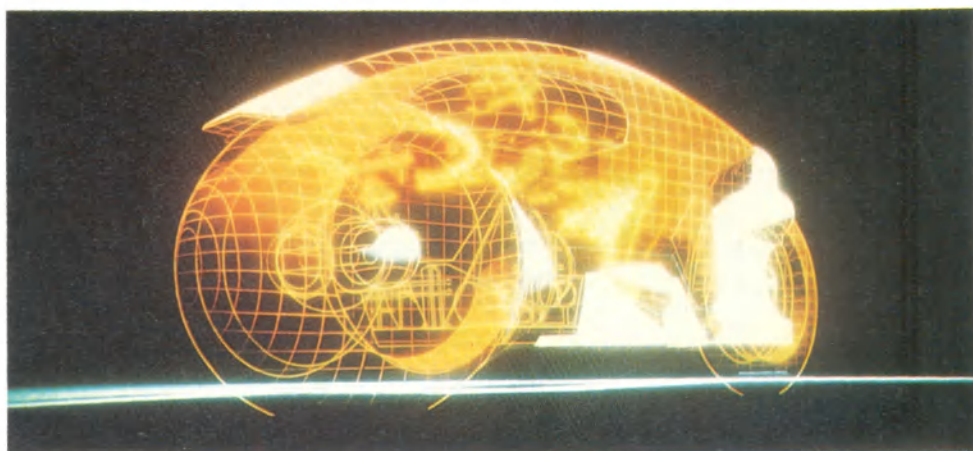
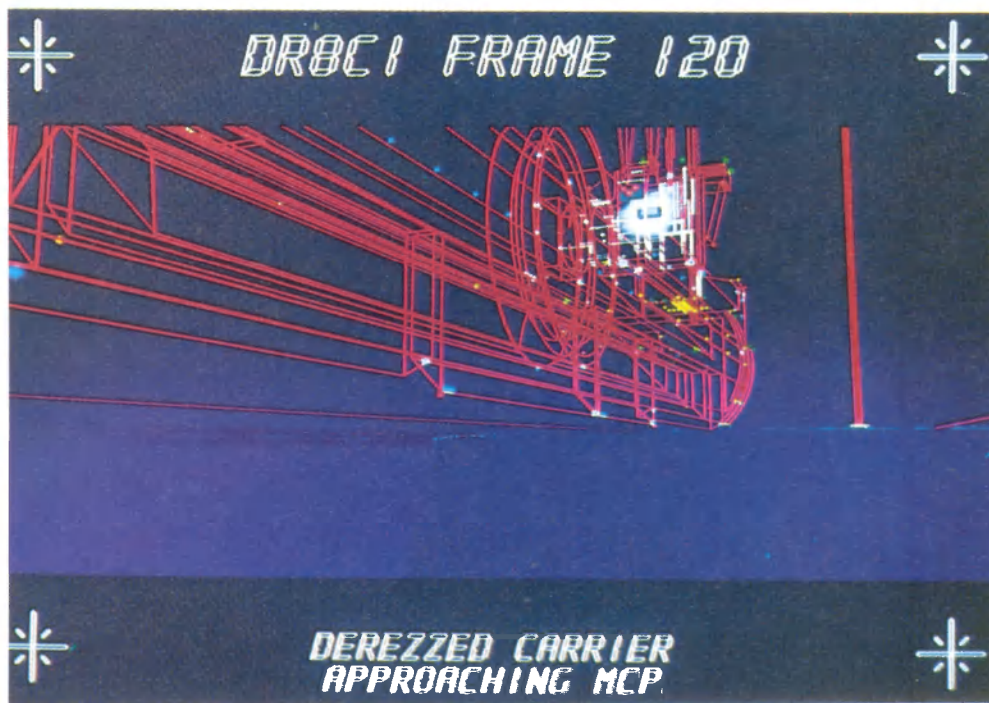
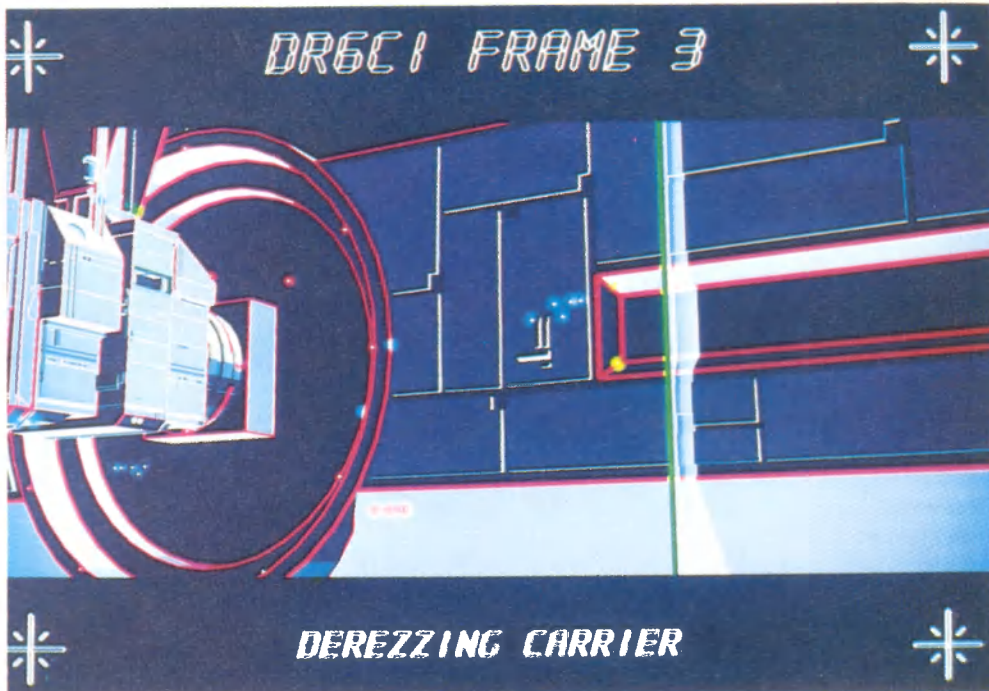
Left: Artist Syd Mead set the style for these computer-generated lightcycles racing on an electronic gameboard.

Right and middle: Sark's carrier is being slowly derezzed as it approaches the MCP. The surfaces of the computer-generated craft become transparent, leaving a latticework of colored outlines

what we did."

And what a powerful tool computers are for the artist. Richard Taylor of Triple-I sums it up with: "For objects simulated in a computer, there are no laws of physics. Each time you sit down to create a computer image, you are getting completely new rules for reality. That's what *TRON* is all about." ●

Below: Richard Taylor of the now defunct graphics department of Triple-I examines one of the hold-out mattes from *TRON*.



Right: *TRON*'s light cycle rezzes-up for action. The light cycles chase is one of the most memorable sequences in the film.

Spirits of the Lost Ark

"Raiders of the Lost Ark" presented unusual photographic effects challenges for Richard Edlund and the staff of ILM.

Though director Steven Spielberg's action/adventure film, *Raiders of the Lost Ark*, is not an effects-oriented picture in the same way as *Star Wars* or *Superman*, it still recalls the 1930s serial cliffhangers and features people and situations which are slightly larger than life.

Still, the film embraces startling production values and relies upon special effects to create some of the locations for the film, (which is set in 1936), to create some of the hair-raising escapes and, most certainly, to create the story's supernatural aspects.

Produced under George Lucas' Lucasfilm Ltd. banner, it would seem that the logical choice for a photographic effects crew would be Lucas' own company, Industrial Light and Magic, and this, indeed, is the case. Lucas has been actively seeking to keep his highly skilled team of cinematographers together between episodes of *Star Wars*, and 1981 found the *Star Wars*-trained ILM crew at work on both *Dragonslayer* and *Raiders of the Lost Ark*.

The first problem to be faced by

any special-effects team is the translation of the script from verbal description to visual imagery. This early stage of special-effects design usually involves conferences between the director, screenwriter and producer on one hand, and the special-effects supervisor, conceptual artist and storyboard artist on the other. These conferences seek to translate the wholly verbal and sometimes vague descriptions of scenes in the shooting script into visual concepts in the form of production art or storyboards.

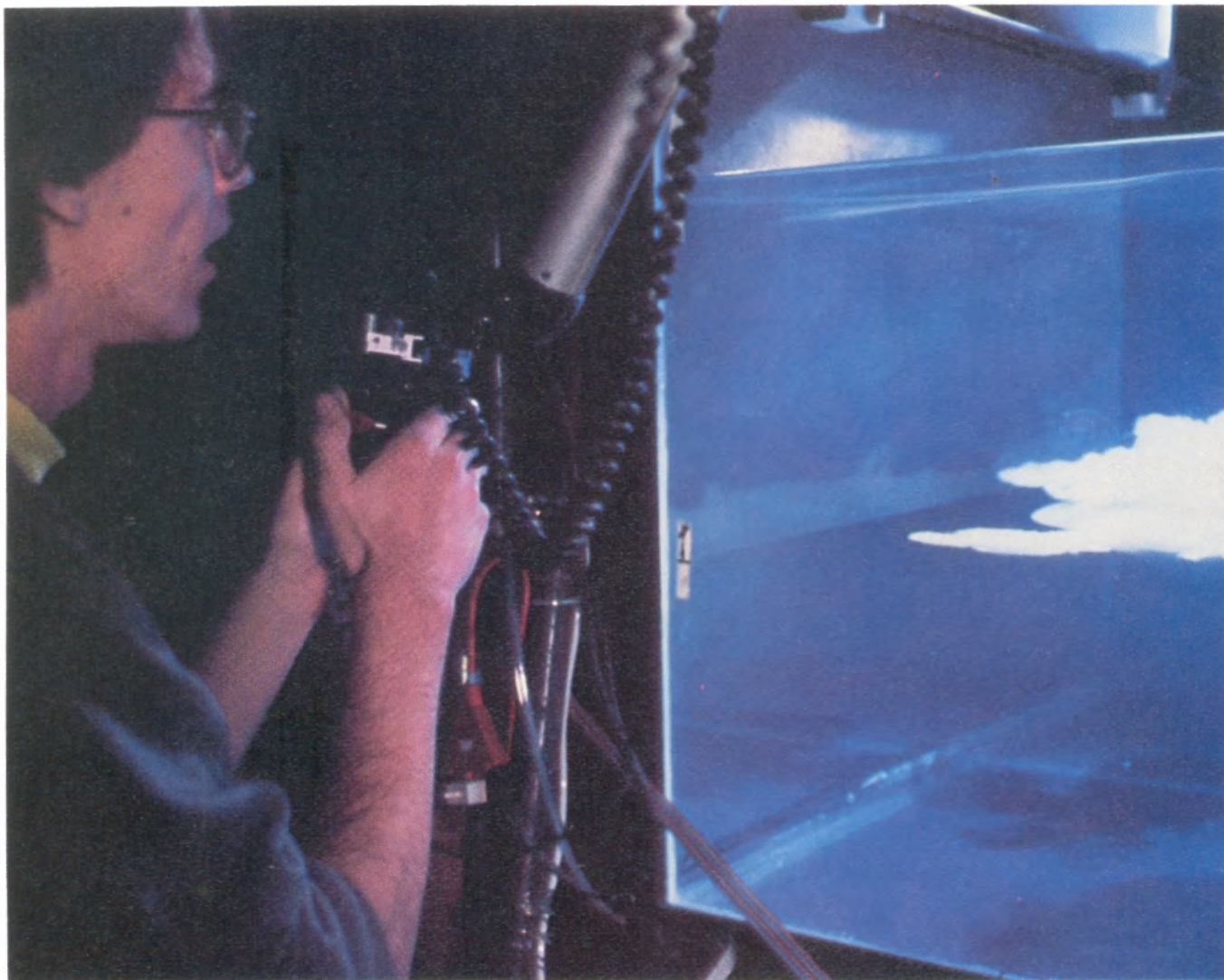
Raiders of the Lost Ark is an epic tale which centers around the fantastic adventures of an archeologist/adventurer, Indiana Jones, and his perilous quest for a valuable holy artifact, the Ark of the Covenant. As such, it presents a number of interesting problems. One of the first people to hear about them was the storyboard artist. At Industrial Light and Magic, this man is Joe Johnston, a young Texan brimming with talent, whose designs for *Star Wars* and *The Empire Strikes Back* have made him famous among fans of the Lucas space age.

"It started for me in summer '79,"

Facing page— The melting of Toht's head was accomplished by blasting it with two enormous heaters and a hand heater held by Christopher Walas (inset).

PHOTO: © 1981 LUCASFILM LTD.





Projects specialist Gary Platek creates sunset clouds.

begins the tall blond Texan. "I was told that ILM was probably going to do the effects on *Raiders*, so would I please look over the script."

The "Ark" mentioned in the title is a gold-encrusted wooden chest which, legend has it, contains the broken tablets of the Ten Commandments given to Moses. The Ark is said to bring invincible and mysterious powers to the one who possesses it. But, so the legend goes, there are disastrous consequences for those who meddle with it.

The Ark has not been seen since it disappeared from the Temple of Solomon in Jerusalem in approximately 980 B.C. One legend suggests that an Egyptian pharaoh may have carried it to Tanis and buried it in the tomb known as the Well of Souls.

In George Lucas' story, *Raiders of the Lost Ark*, the Nazis are excavating in Egypt in the year 1936. They may

have found the lost city of Tanis and are well on their way to discovering the Ark. Adolph Hitler, an avid student of religious doctrine and the power of the occult, has a personal interest in locating the Ark, since many people believe that the Ark will be recovered at the time of the coming of the True Messiah—a designation that Hitler would find quite useful.

The American government has recruited Indiana Jones to get to the Ark before the Nazis do. The film's final sequence involves the Nazis opening the Ark and inadvertently unleashing the mysterious forces which have been locked away inside for 3,000 years. It is this last sequence that Industrial Light and Magic was asked to create on film.

"At first," continues Johnston, "Lucas and Spielberg did not really know what the end sequence was going to be. The script said something

like: 'The Nazis open the Ark and there is a giant cataclysm!' It wasn't quite that nonspecific, but it was almost that bad.

Storyboarding

"There were ten of us involved in these early conferences—three of us were artists. We were told to try to imagine what would happen when the Nazis open the Ark, which is supposed to be the repository of an awesome power. We could do *anything* we wanted to; though we knew that spirits or manifestation of spirits was involved, George and Steven weren't sure how they should appear on the screen.

"Each of the artists did a preliminary set of storyboards on his own. For this film, having three artists at work on the same sequence was a unique and interesting way to work, since we all came up with totally dif-

ferent things. My early thoughts had no ghosts at all—it was all firestorm. Another artist had all ghosts and no flame; the third artist had lots of weird light effects.

“This is really the fun part of the job—someone like George Lucas comes to you and says what would happen if all these Nazis are huddled around this thing and they open the Ark? It’s like opening a Pandora’s box and the Nazis are wiped out. Now, how do you want to do it?”

You might wonder how George Lucas and Steven Spielberg were able to choose between the three concepts that had been sketched, but the solution was simple—Lucas and Spielberg asked that all three ideas be combined! “After the next meeting, I was in charge of taking those three sets and trying to combine them into one workable set of drawings,” Johnston explains.

Johnston likes to give his imagination complete freedom in these early stages of special effects design. Of his work in the end sequence he says, “I knew that the Nazis had to die, so I wanted to think of the most spectacular ways possible. I didn’t give any consideration to how it would be done! Initially, when you are laying out a sequence, you should try not to restrict yourself—you want to give your imagination as free a rein as possible. Money and technical feasibility are later considerations, generally. Ultimately, you always find restrictions further down the line and you never get to do everything you want to do. Though, working for George and Steven, I am certainly given a lot freer rein than if I were in a studio situation.”

Working for George Lucas has its advantages, since he usually is quite specific about what he wants in a given situation or from a given artist. “George always knows exactly what he wants,” Johnston affirms. “He’s a very sensitive and clear thinking person, but he’s always willing to consider other people’s ideas as well. I’ve worked for him for about five years now and he seems to be giving me more and more freedom.”

The spectacular end sequence certainly presents a challenge to the storyboard artist, but there are other challenges in the film of a very dif-

ferent sort. One of them involved adding special effects to live-action sequences that have already been shot. Johnston explains, “About 85% of the work we did here [ILM] on *Raiders* involved the end sequence, but we did have a few other tasks, such as matte paintings and inserts.

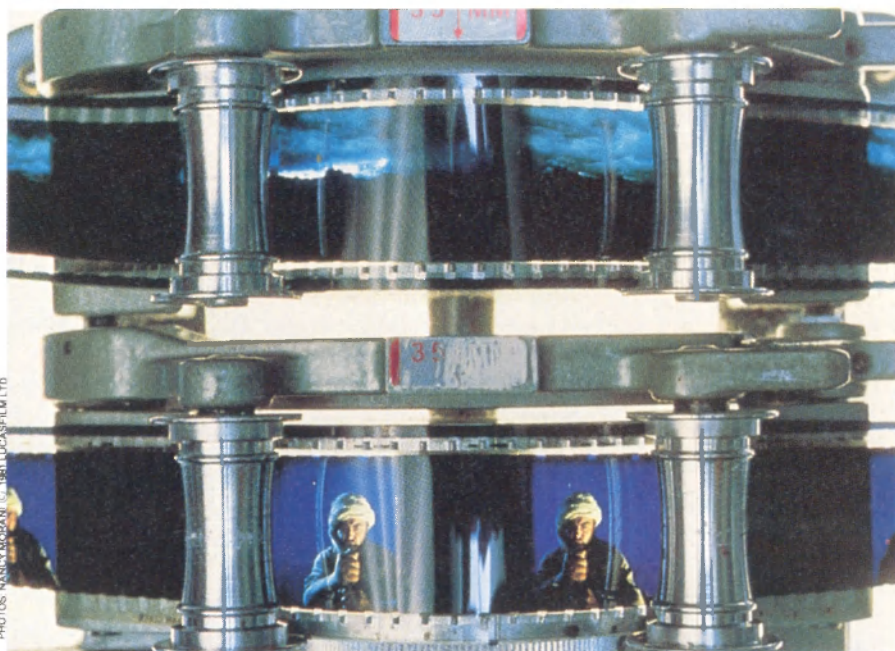
“For a number of these, the lab made frame blow-ups of the live action for us to use. This live-action shot is called the ‘plate.’ We are given the plate and have to add the rest of the scene. Usually, Steven describes in

great detail what the rest of the shot should look like.

“For example, there is a shot of some men clustered around the opening of the Well of Souls and there is supposed to be a Nazi camp off in the distance. We added the matte painting of the Nazi camp and some clouds in the sky, which we will create in a tank. But the first job is to sketch in those missing elements and get Steven’s approval.

“Most times we are given a shot with the actors in front of a blue

A work print of two elements (used in a shot of Sallah against the clouds outside the Well of Souls) are held in a sync block over a light box. A work print is used by the special effects editors to make sure that, frame for frame, each element is lined up as it will finally appear on the screen in a shot. Later, a line-up person will carefully line the negative up in the same way the work print was, readying it to be shot through the optical printer. The pieces of work print are run through a movieola at the same time to see if they work well together.



screen and a determination is made as to what sort of background process will be used—whether a miniature or a matte painting will be composited into the shot. I make that determination some times, at other times, there are meetings with the SFX supervisor and cameraman to specifically determine what a given shot is going to require.

"We had about 70 or 80 shots to do and all of them were very carefully storyboarded," Johnston insists, however, that the drawing is only a guide and that the finished film *should* look better than the drawing. "The storyboards are designed to inspire the rest of the crew—the cameramen, the modelmakers, the painters. Good storyboard art needs not only to get the look and requirements of the scene across, but it should catch the imagination and inspire people to go beyond the drawing.

The Ghostmakers

Effects supervisor Richard Edlund admitted that Steven Spielberg's enormously exciting action epic was a hard act to follow. "It was Steven at his virtuoso best," says Edlund admiringly, "but it made our job that much more difficult. Most of our work consisted of optical effects for the last reel of the film and included one of the most difficult subjects to portray—ghosts—eerie, scary, believable ghosts."

What does a real ghost look like? What would look believable and scary? Obviously, no one has ever photographed a ghost, so the visual concept pretty much depends on legend and the imaginations of the artists at ILM.

Richard Edlund and his team at ILM were responsible for translating these storyboards into film. ILM's resources and personnel had to be

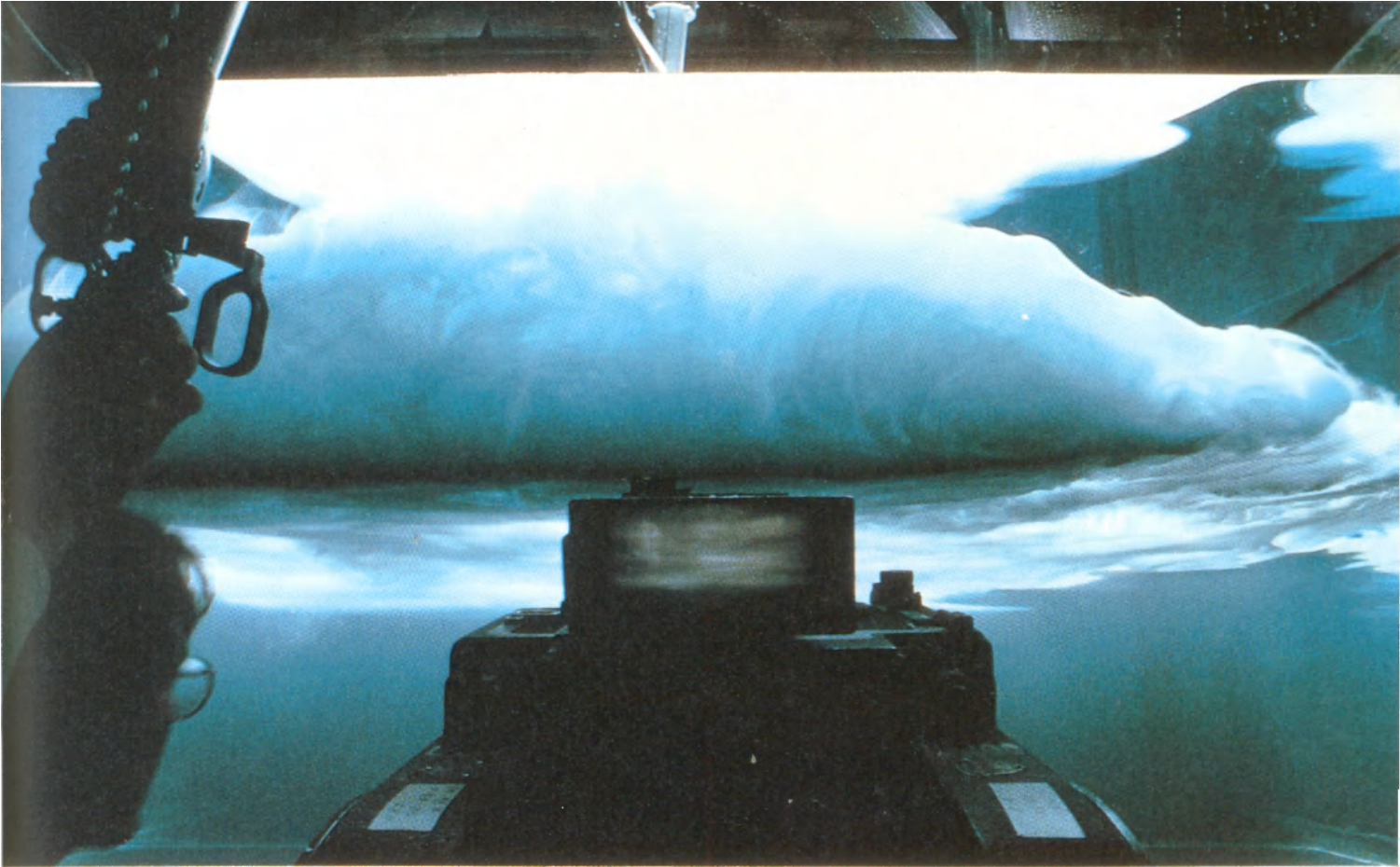
carefully divided between *Raiders* and *Dragonslayer*, which was also in post-production at the time.

At first, it was thought that the ghosts could be created with cel animation, but early tests soon proved unsatisfactory. Edlund was searching for something with a different look. Eventually, the old cloud tank from *Close Encounters* was refurbished and tests were shot with small ghosts in water. Several elements were shot using the tank to achieve the flow and feel of ghosts as insubstantial spectres floating and swimming through the atmosphere. Although there are four shots in the finished film that make use of cel animation to create ghosts and ghost effects, the bulk of the material was shot using other techniques including miniatures in the tank and full-scale puppets and actors. Special optical techniques were developed to com-

A close-up look of the mummy which was used as a ghost in the film's final sequence



PHOTO TERRY CHOSTNER © 1981 LUCASFILM LTD



Gary Platek creator of cloud effects, holds the probe manipulator used to make clouds as he watches them from the camera's eye view. In the foreground the Paramount VistaVision camera with its viewfinder can be seen.

bine the ghosts with the live-action footage with a transparent "look" that would not appear to be a simple double exposure or "burn-in."

Cloud Tank

Cloud tanks were developed by Doug Trumbull for Spielberg's *CE3K* and later seen in the De Laurentiis *Flash Gordon*. For *Raiders*, Edlund's team also generated cloud effects in the tank, but found some other uses.

"Steven likes to call it the *Encounters tank*," smiles Edlund. "And it is the same tank that was used for *CE3K*, though we rebuilt it and designed our own filtering and support equipment for it. The principle is fairly well-known, now," explains Edlund. "You create an inversion layer in the tank using different temperatures and densities of solutions, for example a layer of salt water on the bottom of the tank with a layer of fresh water above it. You can float various pigments and dyes in the plane where the two layers meet, thereby generating different types of cloud effects. We use what we call an 'atomic arm' (a remote-controlled hand, such as the ones used for moving isotopes in

nuclear laboratories) to squirt pigment into the tank at the appropriate level. It is designed so you can see pretty much what the camera sees as you make a shot. The cloud tank has now become part of our repertoire."

While one part of the *Raiders* effects team worked creating elements for the film's breathtaking conclusion, others began with the comparatively few effects shots which occur elsewhere in the film. One of the earliest in *Raiders* (though it was actually shot near the end of post-production) is the shot of the China Clipper that Harrison Ford boards for the flight to Nepal.

"As luck would have it, we found an old flying boat that was in a shipyard a few miles from ILM," remembers Edlund. "It wasn't a real China Clipper, but it was close enough—a four-engine passenger seaplane. One of the engines still worked, but it was parked in a junkyard and would require more than a little matte artistry to place it at dockside in the water.

"We built a ramp next to the plane to suggest a dock and placed pans of water on the ground to reflect a moving water effect underneath the

wings. Actors were dressed in appropriate '30s costume and filmed boarding the plane.

"Then, I took a helicopter trip around the bay to find a pier that would look right for the shot's foreground. I found such a pier on Treasure Island and made a deal with the Navy to film there. It was ideal; the sun was at the right angle, there was water in front of the pier and we could photograph the pier from a camera position on another pier.

"Actually, the completed shot is made up of two separately photographed plates and a matte painting of the seaplane base, taxicabs, etc. tying the elements together. There was the plate of the pier, the plate of the seaplane and the matte painting by Alan Maley." Alan Maley worked with Disney Studios for 10 years after leaving England. He is well-known for developing the front-projection system for combining a painting with live-action plates.

Cooperative Effort

One of the film's most popular shots occurs at the end of the truck chase sequence with the Nazi car flying off



The completed composite for the "China Clipper" shot. The real *Solvent IV*, built by Howard Hughes and now owned by Rick and Randle Grant was used for the ground insert shots.

the cliff. It was a cooperative interdepartmental effort. The cliff was a matte painting by Alan Maley, photographed by Neil Krepola. The animation of the Nazis and their auto was handled by stop-motion artist Tom St. Amand with Jim Veilleux as cameraman.

Richard Edlund outlines the basic steps necessary to complete this complicated shot. "First, a test pan on the painting had to be shot. The live-action plate was rear projected into a corner of the painting as the matte camera recorded the plate and painting with a slight pan of the matte camera to suggest the effect of tracking with the falling Nazis. This test footage was taken over to the miniatures stage and used as a guide to shoot the miniature car and Nazis. The match-up of the matte painting and the stop-motion miniatures were shot against our standard blue screen backing. Later, Bruce Nicholson's optical department went through the necessary steps to produce an anamorphic hold-out matte of the car and Nazis.

"This black and white travelling matte film element went back to the matte department just about the time Alan Maley was putting the finishing touches on the cliff painting. Then, the

matte department shot the final take of the matte painting with the live action rear-projected into the corner window, but this time the black and white travelling matte is running in bi-pack in the camera. This matte leaves a perfect 'window' of unexposed emulsion for the car and falling Nazi.

"Finally, the optical department took this 'held take' and exposed the miniature car and falling Nazi into the hole created by the travelling matte in the matte camera, then the film gets developed."

Though Edlund confesses he would have liked a bit more time with the shot to 'tweak' the color balance a bit, it still gets consistent applause in the theater. Much of that applause, Edlund believes, is because the shot works so well as a "pay-off" to the truck chase sequence.

"There is a similar sequence in *Star Wars*," Edlund observes. "Remember the moment in which the *Millennium Falcon* blasts off into hyperspace escaping from Mos Eisley? Well, for that shot we just used a 4x5 Polaroid of the back of the ship zooming off. It was one of our cheapest shots, but very effective." Edlund emphasizes that it is not the special effects technique that people should be applauding in the theater,

but the moment . . . The real value of special effects is its ability to create those moments that enhance or complete a sequence which would not be possible by ordinary means.

Make Or Break It

The way in which shots are edited can make or break a sequence. Just before the car plunges over the cliff, there is a shot of the Nazis inside reacting to their imminent demise, and then it cuts to the plunge.

"It's extraordinarily helpful to us at ILM to work with a producer and director, who have a great deal to do with the editing of the picture." In this case, it's George Lucas as producer and Steven Spielberg as director. "I don't mean to detract in any way from the considerable talents of editor Michael Kahn, who cut the entire picture, action sequences and all! George wanted to edit the end sequence, since the effects were coming out of ILM much later than the production footage, which Michael was cutting as it was being shot. George edits effects in a very astute way. He knows how to take an effects shot that may be weak and cut it in at just the right moment to get the most out of it.

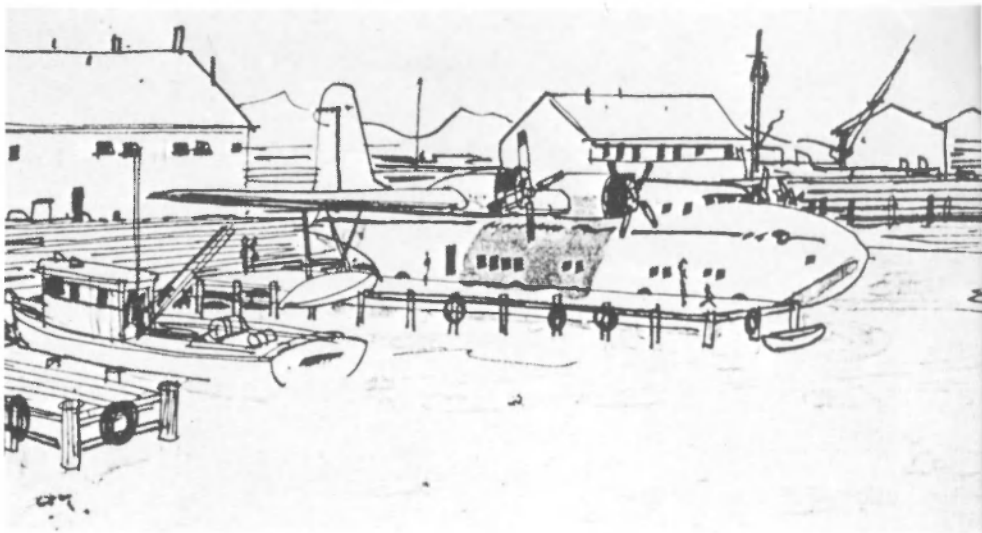
"Modern audiences are very difficult to fool. The audience knows full

well what material photographed with a camera looks like—they've seen millions of feet of film by the time they are teenagers. If something looks 'funny' in a shot—they spot a matte line or notice the purple asteroid going by—then you've let the director down. The director is trying to tell a story and build drama, but a flawed effects shot has distracted them."

Other sequences that required strong interdepartmental cooperation were several of the shots depicting the hunt for the Well of Souls. Jones, Sallah and his men are isolated against a stormy sky, digging like crazy. Edlund smiles when he says that they now have a man in charge of "controlling the weather." He refers to Gary Platek. "He is typical of many people here at ILM in that he is equally adept in many areas. He can design sophisticated mechanical equipment, work with lasers (there was some laser material in the picture) or lend expertise on matters dealing with chemistry. He has become our cloud expert."

"There is that great shot of the hunt for the Well of Souls which required

Top: Storyboard art for the clipper composite shot. **Right:** The shot is an optical "sandwich." There is a foreground plate of the pier and water. **Bottom:** A live action plate of Indy boarding the plane. These two elements are tied together with a matte painting of buildings and sky. The completed shot is on the facing page.



ART: 1981 LUCASFILM LTD.





Left to right: Ted Moehnke, supervising stage technician, Thaine Morris, pyrotechnician, Joe Johnston, visual effects art director and Elizabeth Morris adjust Greta Hick's harness.

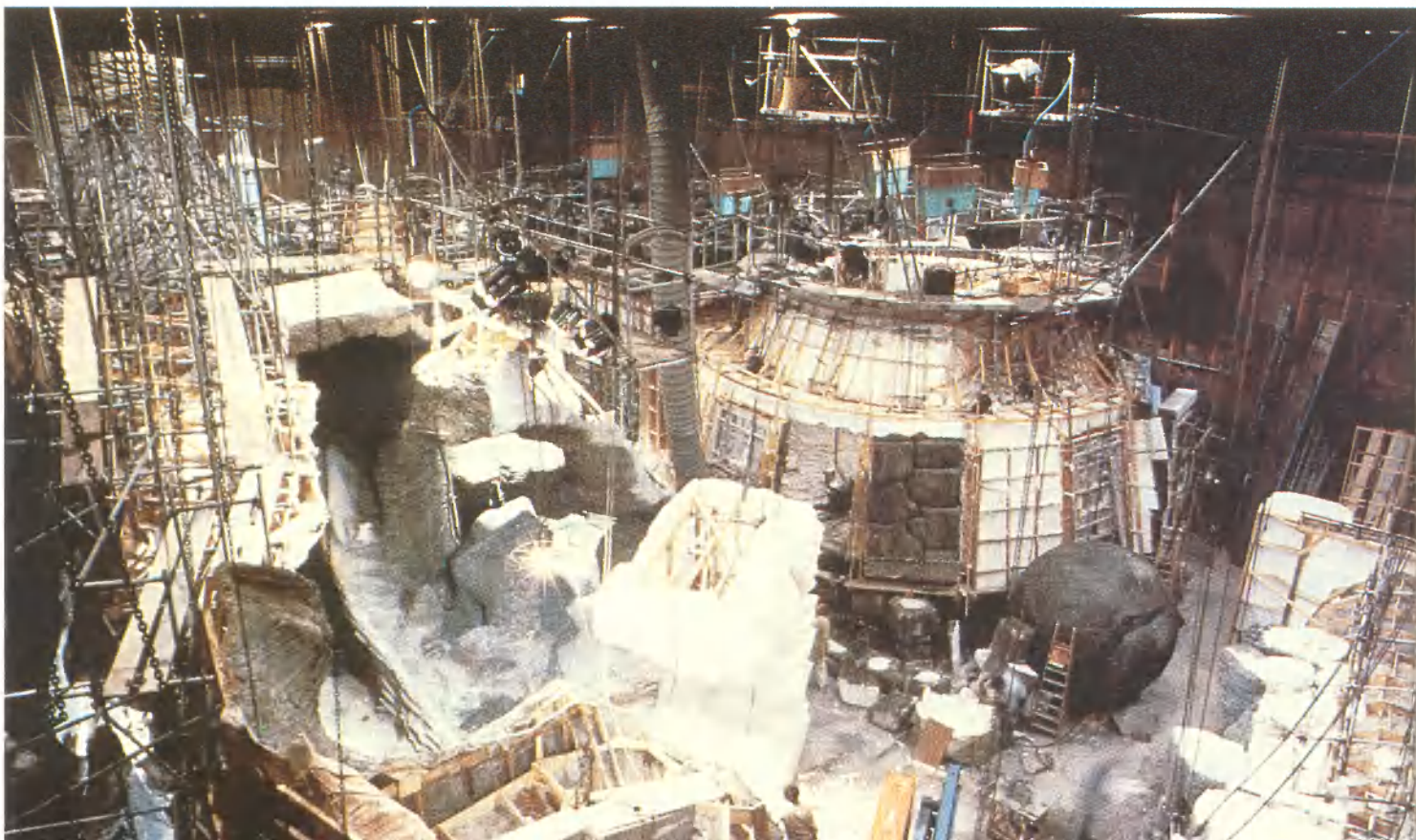
An exterior view of the studio sets created for the underground interiors of *Raiders*.

cloud tank skies, animated lightning and flashed matte paintings. We had to reposition and redesign the shot to enhance the composition. It was a very symmetrical shot originally, but we changed that; also there were four or five blue screen shots nestled in there with the beautiful synthetic skies. It was a sequence which, I think, turned out pretty well."

The picture's finale involved ghosts, a fire storm, clouds, eerie transformations, exploding heads, melting heads, shrinking heads, bolts of electrical energy...your basic cataclysmic apotheosis.

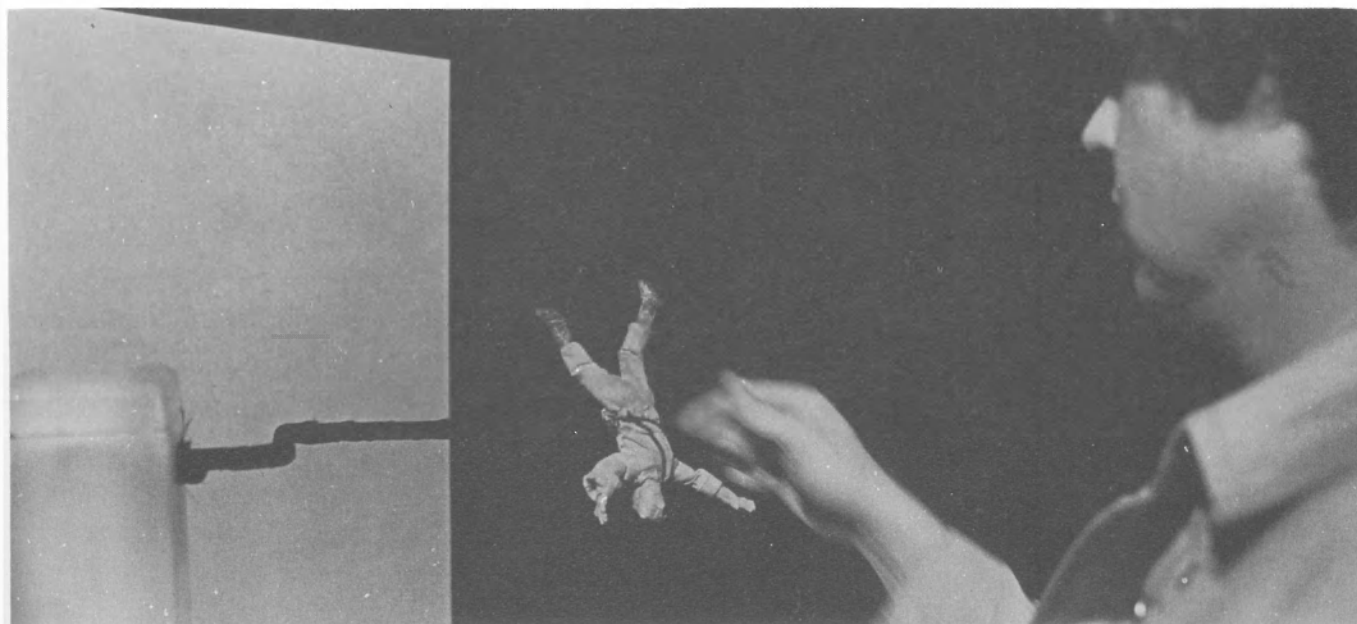
"Our first challenge involved finding a means of controlling flames and fire into storyboarded shapes," Edlund says. "Thaine Morris, our resident pyrotechnician, was pretty successful. Most of the material was shot with Bruce Hill's highspeed Phototonics camera. We shot at 360 frames per second in four-perf anamorphic format. The VistaVision equipment is not capable of such high speeds. I built a little optical printer to convert the four-perf anamorphic footage to VistaVision interpositive, so we could composite the material on our VistaVision Quad printer.

"Paul Huston built a miniature of the mountain top set about four feet wide and five or six feet deep for the





Miniature Harrison Ford dolls dressed as Nazis were used for the insert canyon shot.



Stop-motion animator Tom St. Amand makes another minute movement on one of the Nazis who drives off the cliff in the truck chase sequence.

shot in which the firestorm sweeps over the scene. We turned the miniature upside down in order to get the flames to cling to the set. It was pretty successful and I think audiences tend to buy that shot."

For the live-action in-camera effects, two special techniques were brought to bear. "We built a special harness that housed an enormous flashbulb for the Nazis." The flashbulbs are special purpose units, which produce an average lumen level of 55,000 lumens for a duration

of 2.5 seconds. The total integrated light output is 140,000 lumen-seconds.

"The trigger for the flashbulb was concealed in the hands of the individual stuntmen. On cue, the stuntmen fired the flashbulb, which lit up the entire inside of their shirts, so that it looked as if something was actually burning inside. Of course, the stuntmen were protected with asbestos pads. But the effect... was effective!

"I made a special filter for the camera lens that would create a uni-

que flare effect. I wanted an arc-shaped flare, so I made up a filter from an optical flat on a ruling machine I have in the shop here. It's a subtle effect; but if you can create enough little subtle effects, they can really add up to something."

And add up to something they did. It's a special kind of magic that George Lucas, Richard Edlund, Dennis Muren and their teammates are brewing in Marin County...it must be one of the most exciting places on Earth to work.

PATCHING THE PANDEMONIUM OF DARK'S Shadow Show

Dreams become nightmares when
the Disney Studios tried to resculpt the dream of
"Something Wicked This Way Comes"

It wasn't until after shooting was completed on Ray Bradbury's *Something Wicked This Way Comes* that Lee Dyer's special visual effects team was called into action. Post-production is not the best time to begin effects work on an effects-oriented fantasy film, but Lee Dyer frankly admits that the studio had no choice.

"I was working on *TRON* at the time, 10-12 hour days, seven days a week. My effects animation department is the only one here at the studio which works with live action, so when director Jack Clayton got into full swing on *Something Wicked*, no one was available," Dyer confesses.

"Certainly, *Something Wicked* is a film which *should* have been storyboarded from the beginning. It wasn't. So, we went back in during post-production at a time when the studio wasn't fully occupied on *TRON* and the various EPCOT films and added four entirely new sequences. We storyboarded them thoroughly and I personally went over all of the

new ideas with Clayton. What he didn't agree with, we talked through—ultimately compromising in some way to reach agreement. [Disney's former Vice-President of Production] Tom Wilhite was really the driving force behind putting all this together," he continues.

Animations of Evil

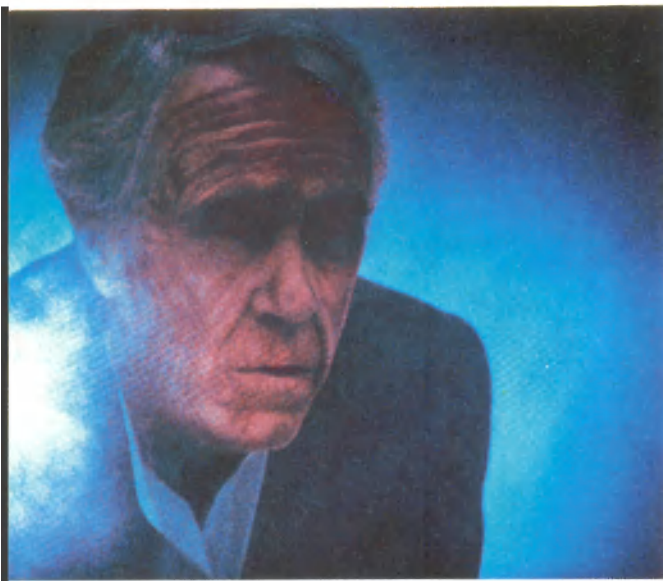
The first of the major sequences added to the film was the opening autumn countryside scenes lensed in Vermont in fall 1982. Not only was live action involved, but the Disney matte department was called upon to help establish the town itself nestled in the New England mountains. Lee Dyer explains that this new footage established the autumn season, the locale and the fact that Green Town is a real community filled with people *other* than the story's main characters. "Jack shot his film on the Disney back lot and on the soundstages so these shots serve to 'open up' the film a little."

In Jack Clayton's original edit of the

Facing page— Lee Dyer, Harrison Ellenshaw and Ron Tantin, all three effects supervisors on *Something Wicked*, are seen with the upside down miniature set of Mr. Dark's carnival.

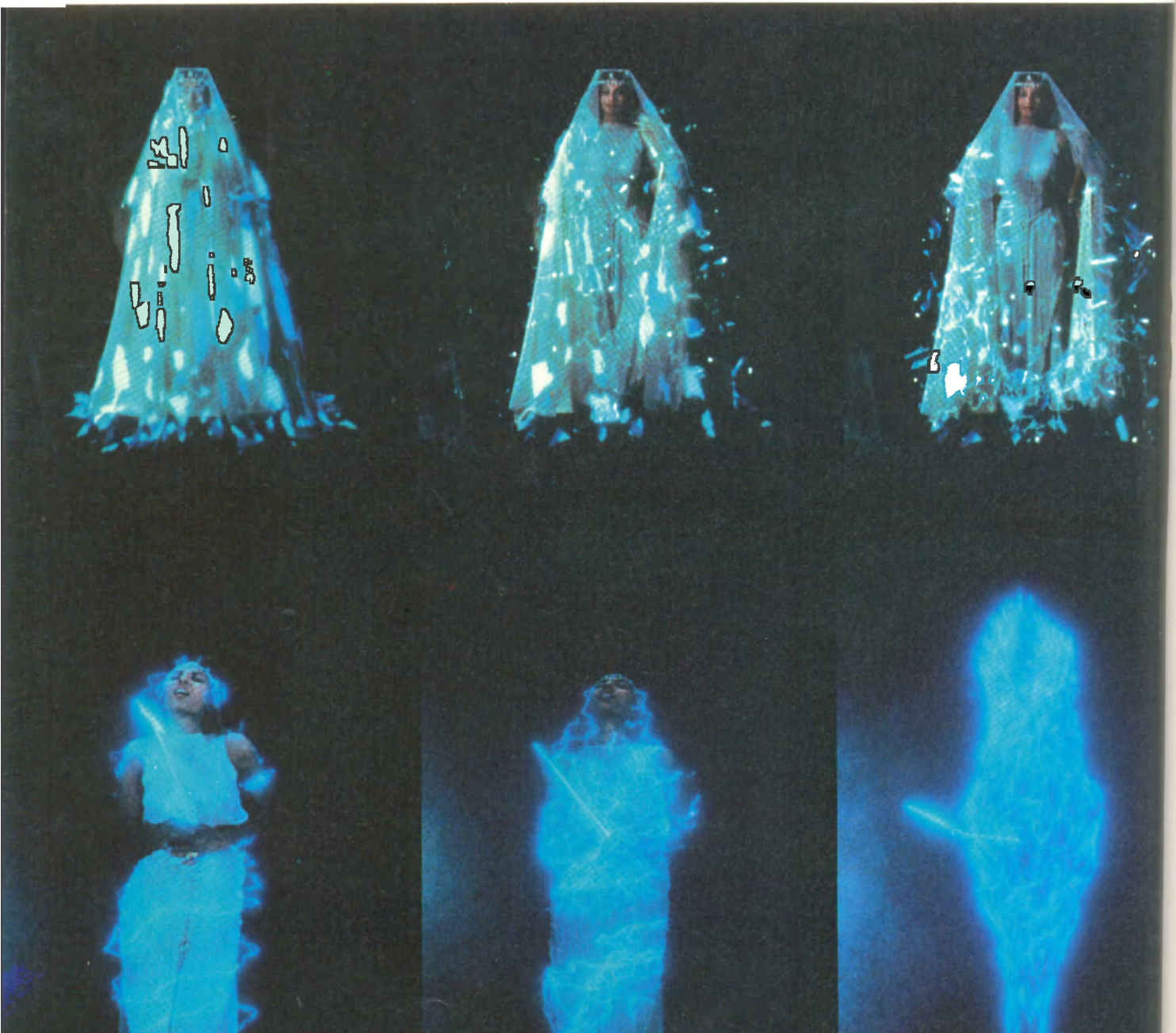
PHOTO: 1983 WALT DISNEY PRODUCTIONS





FX animation on Jason Robard's face in the mirror maze sequence. Close-up of FX animation on Pam Grier's face as the ice fractures.

Top row: Ice fractures and falls away from Dust Witch Pam Grier in these frames selected from the sequence. **Bottom row:** The Dust Witch is electrocuted. All FX are hand-drawn multi-level animation. Such-labor intensive effects artistry is a very specialized skill mastered by comparatively few animators.



film, the boys discover Mr. Dark's carnival already assembled in the meadow. "I wanted to see the carnival come together by itself," Dyer reveals. "We could have done this in several ways, but we thought that in order to give the sequence a different look, it might be a good idea to use computer animation and to get MAGI involved. MAGI, the company that did a great deal of work on *TRON* for us wanted to try simulating live action."

MAGI was assigned to create the shapes and moves for the carnival train, and its transformation into the completed carnival. Disney animators were enlisted to create the sequence's organic effects, elements which computer animation does not do particularly well such as blowing leaves and flapping tent canvas.

The sequence was planned to last for almost two minutes. MAGI's challenge was to blend its work in with both the hand-drawn animation and the look of the remainder of the film. MAGI technicians created programs to eliminate the "crisp" look of computer animation so that it would not call attention to itself. Unfortunately, the completed work didn't meet the expectations of Jack Clayton and the rest of the production team, so the entire carnival computer animation sequence was deleted from the movie before its release.

Though the carnival's genesis is absent from the film, its apocalypse survives as the story's climax. In Clayton's original version, the boys run away from Mr. Dark and his Pandemonium Shadow Show, stopping only to look back at a matte painting of the destroyed carnival. Lee Dyer was looking for something more convincing.

As the movie stands now, the climax centers around the final confrontation between the forces of good and evil. In the film, the good is represented by the cleansing power of a lightning storm (which is unusual, since such storms are normally called up to do the bidding of demonic forces) and the evil is, of course, Mr. Dark and his traveling show of nightmares.

We first see the storm brewing early in the picture, but by the film's end, its full force is brought to bear on the demonic carnival of Mr. Dark.



Effects animator Scott Santoro working on the ice cracking sequence seen on the facing page.

"I wanted to create a vortex effect," explains Dyer, "but I didn't want a *Wizard of Oz* cyclone effect. I wanted something to come down in slow motion and suck everything up into the storm, everything—the townspeople, the carnival, Dark—so that nothing at all remains. The two kids come over the hill and you see all this churning behind them. And then, after you cut back from the master shot, it starts to dissipate and the kids race back towards town."

Roland Tantin, who recently replaced retiring Danny Lee as head of the studio's mechanical effects shop, supervised the mechanical effects for the post-production effects work.

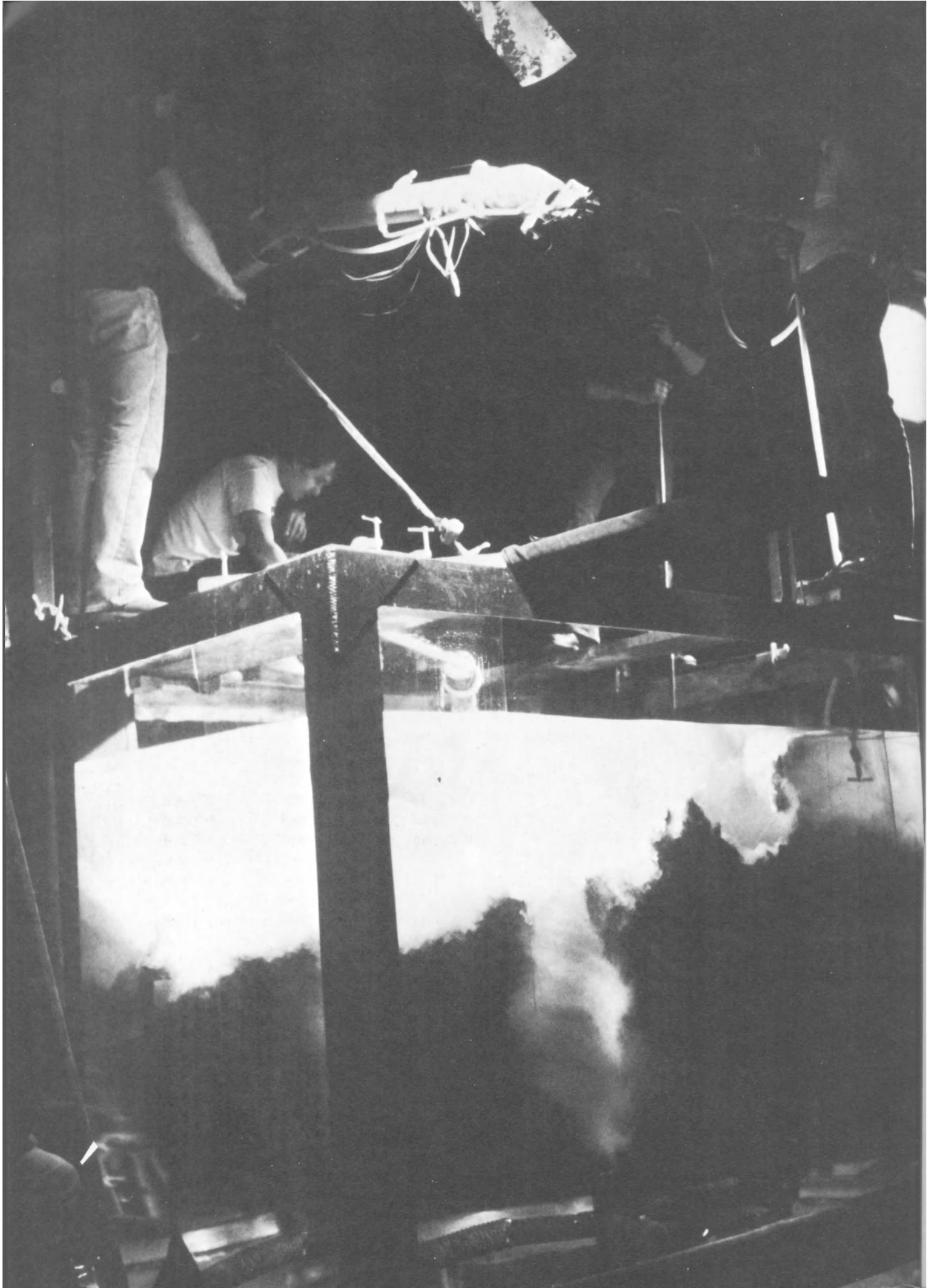
"I was approached with the storyboards for the carnival destruction by Lee Dyer," begins Tantin. "After two or three conversations, I realized the enormous scope of what he had in mind. My idea was to invert the model of the carnival and release it mechanically. With fans, dust and debris, we could create the image of the chaotic turmoil which would suck the carnival up into the air."

"We built the model out of very lightweight material on a 20 by 40-foot foam core platform. All of the

carnival's facades and structures were built out of a combination of foam core, parafin and balsa wood. The lighter our construction could be, the greater our opportunity to play with wind effects after the release of the upside-down structure.

"The destruction begins with the carnival filmed right side up using fans and wind effects to start the sequence. For the upside-down filming, units were pre-broken and then reassembled with parafin. On cue [from miniature supervisor Harrison Ellenshaw], the wind, dust and debris were started. Harrison cued us for the buildings he wanted to go first. Mechanically, we released the trips one after another. Some pieces were rigged to tumble in the wind using monofilament line." Tantin reveals that nearly a month of experimentation was involved to find the right materials and to get them working properly.

It was a two-take situation with the cameras turning at various speeds from five to seven times normal. Most shots were done in a 4-perf format, though a few VistaVision plates were made for those shots re-



quiring optical matting. Individual structures were also isolated in separate shots. After the first take, the pieces were gathered up and re-assembled for the master shot.

The Ferris wheel was specially constructed out of lead, so that it could be distorted by pulling on parts of the structure with monofilament line. When the sound effects of twisting metal are added, the technique works fairly well.

Harrison Ellenshaw expressed no small measure of relief that the destruction sequence would occur at night. "It was easier because it was a night shot — the darkness hides a multitude of sins. You can sell *anything* at night. They make whole pictures at night — I won't mention which shows — just so the effects don't look crappy. The toughest effects in the world are the ones which must take place in the full daylight reality—and those are very, very difficult. Daylight effects really separate the men from the boys. You can get a lot of notoriety for doing flashy stuff in outer space, but, boy, when you bring it back to Earth, it gets a lot tougher."

Ellenshaw sums up the effects business, noting, "The truth of the business is that either you pull it off or your don't—anything less is *not* a successful shot."

Storms of Spiders

The vortex which destroys the carnival at the film's end was created in a cloud tank built especially for *Something Wicked This Way Comes*. The tank, which measures six feet high, six feet deep and eight feet wide, is constructed of one-and-a-quarter-inch thick acrylic plastic. The tank was used not only for the apocalyptic vortex, but to create clouds for various scenes throughout the film. Ron Tantin anticipates using the tank in other future Disney productions, perhaps even in animated features such as *The Black Cauldron*, which is currently in production. Tantin believes that the tank's full potential has yet to be realized; creating clouds may be only *one* possibility.

It's a twister! A churning vortex is created for the Disney cameras which will be composited into the carnival destruction sequence.



Effects animator Gail Fox working on the sequence with Jason Robards aging in the mirror maze.

Compositing the tank FX footage with the rest of the film proved to be an interesting challenge. Harrison Ellenshaw explains, "If you look at the raw tank footage, you see the tank and the surface of the water, but you shot against black so your initial thought is that you'll have to draw hand-rotoscoped mattes for everything. Basically, though, we are compositing the vortex master shot in the matte department. In that way, we can darken some areas on the glass and lighten others — holding back some things and letting others come through. It's like a giant animation stand or optical printer in that you have this large area with which to fiddle with the film. You don't have to worry about pulling elements photographically or doing hand rotoscope or animation frame by frame in order to create your photographic elements. We tried shooting the vortex against a sodium backing, but it didn't work for us—it was just too difficult to get enough light on everything."

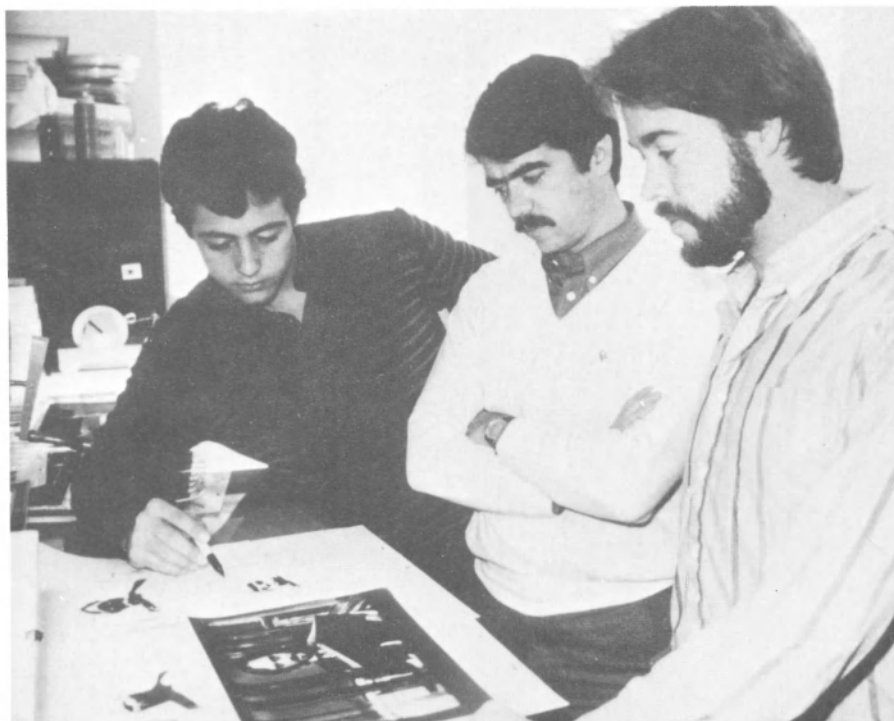
One of the new sequences supervised by Lee Dyer became a particularly personal nightmare. The spider sequence was designed to replace a shot of a large mechanical hand at the boys' window, an idea which didn't work well and was scrapped. Dyer had to muster a good deal of

courage to supervise the sequence and its arachnid extras.

"I have a terrible phobia for spiders," he explains, "which may be why I suggested the idea. I had to condition myself to be around them. One Saturday, I had our animal handlers put a spider on my shirt-covered arm; the next Saturday, I let it crawl up my bare arm. I became accustomed to them, but it was terrible . . . and it was terrifying."

We had more than 200 live tarantulas on the set, plus an additional number of fake spiders to help fill up the background. Isidoro Raponi also created several ingenious mechanical spiders which were used in special situations. Most shots, however, used the real spiders. Even when the kid pulls open the covers on the bed—all those spiders are *real*. The kids, Shaun Carson and Vidal Peterson, were real troupers, though; they allowed us to place live spiders on their hair and skin. I couldn't have done it. My skin crawls now just talking about it.

"Tarantulas, apart from biting, fill the air with a sort of 'pollen.' You can see the stuff floating in the air illuminated by the stage lights. The minute it comes in contact with your skin, you start itching like crazy. It washes off, of course, but the whole soundstage was just full of it and people



Assistant scene planner Scott Russo, effects animation supervisor Mike Wolf and composite supervisor Clint Colver check the effects cels for the sequence with Mr. Dark in the library.

light which shines on Dark, Halloway and the library itself.

"We used Jack's footage, *exactly* as he shot it," Dyer says. "We did not add any new shots or change the lengths of the edits. Actually, the sequence was perfect as it was—it certainly didn't *need* animation to make it work. Ron Miller asked me to animate one or two shots as a test (we were talking about over 20 shots for the sequence). So we did. He liked them. Ray Bradbury even said, 'When we talked about this idea a few months ago, I insisted that it could not be done in my film, but'"

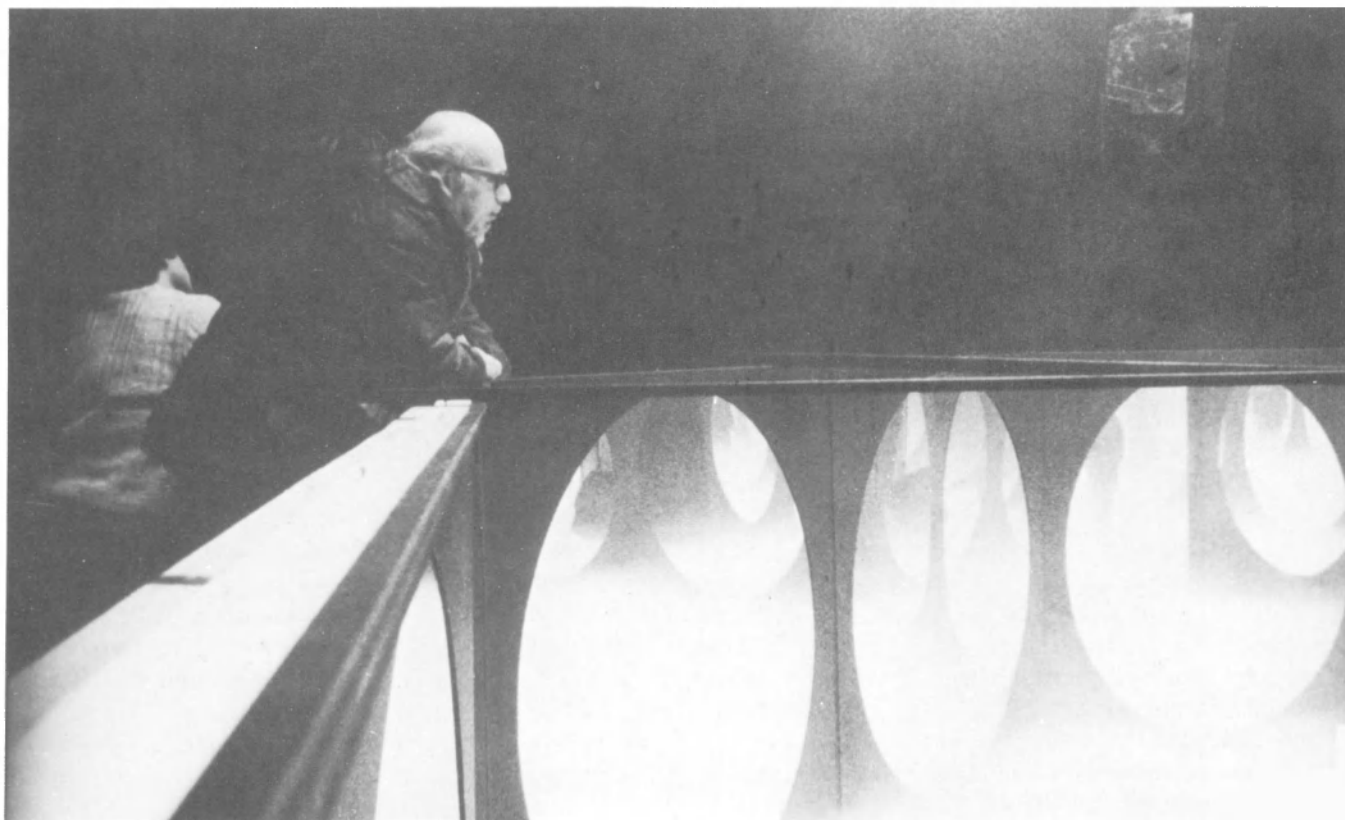
"The principal means of making an animated effect look like it's happening on set is to add interactive light to the character. If I tear a page and that page—and nothing else—lights up, it will look like an effect which has just been laid over the original shot. But if you put a glow on both the character and his face, then it looks like the effect is occurring on the set. In fact, we were able to make Dark look a little more demonic by doing it in that manner. We could almost make a skull out of his face with the technique. We also picked up a few highlights on the wall."

were itching like crazy. The spider stuff even got into my lungs. For three weeks afterwards, I was taking cough syrup so I could sleep. It was really a terrible experience, but no one was bitten and it wasn't even really dangerous."

One of the most interesting effects

contributions to *Something Wicked This Way Comes* was that made by the effects animators. In an extremely dramatic sequence, Mr. Dark confronts Charles Halloway in the library. As Dark tears pages from Halloway's father's diary, the pages seem to heat up with a little burst of

Director Jack Clayton peers over the edge of the mirror maze set.



"With Richard Portman's sound effects and our animation effects, a special magic has been added to the scene now. With all of the effects animation, we tried to be as subtle as possible and to make it work within the story's context."

Dark of Aging

"Near the film's end," Dyer continues, "Dark is trapped on the carousel and begins to go forward in time, aging. This sequence just didn't work for me. The only thing that Jack did was to catch Dark's pants in the stirrup of the carousel horse. However, if Dark is really a demonic figure, all he would have to do is snap his fingers and he would be off the carousel and out of danger."

"So, since I made the storm the good force in this movie, a bolt of lightning now hits the carousel tent and the carousel. The carousel is totally electrified, the bolt runs down the pole and into Dark's body. He's jerked back and falls. The lightning pins him to the ride and he dies."

"This scene was one of those situations in which you really can't keep the effect from looking like an effect. Even though we played around with the interactive light on the wooden horses in the foreground, some of it still looks animated. It's very difficult to get around that aspect, although I think the electricity looks very good."

Effects animation is added to live action on a frame by frame basis. The effects animator works with a stack of photo blow-ups of each frame. The animator works in pencil on white paper which is placed over each frame blow-up. Each registered pencil drawing is photographed either as a black-and-white high contrast element or continuous tone if shading is required. If there are large areas of interactive light, for example, then Disney animators will ink right on the paper. No cels are used. For this picture, Disney fielded a team of seven effects animators working over a period of five months: Wm. Allen Blyth, Ed Coffey, Gail Fox, Allen Gonzales, John Norton, Darrell Rooney and Scott Santoro.

One complex sequence involved Pam Grier as the mysterious Dust Witch. Ice is seen cracking and falling



Effects supervisor Lee Dyer checks a scene on a movieola with Jason Robards.

from her body; then, she is enveloped in electricity after being stabbed with the lightning rod.

Effects animator Scott Santoro explains some of the difficulties. "The ice sequence was complicated because of the way it was designed. The effect is animated on six or seven different levels; we had problems getting the colors right. It was pretty difficult to get the animation to look as though it was happening on set."

"The multiple levels help the animation take on a dimensional quality. There are two different levels for the ice itself, a level for facet sparkling and one for shadow as well as a level for bright areas and one for medium bright areas."

"It took some time to figure out just how the ice effect should work. The cracks begin as she removes her veil. The effect had to look as if this thin layer of ice was breaking at some distance from the body. It was a little difficult to imagine how it might look in reality if a person were covered with a thin sheath of ice and then it would break away."

It wasn't only special effects sequences like the MAGI computer animation at the film's beginning which were dropped, but live action scenes

littered the editing room floor as well. Mr. Dark's Freak Show was almost entirely eliminated—only glimpses of the characters remain visible in the carnival's march through the streets of Green Town.

A few of the alienesque beings were created by makeup artist David Ayres. Disney makeup artist Bob Schiffer spotted one of Ayres' character masks in a store and thought that something like it would work very well for one of the background characters in the carnival's sideshow freak attraction.

"Schiffer wanted to know if I had anything original that hadn't appeared in any movies," explains Ayres. "So, I sent him my catalogue and some photos."

One of the masks that Schiffer selected, which Ayres calls his "Pascagoula Alien," was inspired by a description of a UFO abduction given by Charles Hixson and Calvin Parker from Pascagoula, Mississippi. The character can be seen in the back of the parade walking on stilts. Later, the mask is seen hanging on a post inside one of the tents.

There was also a midget mask, Mornac, inspired by Ayres' favorite TV series, *The Outer Limits*, and a long-



Guide wires are set to control the direction of the Carnival's break up.

nose mask prompted by a character in *Star Wars*. An Oriental-looking appliance named Ebon was also inspired by *The Outer Limits*.

"It was a tremendous thrill to be associated with a Disney movie, even in a small way," Ayres says. "I grew up with the Disney films since they were the only films that my parents would allow me to watch."

Amazed of Mirrors

The only other major cinematic sequence to go back before the cameras was the mirror maze segment near the film's end. Consulting with staff art director John Mansbridge, Dyer assembled a mirror maze out of the 1930s with oval shapes. "I was afraid of creating something which would look too high-tech," Dyer admits. "With all the dry ice vapor on the floor, the glass and the beams of light, I could have almost inadvertently created a disco feeling. The oval shaped mirrors created a period look.

"In the mirror maze, we come to grips with the time that Charles Halloway couldn't save Will from

drowning at the river. Instead, Mr. Nightshade saves the boy. In the film, Halloway enters the mirror maze looking for Will. Mr. Dark entices him into looking into the mirrors. We see Mr. Crosetti dancing, Miss Foley growing young and so forth. Dark says something like, 'Now, look into your mirror and see your past.' Then, we flash back to Vermont and see Will drowning as Halloway is standing on the river bank.

"In his effort to save Will, Halloway plunges his hand through one of the mirrors which has turned to liquid. The camera quickly cuts to a reverse angle and we see Halloway's hand plunging through broken glass. He reaches through, symbolically saves Will, and thus destroys the mirror maze."

From there, Halloway and Will race to save Jim Nightshade from Mr. Dark's nightmare merry-go-round, prompting the final climactic fate for Dark's Autumn People and his Pandemonium Shadow Show.

"So, we've tied the story together, not only with effects, but with new

Final preparations are made for the first take in carnival destruction sequence. The ferris wheel was constructed of lead wire which could be bent and twisted as if torn by terrible forces.

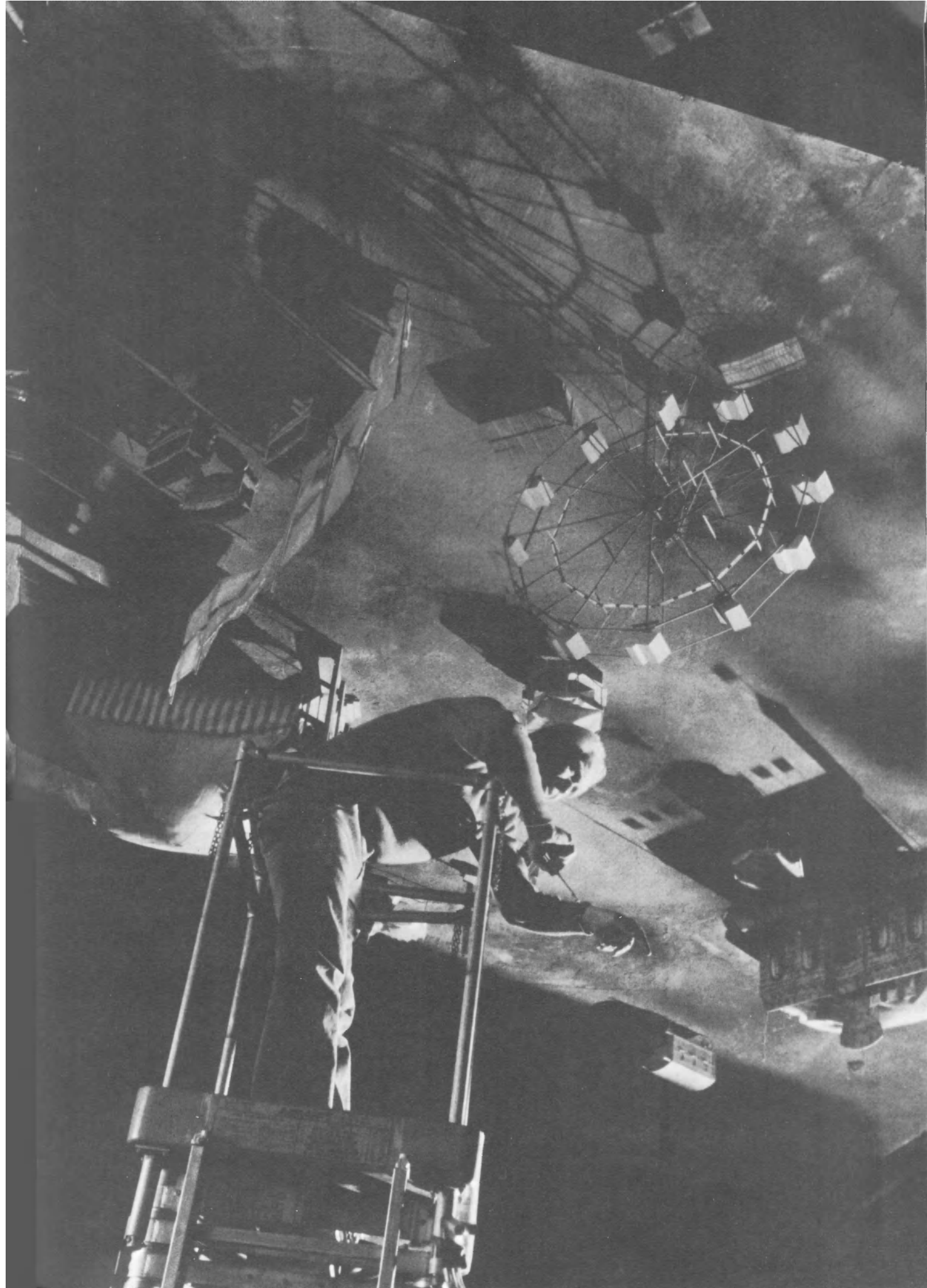
sequences," concludes Dyer. "Bradbury's original script was very good and I was overwhelmed when I saw the first cut of the movie, but I could see that many things had to be discussed. Now, with the post-production effects, James Horner's excellent score and Richard Portman's sound effects, we have a very exciting motion picture."

There is one other effect in *Something Wicked This Way Comes* worth mentioning here along with Harrison Ellenshaw's outlook on special effects and filmmaking in general and that involves the genesis of the movie's opening title sequence.

"I submitted an idea for the titles," begins Ellenshaw, "and it didn't work out. But out of that idea grew another idea and out of that, another idea . . . and so on. Basically, we (you can always tell when it's *not* somebody's idea when they say 'we'), somebody else (Ron Tantin, actually) conceived the idea of using milk on a latex sheet pressed into indentations which spelled out the title and filming it in reverse (it was my idea to shoot it in reverse) as the latex sheet is pulled out.

"It actually worked out very well. It's kind of the nature of this industry that motion pictures are very much a collaboration. It's funny. Magazines like STARLOG don't really like to talk about that too much, because it doesn't sell magazines. You know? Who wants to hear about 40 people, when you can pin all the credit or blame on just one? It's much easier, much more manageable. And it's better for the reader. If you were to follow how the credit came to be for *any* given idea, there must be eight nine or 10 people who were involved at each point, and finally, *one* very good idea results out of many other ones.

"I know many people in town, who would *run* to take full credit, but it's so rare that one person is really responsible—it really is. There aren't that many great geniuses in the world who don't rely on the input of others."



Flights of DRAGONS

Sorcery abounds in the flame and fury of "Dragonslayer."

Vermithrax Perjorative is the star of the recent Hal Barwood/Matthew Robbins fantasy, *Dragonslayer*. David Burnett's original storyboard panels depicted Vermithrax (whose full name, loosely translated, means, "The Worm of Thrace Which Makes Things Worse") had to be a real fire-breathing, flying dragon with all the power and majesty of legendary dragons.

The special effects team at George Lucas' Industrial Light and Magic had to make use of a variety of vastly different techniques to capture each attribute of the beast's character. For the film, Vermithrax is a creature of many forms and parts—from full size pieces weighing many tons to be operated on the live-action set, to precision miniature puppets for the motion-control stages at ILM. The *Dragonslayer* storyboards are filled with dragons that fly, dragons that walk, dragons that breathe fire, dragons to be ridden and stabbed and dragons that express anger, hatred and sadness.

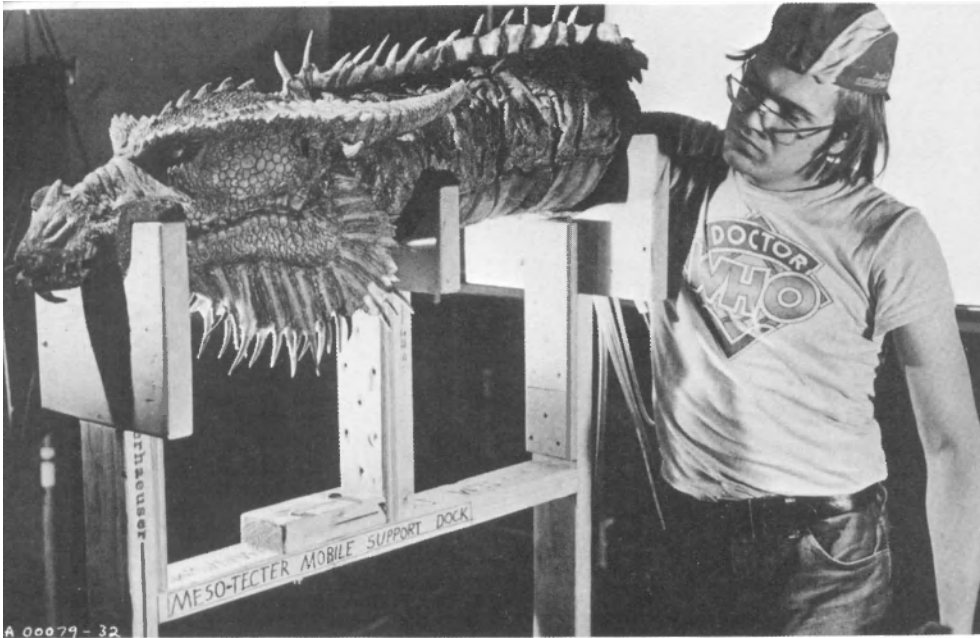
Dennis Muren, Supervisor of Miniature and Optical Effects for *Dragonslayer*, explains how a very fine mixture of techniques—including hand puppets, full-size props and new animation technique—were all blended into the creation of one very impressive dragon. Roughly one-fourth of *Dragonslayer*'s \$16 million

budget went into the special effects to bring the mythological creature to life.

The full-size effects with fire, smoke and water involved a large dragon head, a section of tail, a leg and wing that were constructed under the supervision of Danny Lee and Walt Disney Productions. The 16-foot head and neck assembly was designed with *fully articulated* eyes and jaws; Brian Johnson, Supervisor of Special Mechanical Effects, rigged the beast to shoot a 30-foot jet of flame from its mouth. "It was unreliable, but when it worked, not only was it absolutely terrifying, it was truly magical—a storybook come to life in front of your eyes," exclaims producer Barwood.

The full-size dragon weighed in at over two tons and had to be suspended from the end of a 70-foot industrial crane. "It was extremely effective for the master shots and at mid-distance," Johnson says, "but not for the small incremental moves." Both Johnson and Barwood turned to ILM to create the 160 composite dragon shots that would account for only 15 minutes of screen time, but on which the real success of the dragon as a character—and *Dragonslayer* as a film—would hang. Producer Barwood knew from the start that the dragon had to be believable. "That's the key to fantasy—to make it real, to





Chris Walas checks the internal mechanism which can be used to manipulate the eyes, lips nose, neck, brow and temples of the dragon.

go beyond symbolism and allegory to actuality," states Barwood.

The traditional approach to breathing life into fantastic creatures for the movies involves the technique of stop-motion animation. This technique became famous under the hands of Willis O'Brien in the 1933 *King Kong* and still prevails today in the fantastic adventure films created by Ray Harryhausen. Stop-motion was the first choice of producer Barwood and director Robbins when they began their early meetings with the effects staff at ILM. The script was designed for it—the dragon was to be kept very dark, generally in a cave setting, so that it would have a chance of looking real.

Taun-Taun Connection

It was after *The Empire Strikes Back* was released that Dennis Muren and others at ILM began to have doubts about using stop-motion in the traditional manner. Dennis Muren explains, "The body of the taun-taun was blurred going forward and going up and down when it was running, but the legs were still stop-motion." Though the ILM team was generally pleased with the results when they saw the dailies, the movie going public did not respond so positively; many in the audience thought the taun-taun looked "fake."

"It was about that time that I started thinking that something was wrong with our perception of the process," Muren remembers. "Many of

us here at ILM grew up loving the Ray Harryhausen/Willis O'Brien films and we have a definite prejudice in favor of the technique. There's nothing wrong with that, but regular movie goers don't have prejudices in favor of something and, to many people, the stop-motion technique is not believable. As we were going into *Dragonslayer*, I thought that maybe Phil Tippett should consider animating the dragon as a rod puppet—something they had done years ago on the *Amicus* films. It was all I could think of, even though the result often looked terrible for the most part; but within some of those cuts from the *Amicus* films there were moments that looked real."

Dennis Muren believed that rod puppets had the potential to look more realistic than those animated by classical stop-motion—the animator could achieve the same degree of control that stop-motion provides but without the problem of strobing. The set-up for filming the rod puppets would be very difficult to work with, however. It would involve four or five puppeteers under the table operating the rods and intense arc lights to get depth of field, since the cameraman would be shooting at normal speed or faster.

"An alternative which we discussed at the time was to try to put motors in a puppet. But precision motors are not small enough yet and they may not be for 15 years or so."

Even though motorizing the puppet

was out of the question, motorizing the rods from underneath was not. "We rejected motorizing the rods at first because there were too many movements. The dragon has four legs and each leg has to move in three directions—up, down, forward and backward, left and right. Then you have the body motion to worry about. Well, that's at least 15 motions and we didn't have any motion-control equipment that could handle 15 motions... but it was a daring idea.

"By this time the design of the dragon had been established and it was discovered that the wings of the puppet were so large that they blocked the legs; it would be practically impossible to move the legs of the puppet with conventional stop-motion without the wings being in the way, which meant that someone would have to get under the table to move it. So as long as you are going to have to be beneath the table, then maybe working a system of rods isn't so bad."

Phil Tippett and Jon Berg were intrigued with the idea of a motorized rod puppet, but there was the question of getting the equipment designed, built and working in time. "Gary Leo, one of our electronics people, made some modifications to an off-the-shelf Apple computer to give us 16 channels of motion control memory capability! It was a very significant achievement," Muren states. "The biggest thing we had at ILM at the time handled only 12 channels—and I don't know how the dragon would have looked with that limitation. Jerry Jeffress, ILM's Electronic Chief, came through with the power supplies to drive each motor."

Once the motion-control system was built, the motorized rig for the puppet had to be constructed. It was decided to build a carriage that would have flexibility, something that could be used for any puppet. The motorized carriage is modular—the motorized units are assembled beneath the puppet and underneath the leg or limb that will be moved. Stuart Ziff designed a carriage about two and a half feet wide and about four feet long. The entire assembly moves along underneath the puppet, which is maybe 10 inches wide and about three feet long. The miniature set is built around the puppet and the

motorized carriage.

ILM decided to go with this untried and unproven motorized system because so much of the dragon footage would be taking place in the dark; the legs of the dragon would show, but the feet never would. The rods of the puppet would never have to be disconnected, they could grab onto the feet of the dragon at all times.

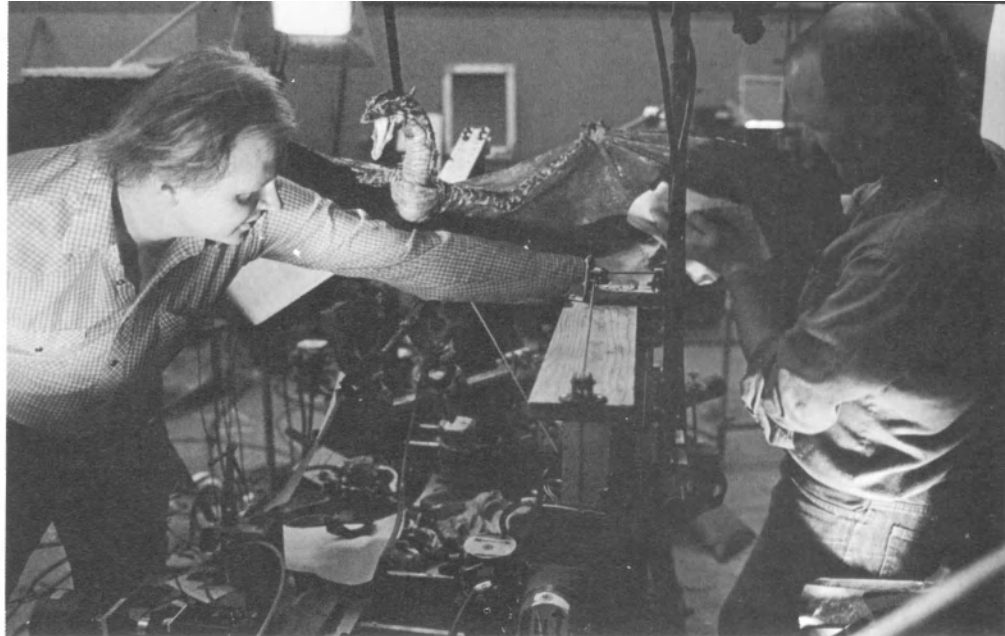
Breaking Tradition

Programming the movement of the dragon puppet with its motorized rods is almost exactly the reverse of traditional stop-motion. Classical stop-motion requires the animator to make a tiny move on the model, click off a frame of film, make another tiny move, click off another frame and so on until the end of the sequence. When the film is projected the illusion of continuous movement results. The amount of life, character and personality the model or puppet takes on depends upon the skill of the animator.

The illusion of movement with the motorized rod puppet works in the opposite manner — the puppet moves while the frame is being exposed, rather than moving in between frames and is programmed in continuous time, though slower than it will look on the screen. The motion of the walking dragon was programmed by Phil Tippett one step at a time with a joy-stick control. "First you might start with the left front leg," Muren explains. "The leg first has to be programmed to move forward; then you run that motion back and program the left front leg moving left or right; then you run those two motions back and add left front leg moving up or down. Now, you have all of the left front leg done. . . then you go on to the other legs.

"Sometimes it's possible to use the same program for the other legs by flopping it or running 90 degrees out of sync to simulate a walking cycle," Muren continues. "Phil hadn't done any motion programming before and it took him quite a while to learn how to do that. It took him time just to learn to think in terms of a continuous speed approach, which is what you have to get used to in motion-control work.

"The technique is different and it took time to learn, but the one thing



Dennis Muren and Phil Tippett prepare the dragon for the Lake of Fire sequence. The dragon is attached to the dragon mover.

that remains constant — and which you absolutely must have to do in any kind of animation work—is the image in your mind. You absolutely must have the talent to pre-visualize a concept. Without that image, it doesn't matter what animation technique you may learn. You must be able to see it first, in your mind. In addition, Phil studied film of lizards to get some ideas of how the dragon should move, but that's the kind of research that any animator does."

"Go-Motion"

The technique of motorized movement was dubbed "go-motion," since the puppet moves during the exposure instead of in between exposures. "The frame rate for go-motion depends upon what sort of supplementary animation is necessary. Not everything is motorized; the mouth wouldn't be motorized for example. There are probably times in which we can shoot eight, 10 or 12 frames at a time and other times when every frame has supplementary hand animation. The exposure per frame is about one second at f/22. Not much light is necessary because of the long exposure time per frame—it might be around 100 foot candles or something like that. But that's just if you want something that's normally exposed. We don't want anything that's normally exposed! Every shot has a special drama to it — either brighter or darker or silhouetted or something."

At first only the legs and body of the dragon were animated in go-motion. The head and neck had to be animated in stop-motion, because no one could figure out how to get a rod so that it wouldn't be visible. "It looked terrible in the dailies," says Muren. "In some ways the mixture of the two techniques looked worse than if it had been fully stop-motion animated. But it was interesting because there was some sort of credibility to the go-motion that we had never seen before, but there was another part that just looked fake. I think that might have been part of the problem with the taun-taun, too. When you start mixing these techniques it just doesn't work—it's got to be one or the other. An audience will either accept it looking artificial as part of the style and love it and the story or they have to see it as real and be overwhelmed by it.

"The shot I am referring to is the one in which the dragon kneels down to look at its baby; then you cut to a shot that is a hand puppet that Chris Walas built and the hand puppet actually nudges the baby. Phil had to do the animation shot three or four times, each time trying to cut down on the motions of the head as much as possible to eliminate the strobing. The moves were very subtle and that shot is in the film. But after taking so long with that shot, we decided that it just wasn't worth it. It didn't look right and it took a lot of time to build the set and get the scrims up in such a tight



Chris Walas displays the dragon head and wing that he designed and built.

area. So we decided to shoot the dragon in go-motion in front of blue-screen. In this way we could grab the neck of the dragon with one of the motion-control rods.

"Now, in the film, all those scenes where you can see the head, neck and some of the body of the dragon thrashing around were shot in front of a blue screen. The close-up shots were mostly a hand puppet and a couple were usable footage of the full-size dragon. The one scene when it walks into the cave and the camera tilts up to Galen walking out is a full miniature shot. The head of the dragon is down to the ground, so the rod can attach from underneath and you can't see it. Mike McAlister was a master at building rigs for us and devising ways of mounting them."

Blue-screen photography, of course, presents other problems. It was up to Bruce Nicholson and his optical department to create mattes that wouldn't undo all of the careful blurring that the go-motion had created.

The mattes had to retain all those soft blurry edges and the optical compositing had to be handled in such a way that the dragon didn't look like a cut out pasted onto the scene. Also the composites had to match the smokey atmosphere of the live-action and full-miniature set photography!

"It was a big problem duplicating that low-key smokey look that Derek Van Lint was using for the live-action filming in England on our miniature sets at ILM," Muren reveals. "Originally we planned to use scrims on the miniature sets, something like we did on *Empire* to suggest the atmosphere of a smokey cave. That, with a piece of glass in front of the camera to reflect some smoke effects into the camera, we thought we could match with what they were doing on the live-action set. But when we went to blue screen the smoke problem was transferred over to Bruce Nicholson's.

"We shot the background elements for Bruce without any smoke in them and let Bruce flash them for a smoke

effect — smoke is just illuminated atmosphere. Bruce took that background element and the blue screen dragon animation shots and combined them in the optical printer.

"Basically, Bruce would take the background element with the hold-out matte of the dragon, print that, rewind the film and print a flash exposure over it. The flash was a special piece of film that we shot on the stage that was a clean, white field that was brighter on one side of the frame, so we could suggest a light source in the smoke effect. Next, the dragon was printed in and a smoke effect added over the dragon. The dailies would be intercut with the live-action footage so we could see how the smoke characteristic matched.

"It takes a lot of discipline to keep up the quality on work like this, but the results are worth it."

Preparing For Flight

Ken Ralston was in charge of the flying sequences, which were blue

screened—the dragon mounted on a blue pylon very much the same way that spaceships are photographed. “The interesting thing about this final sequence was that it involved 10 minutes, a full reel, of a totally fake environment that would climax the movie. That seemed to me to be very daring,” Muren states. “The inspiration for this sequence comes from the ‘Sorcerer’s Apprentice’ sequence in *Fantasia* with Mickey on a mountain top conjuring up the elements.

“The first problem was to come up with backgrounds. We chose to use real clouds, rather than the cloud tank. The tank was being used for *Raiders* and we thought we should have something more realistic than the fantasy clouds that are produced in the tank. Rick Fichter spent two weeks in Hawaii shooting clouds; the landscapes were painted by Christopher Evans in the matte department. The actors had been shot in England against a giant blue screen constructed by Brian Johnson. Now we had to carefully piece together all of these elements.

“There were at least 80 shots in that sequence and each shot had at least three elements. After those pieces were assembled and working, then we had to add the dragon! That’s where Ken Ralston came in.

“The dragon puppet has a wingspan of three feet and was shot with our regular motion-control boom camera. Ken originally wanted a large majestic creature that would fly relatively slowly and flap its wings as a means of gaining speed. The first shot that Ken chose to do was the one in which the dragon and the wizard are seen together for the first time—the dragon flies off into the distance, hovers for a moment and dives back toward him. Ken’s first take had the dragon flying much slower than what you see now, flapping and looking back at the wizard as it begins to circle. When Matt and Hal got back from England they thought the dragon should move much more quickly. So over the period of the next two or three weeks they worked with Ken to develop what you see in the film now—the dragon travels at 150 miles per hour and doesn’t flap. They felt that that was what was necessary for the climax of the film. It doesn’t

necessarily look very real, but perhaps that doesn’t matter. Ken worked with that sequence for about four months.”

For all of the new excitement at ILM with the development of go-motion, Muren emphasizes that classical stop-motion has not been abandoned. “Stop-motion will always be fine for the ‘chess set’ animation problem that you saw in *Star Wars* or in certain kinds of films where believability isn’t necessary, or whenever things are small in the frame or for mechanical things like the walkers in *Empire*. But, for a featured character, go-motion is the logical choice. I’ve seen *Dragonslayer* with several different audiences now, and I think that go-motion sells those sequences much better than if stop-motion had been used. There is a higher intensity of response from the audience, because they are seeing something that they haven’t seen before.”

The real secret to the success of ILM lies in its teamwork, its technical excellence and its artistic vision. All the technical gadgetry in the world is useless without the ability to hold a visual image in mind. Sometimes the technical side of a problem can draw your attention from solving the artistic problems. ILM is managing to weld the artistic and the technical into exciting visual experiences.

Peter Kuran

Peter Kuran got his start in the business of special effects animation and rotoscoping with *Star Wars*. “I was going to Cal Arts at the time,” remembers Kuran, thinking back to those pre-*Star Wars* days. “I had gotten together a portfolio to show John Dykstra and I just kept pursuing it until he said, ‘maybe.’ Then, I offered to work the first week for free, and so . . .

“After that, I worked on the first episode of *Battlestar Galactica* with John Dykstra’s company before going freelance to work on such ‘memorable’ pictures as *The Dark*, *Piranha*, *Witch’s Brew*, [so far unreleased theatrically], *Airplane!*, *Galaxina* and *The Vortex* (released as *The Day Time Stood Still*) plus several commercials.” With his partner Chris Casady, Peter Kuran has formed his own company in Los Angeles, V.C.E., which specia-

lizes in special effects animation and rotoscoping. Recent major assignments include supervising animation and rotoscoping for the second film in the *Star Wars* saga, *The Empire Strikes Back*, and *Dragonslayer*.

In *Dragonslayer*, the scenes to which Kuran’s company made contributions were the climactic sword fight, the old wizard’s resurrection, the lance forging and a sequence at the film’s beginning in which the old sorcerer appears to look into a bowl of flame. Besides these major sequences, Kuran was able to provide a number of little subtleties throughout the film by adding flares to magic amulets and the like.

In January 1981, Kuran contacted the film’s producer, Hal Barwood, when he learned that Industrial Light and Magic, which had been working on the effects for six months, was scouting around for someone to do the effects animation. “Hal Barwood asked me to come up to San Anselmo the next morning. They ran some scenes for me that they wanted me to work on. I guess they ran about 1/3 of the material that I eventually wound up doing,” Kuran recalls.

Kuran returned to Los Angeles to begin work on the assigned scenes. About a week later, he got another call to come up and look at some more material. Kuran brought with him some completed composites, so he could get some feedback. “I think they were very surprised. In the short time since I had last been there, I not only had completed some animation, but had actually composited some scenes.” Pleased with the quality and speed of his work, Hal Barwood and I.L.M. gave him a lot more work to do.

If you examine the frame blow-ups from *Dragonslayer* that illustrate this article, you will note that many of the glows and light effects appear to have an “optical” rather than “animated” quality. Kuran wanted the animation effects and enhancements that he added to a shot to look as if the flashes of light actually happened on set and were photographed along with the live-action photography.

“I wanted to give the animated effects sort of an ‘anamorphic’ look—as if it all had to be photographed through the same lens. You’ll notice that many of the effects have a blue

horizontal flare that goes from one edge of the frame to the other. We handcrafted our effects to make them look as if they were actually shot with the live-action camera." To achieve this look, Kuran spent a good deal of time studying individual frames of various anamorphic pictures, trying to identify the characteristics of light flares of the lens.

Some people might say that an animation effects artist should try to mimic "reality"—to duplicate the effect as it might appear to someone actually standing there. But Kuran believes that the emphasis should not be upon how something appears in reality, but how it looks through a lens. "After all," he says. "You are looking at a movie—it is not reality. You are dealing with light that is going through a lens and being recorded on film. So, the effects animation must have the same look—aberrations and all!"

Working with Fire

An extreme example of Kuran's technique of mimicking lens effects is in the sequence at the movie's beginning when the sorcerer Ulrich (Ralph Richardson) peers into a bowl of flames. "We put the flames into the bowl as an animation effect," begins Kuran. Ulrich's face was illuminated with a 16mm projection of actual fire. Our job was to match the projected reflections on his face with what we had to put into the bowl."

This work was initially pencil-tested by Sue Turner who was working for Kuran at the time. Kuran creates the artwork for his special effects in pencil on individual cels. These cels are photographed to produce continuous-tone mattes and become elements for final compositing in an optical printer. Kuran talks about the difficulty of achieving a realistic fire effect in pencil.

"It's a matter of study and observation," affirms Kuran. "If you are trying to make something look real and it doesn't end up looking real, it just means you have not been sufficiently observant of the effect you are trying to achieve. You look at books and films, but you need to study more than the movement, you need to study the actual *quality* of that movement, the quality of what something looks

like and what it does.

"For the fire in the bowl shot, we added the effect of lens reflection—you see a small inverted fire underneath the bowl. When I turned in that shot, someone remarked that there must be something wrong with the matte, 'You can see the fire beneath the bowl.'

"I agreed, but explained that it was deliberate. I explained that if this fire were actually in the bowl and you were actually photographing it with the live-action camera, you would actually get sort of an inverted image of the fire beneath it.

"There are a lot of examples of this sort of effect in regular photography. In *The Howling*, for example, in the shot when they lit up the barn, there's an actual inverted reflection of the fire itself in the lens. I don't know if that was 'bad' or desirable, but if it's a function of most lenses, if you have something bright, the light sort of ricochets all over the lens giving you these extra images.

"I think the eye of the moviegoer gets used to seeing things like that, subliminally. So, I like to add those things in. Artistically, you might look at it and think it doesn't look right, but it actually is 'right'—it belongs there—whether or not people are really conscious of it."

In the second half of *Dragonslayer*, the old wizard Ulrich is resurrected from a lake of fire. Kuran's company had to supply a spinning flame effect for this scene. I.L.M. gave Kuran's company a good deal of leeway in coming to terms with the effects for the shot. "They sent us a black and white print of the sequence in rough cut and told us to come up with something," he says. "There were a number of cutaway shots with Galen watching the transforming sorcerer and I was told that I could utilize these cutaways at points where the animation should be stopped and then restarted into another scene; which essentially meant that I could restructure the whole sequence from when Galen first looks into the fire to when the sorcerer spins up and then rights himself. We followed the storyboard animation that had been done for that sequence very closely. Our effects stop just at the point before he begins to float across the water, which is

where another optical company took over."

Using the Optical Printer

"The great advantage to my situation here in Los Angeles, is the access I have to an optical printer. It's not really ours, it belongs to another company, but it's great to have it at hand. When I was working freelance or a I.L.M., I was never really able to go in and have the ability to watch the optical printing being done, though I did get very good feedback from Bruce Nicholson, the optical printer supervisor when I was working on *Empire*

"When you are working on any given shot, ideas occur to you constantly while you're working. Your creative ideas shouldn't stop when your work gets to the optical printer. When you are getting everything ready for the printer, there's the line up or layout sheets to be done. Well the ones that I write are usually fairly complicated and occasionally need an 'interpreter' to understand them. This optical company that I work with has sort of a symbiotic relationship with my company; they allow me to do my own line-up sheets and watch the guy who does the optical printing. I'm on hand to answer the questions if he doesn't understand something... that frequently happens.

"It also allows me to catch mistakes. By being in there watching and working with the operator, you can eliminate the immediately apparent mistakes and you can get ideas as you are watching the material being put together. You can think of other ways the optical printer can be used, such as cycling a couple of small pieces of live action or creating a different sort of matte that can be added to your animation. In the resurrection sequence, we created special mattes to make it look as if Ulrich was really inside the spinning fire. Look at the close-up shot... it's as if he were really floating in the middle of the fire. Much of this effect was generated inside the optical printer."

Operating an optical printer is a difficult and tedious job requiring a high degree of precision. Unless all of the elements that make up a composite are accurately aligned and properly exposed, telltale "matte lines" distract from the effect, or color shifts

between the elements lessen “magic” on the screen.

“Out of the shots that we did, I would guess that maybe 10 of them were perfect the first time,” Kuran says. “Out of the rest of them our average ran at about four tries before it was right. I think that’s about the average for I.L.M., too. When you’re putting several things together on the printer, sometimes it takes more than four tries and sometimes it’s right on the first or second time; so generally, it averages out to about four tries per shot.

“During that time while you are trying to get the compositing to match—all the separate elements to matte properly—you may see something that doesn’t exactly look right or it gives you a chance to decide exactly how the color should match and complement the scene. Fortunately, even though I came in on the last six months, it was plenty of time to be able to go over all of the material and ‘tweak it’—to get it to look like it really belonged in the scene.

“We did about 44 shots for the film. Forty of those came directly from producer Hal Barwood and four of them were compositing dragon shots for I.L.M. They didn’t give us any of the really complicated dragon shots to composite. They were probably getting a bit rushed to the last and thought they would try us out on compositing a few of those shots.”

The final duel between Galen, the young sorcerer’s apprentice (Peter MacNicol), and the villainous Tyrian (John Hallam) was turned over to Kuran to add that extra dash of sorcery. It was a logical choice. After all, he had done the laser and light saber effects for the first two *Star Wars* films. Kuran was asked if he was worried that the final conflict between Galen and Tyrian might not look like Darth and Luke battling it out. “I deliberately went for a different look as far as the actual clashes of the weapons were concerned. There certainly weren’t any glowing spears of light in the shape of light sabers to worry about.

“If you examine a flash on the light saber fight, you’ll see that it is a single piece of artwork. Actually for all the light saber clashes on *Star Wars* and *Empire*, where they hit is basically the



Ken Ralston spray painting the baby dragons.

same piece of artwork. What we did for *Dragonslayer* was a little more extreme. We created moving artwork to create the moving lens flare effects. I wanted these bright flashes to look like they were on the set and going through the lens. We also added several reflections into the scene as well.

“As sword and spear clash in the final duel, the bright flashes from the magic weapon not only create a flare of light, but must illuminate part of the scene. This illumination is seen as reflections on the various surfaces, in this case rocks and cliffs, from the bright clashes of the weapons. The amount of detail that can be put into these reflections is a direct function of the amount of time available.

“Each time you work on a film like this,” explains Kuran, “you make it a point to do a bit more than you did the last time. Hopefully, if you can get the reflections done a little bit faster, then you can add just a little bit more to them. I’ve only just begun to get into the possibilities for animating the negative values—the shadows that may be cast. You look at a shot and you say that we need this and we need this . . . if I have enough time I’ll throw that in, too. The first thing that we get done are the highlights, then if we can get all of the light highlights that we want in a shot, I’ll go back and add in shadow details.”

There are a number of sequences in *Empire* with animated shadows. Look at the sequences with the snow-

speeders skimming over the snowy landscapes with their shadows cast on the glacier below. The shot is made up of a live-action “plate,” snow speeder models and the animated shadows. There are also a few drop shadows cast on passing asteroids by the *Millennium Falcon* during the chase sequence and other moments here and there that add to a scene’s reality. To Kuran, it has been a slow progression of experimentation over the years.

“Much of my experimenting has enabled me to always go a step further. In the first picture, when everyone was trying to give the lasers perspective, I went on and tried to add reflections to things. It was very complex and very hard to do, but I wanted to do something a little bit harder. On *Galactica*, I started experimenting with shadows and my technique has begun to improve. *Empire* has many more animated shadow effects.”

Other than perspective and creating a shadow that appears to follow the contours of the surface on which it is being cast, the other problem is shadow density—allowing just a little of the background to show in the shadow so it doesn’t look like a black blob. “The first shadow I ever attempted was the shot of the Cylon ship skimming over the surface of the *Galactica*. The question of shadow density has been handled much better on *Empire*. Much of it depends on the amount of feedback you get from the optical department. On *Empire*, Bruce



Chris Walas' three assistants who helped make and manipulate the dragon head. Left to right are: Wesley Seeds, Mark Thorpe and Eric Jensen.

Nicholson, the optical photography supervisor, took a great deal of time wedging those elements with the background so that the shadow density of the animation would match the density of the other shadows in the shot. It really helps. I really admire Bruce and thank him for taking some extra time with them. Animation rotoscope elements have a way of being thrown in at the end of a shot... that's not the case at I.L.M."

A Variety of Techniques

"On *Empire*, the front projection material was completely done away with on the light saber fights. The front projection material made it easier for the animator, but harder for the director and cameraman. They sacrificed the front projection material so they could get better and easier camera set-ups. And easier camera set-ups mean faster camera set-ups, which means it costs less. It was OK for us in the animation/rotoscope department, it just meant that we had to do an awful lot of hand rotoscoping. There are two shots that we

did as held takes, that is the matte painting was put in and then the film was frozen until we are ready to put the animation in. It saves a generation."

Laser beams are hard-edged effects and lend themselves easily to pencil animation, but what about soft-edged effects like glows and reflections? Do cels for reflection effects have to be airbrushed? "No. What we've done with reflections has been done both ways—airbrushing the cel and putting it in with pencil. One of the things we have been experimenting with is duplicating airbrush effects with pencil. If you can do it with pencil and have it come out just as good, then you've saved half the time right there. You can use the time you've saved by not having to airbrush to do other things, like adding detail to reflections... and shadows.

"On *Dragonslayer*, we did our reflections in pencil, gave them a soft look and were able to add quite a bit of detail. If you try for that much detail with an airbrush, you will spend five times as much time doing it. Whether or not anyone likes it, the name of the

game is *time*. We try to spend our time as efficiently as possible. That way we can add many little extra things in our shots. For example, when Galen's spear hits the post to free the princess, we heated up the chain as it came apart. It's just a little thing which goes by very quickly, but anything like that we certainly try to do," Kuran says.

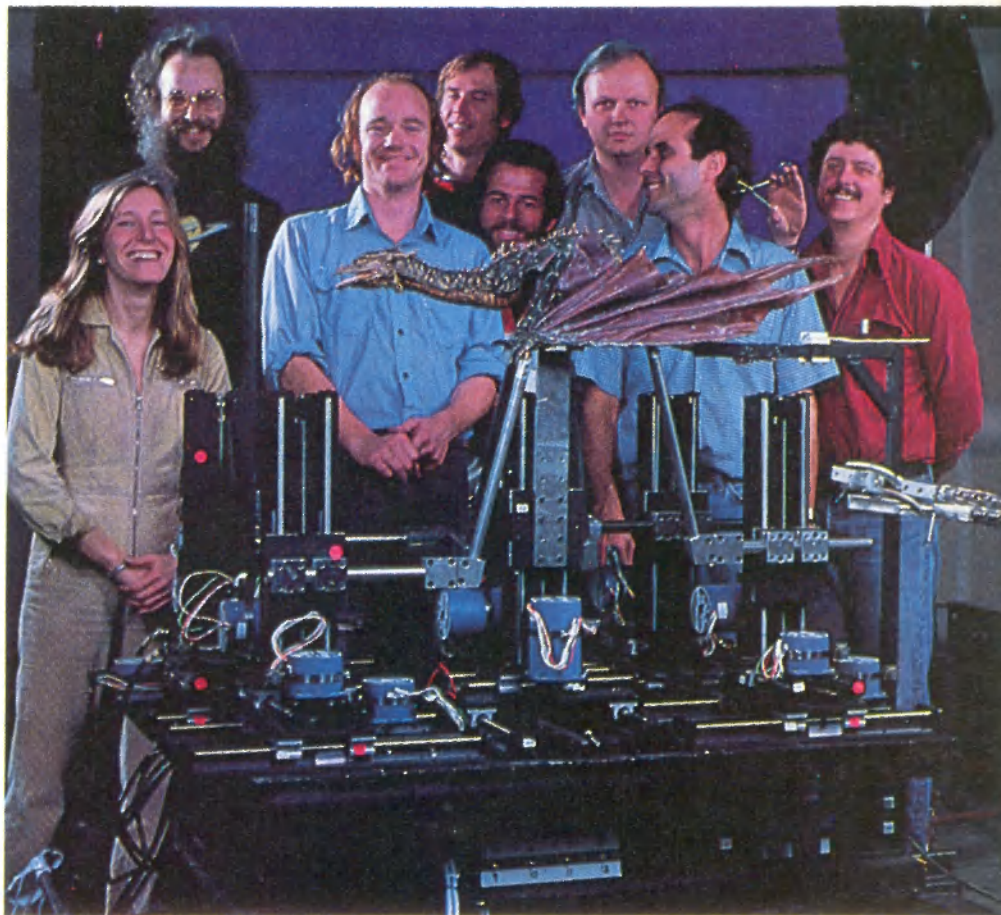
"All of our pencil cels are photographed on continuous tone mattes. I think the basic rule of thumb is that the higher the contrast, the faker it looks, the less it actually blends into the scene, and the more it actually looks like a cutout placed in the shot. Our experimentation is based upon seeing how low a contrast we can actually use. It gives a subtler effect and it's something we have to continually experiment with accomplishing.

"As far as the number of frames per cel, our whole approach to naturalism and realism means that you can't print anything twice in succession. When you start shooting in twos and threes, you start getting into Saturday morning cartoon work. All

of the artwork that is created is created for an individual frame and is not really used twice in succession.

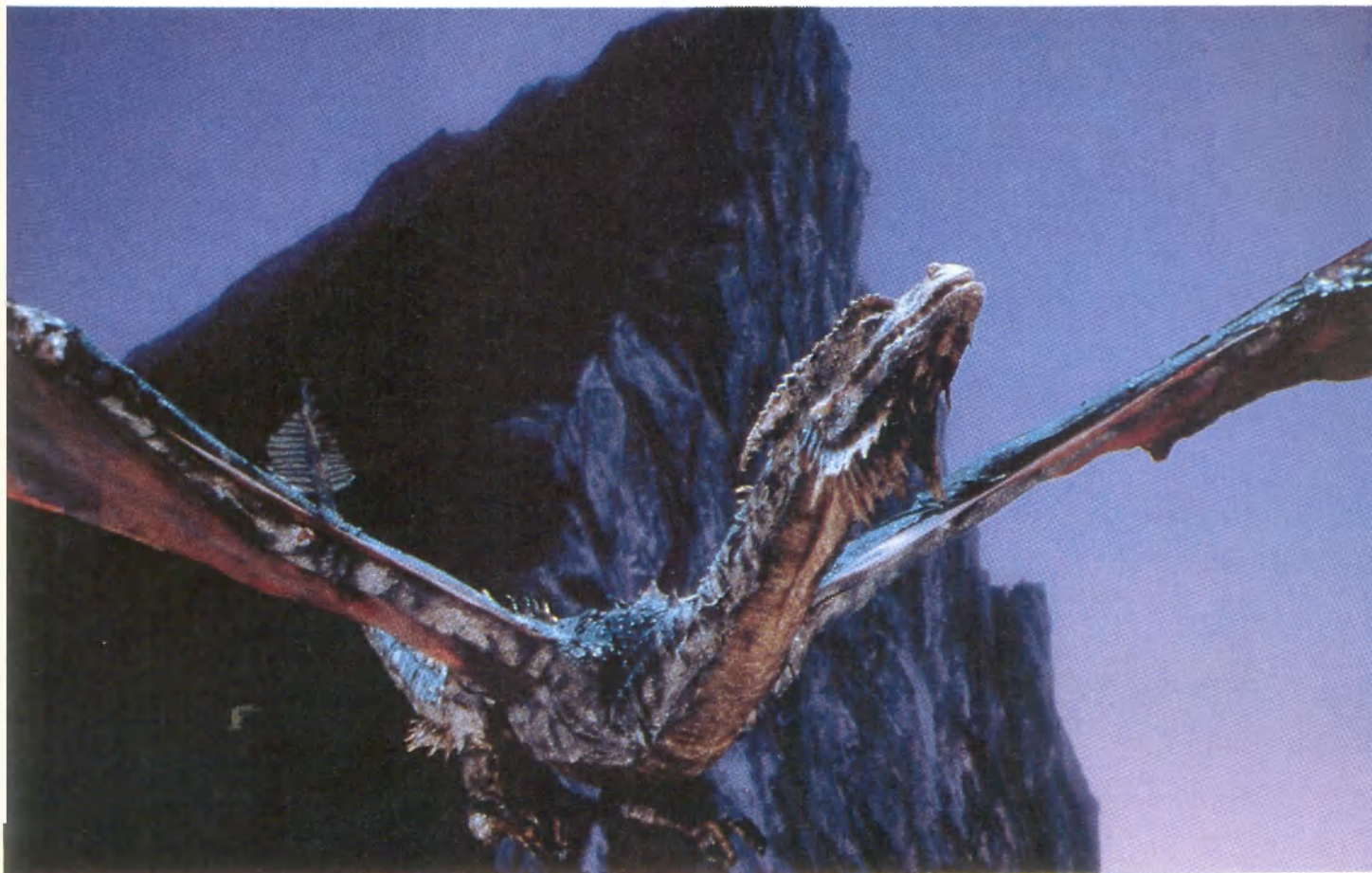
"This is not to say that there is no place for animation cycles. Cycling is very useful for certain effects. The resurrection sequence has cycles in it." Kuran's approach is that cycling is a tool and should be properly and not casually used.

Peter Kuran reveals that one of the most innovative uses of his department's skills is never seen by the public. "For *Empire*, George had us create what he calls 'animatics.' Animatics is his term for animated storyboards. For *Empire*, we created 124 animatic shots, which of course, will never be seen by the public but are invaluable for the filmmaker. In an effects picture, the effects are the ast thing to be put into a film. So you have lots of live-action shots interspersed with yellow leader which says 'scene missing' or maybe just a line indicating where an effects shot is supposed to be. George was interested in getting a better grasp on the cutting of the picture so he asked us to animate the storyboards of the effects. We added motion to the storyboards in much the same manner as



The Walking Dragon Crew (left to right) Bess Wiley, Gary Leo, Phil Tippett, Dave Carson, Mike McAlister, Dennis Muren, Stuart Ziff and Ray Gilberti.

Vermithrax Pejorative takes wing at the climax of *Dragonslayer*.

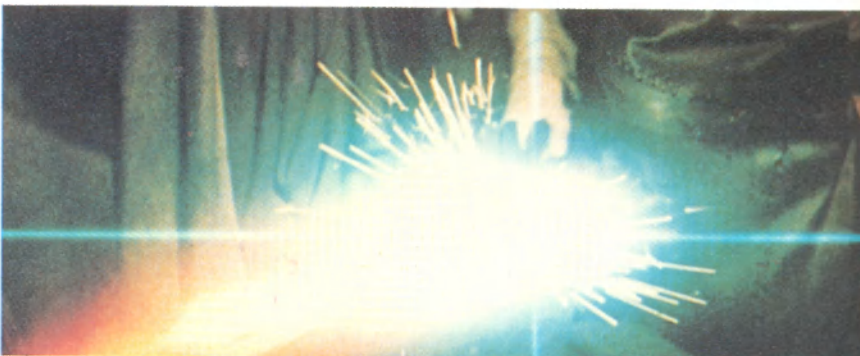


Saturday morning cartooning, though we tried to animate them with as much detail as possible. We even started Xeroxing the cels and inking and painting . . . really high class.

"George was able to cut our animation into the picture many months before the final effects were ready, so he was able to make many decisions very early in the game. As the effects shots were completed, the animated storyboards would be replaced."

Though Kuran is an excellent spokesman for his company and fairly expressive when it comes to describing his approach to a shot, he is quick to point out that no one works alone and that filmmaking is the most collaborative of the arts—incorporating many people's skills into a finished product. Kuran expresses his gratitude and appreciation to those people who work with him.

"I would like to credit our company's employees for their work in *Dragonslayer*: Susan Turner, who animated the flames in the bowl and contributed to the animation of the sword fight; Kathryn Kean, who animated the spinning sorcerer in the resurrection sequences and the heat spreading in the spear forging sequences; James Hagedorn, who composited all the material on the optical printer without the assistance of any other printer operators; Chris Casady, who provided the flashes on the spear forging; and Pam Vick, Len Morganti and Robert Jacobs who provided their skills as assistant animators." ●



Chris Casady provided the flashes for the forging sequence. Kathryn Kean created the glows.



Susan Turner animated the bowl of flames effects. Interactive light effects in Richardson's face were projected during filming.



E.T.: THE LITTLE FX MOVIE THAT MADE Good!

It's the toughest effects
challenge — optical effects
in bright daylight scenes.

Shot almost entirely in Los Angeles, E.T. began principal photography on Tuesday, September 8, 1981. The first two days were devoted to interior scenes at Culver City High School, then the production moved between the communities of Northridge and Tujunga for the next 11 days for exterior shots. Forty-two days were spent on three soundstages at the Laird International Studios (the former Selznick Studios) in Culver City. And, finally, six days of exterior shots were completed on location near Crescent City, CA, a coastal town near Oregon.

Originally scheduled for 65 days of principal photography, it was completed four days ahead of schedule. Then came the completion of the complex post-production activity, which included the myriad of special sequences which had been assigned to George Lucas' firm, Industrial Light and Magic, in San Rafael, CA.

ILM had its hands full. Three films were in post-production at the facility simultaneously: *Star Trek II*, *Poltergeist* and *E.T.* Of the three, Spielberg's *E.T.* was the low-budget quickie. The film was scheduled to cost under \$10 million; with \$1.5 million set aside for the creation of the film's star, there was less than one million budgeted for the film's other effects.

The film was supposed to only have about 35 effects shots in all, but when all was said and done, there were about 50. Also, the FX in *E.T.* do not have to function the same way as the effects did in, say, *Blade Runner* or *Star Wars*. Those films depended upon effects to create worlds and settings for the story. For *E.T.*, the effects work like punchlines, underscoring moments or capping-off sequences. They are special little "oh, wow" moments for the audience, which is being carried along by the story rather than the visuals.

PHOTO: 1982 LUCASFILM LTD.

Facing page— Tom St. Amand displays the armatures for the bicycle riding go-motion figures.





Bob Elswit and Dennis Muren film a table top landscape for the puppet E.T.



PHOTOS: © 1982 LUCASFILM LTD

Tom St. Amand operates the "E.T.-on-a-stick" puppet. The matte department created the background painting seen in this shot.

Tricky FX for a Low Budget

Effects supervisor Dennis Muren was pleased to accept the challenge of working on a low budget to see what could be done quickly and inexpensively. "We decided to work entirely in four-perf," begins Muren. "It's the first time we've done effects work on anything less than Vista Vision. The other films that were in here were anamorphic and were going through our regular printer. It has the advantage of larger negative, finer grain and lower contrast. But I was curious to see what could be done in four-perf with the 1.85 to 1 ratio of the non-anamorphic format.

"Richard Edlund came up with an old printer that had been at Warner

Brothers for years and years. He bought it, brought it here and we fixed it up. Also, John Ellis built another printer, sort of off-the-shelf. With those two printers, we were able to work entirely in the four-perf format. ILM optical supervisor Bruce Nicholson was occupied with both *Poltergeist* and *Trek II*, so the optical chores were given to Ken Smith.

"Looking at the finished film in the theater, there is a slight difference in grain when the dupe shots come on, but not as much as you might expect, because we came up with a number of tricks to cut the grain down. Of course, there is still nothing like using a bigger negative."

One of the methods used to

minimize grain involved running two background plates through the printer. "Instead of making the traditional black-and-white separations on the background plates, we used low contrast color positive prints, called interpositives," Muren explains. "Interpositive stock has a certain grain pattern to it, of course, but it is still finer than running the three black-and-white separations. To cut the grain way down, we ran two interpositives through the printer—which means that you have to go through all of the matting twice. At least with the backgrounds, you must go through all of the hold-out mattes twice. Then, you just do the burn-ins once. The double pass on the interpositive background gives the grain a 'transparent' look. Also, we ran a slight diffusion on the background."

Generally, the results in the 35mm prints seem to have been worth the effort. The 70mm prints were made a little hot, however, and, of course, had to go through another duping stage, so the grain shows up more.

Another approach taken to maintain image quality in the four-perf format was the use of held takes on the matte paintings. It's a system that Albert Whitlock has long advocated (see *STARLOG* #60 for the full story) and involves setting up the pin-registered camera on the live-action set and filming the action with a matte in front of the camera blocking out the area where the painting will later be. The film from that take is put in a freezer and preserved until the matte painting is finished. Then, the live-action take is removed from the freezer, re-threaded into the matte camera and the painting is recorded. The film is developed and printed normally and, *voilà*, you have a finished scene—live action and painting, all on the same piece of film, the original negative.

Matte cameraman Neil Krepolka explains, "Dennis Muren, Mike Pangrazio and I went down to the Culver City studios to shoot the plates [for the shots of backyard sequences with the bright moon and silky drifting clouds in the upper part of the frame]. "We set-up a matte camera and a protection camera as close as possible. All the footage was brought back to ILM for Mike Pangrazio and Craig Barron.

They fed the footage through another Mitchell camera to record the painting.

"It was our first venture with held takes and I think the resulting quality and special look of the shot is very successful. We ran into the classic problem with the system, though. Even though it looked good in the camera, we really wanted to move the shot around a little, recompose it, and, of course, you can't."

A Little Disney, A Little Oz

Still, though, the silky pristine quality of the shot adds much to the scene's impact. Spielberg had suggested that the shots should have a Disney look to them, similar to what Peter Ellenshaw might have done. Some tests were made moving a large glass in front of the camera during the painting exposure to soften the clouds and create a slight drifting effect. Of course, like most of the effects shots in *E.T.*, the emphasis was not on the ef-

fect, but on the action happening in the backyard. The sky was there to emphasize the mood, while the live action carries the scene.

"It reminded me of that shot in *The Wizard of Oz*," begins matte photography assistant Craig Barron, "when Dorothy is going from her house to the storm cellar. I rented a tape of the film to look at and noticed that all the clouds were soft and diffuse. So, that's what I did for this scene. I made up a little Vaseline filter to soften the clouds; as the clouds moved through the filter, it distorted the shapes a little, too."

The ILM matte department also created background paintings for the miniature landscapes. One of the best examples is the shot near the film's beginning with *E.T.* standing on a grassy knoll looking down over the city lights below. It's a remarkably realistic painting. It is easily mistaken for a photographic plate. Matte artist

Chris Evans explains, "I created the painting without any specific references to Los Angeles or any other city. I knew the basic geography that was specified in the script like the silhouettes of the mountains in the background, but I worked up the grid for the streets and then airbrushed in an atmospheric glow. It was a fairly easy painting. For detail along the boulevards, I added a McDonald's, a hospital, a tennis court; there is even a drive-in playing *Star Wars*."

If you look closely, you may notice that the city lights seem to shimmer and have flare effects. That's because they really were lights.

"All the major lights on the painting were drilled out right through the masonite," explains Evans. "Inkies (small spotlights) were placed behind the masonite to shine through the tiny holes into the camera. We hung strips of colored cellophane behind the painting and rigged a little fan to blow

Charlie Bailey and Mike Owens check out a landing sequence shot.

PHOTO: TERRY CHOSTNER





Above: Tom St. Amand makes a minute adjustment to the armature of the go-motion miniature used in the filming of the flying bicycle sequence. Wheels and pedals were animated with go-motion while head movements used traditional stop-motion. **Below:** A close-up view of the complete go-motion bicycle miniature. A fine mono-filament loop was run in a groove around the bicycle wheel down to a go-motion motor. The feet of the puppet were fastened to the pedals which moved naturally as the wheel and sprocket rotated.



them. The result is a sparkling light effect that suggests real atmospheric shimmer.

"As soon as it was finished, Dennis Muren grabbed it and set it up on the stage with the miniature landscape that Scott Marshall's team was building."

The painting was set up where the little hill slopes down to meet it. There was a slot for Tom St. Amand's five-inch high E.T. puppet, which was manipulated from below. The set was re-dressed three times before it looked real. "Making miniatures of Earthly terrain is incredibly difficult," explains Muren. "While we all know what the Earth looks like, it takes incredible discipline and concentration to make a model of it." The set is very skillfully lit and does not read as a miniature at all.

Model shop supervisor Lorne Peterson is very pleased with the look of the model landscape of the bald spot where the ship lands, though that miniature set went through an evolution. "Scott Marshall headed up the group which created the landscapes," Peterson reveals. "There were about

PHOTOS: © 1982 LUCASFILM LTD

seven people working on that forest and building about 50 trees." The idea was to duplicate the actual location, but that proved not to be the ideal solution."

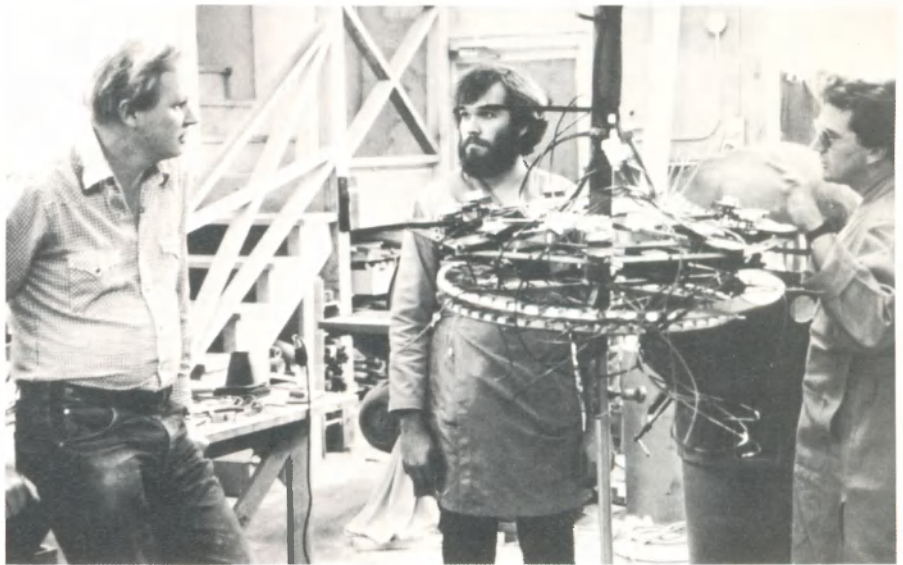
"In creating the bald spot set, we ran into exactly the same problems that we had in the Walker battle in *The Empire Strikes Back*," begins Dennis Muren. "You look at something, and think you know the geography, you build it that way...and it doesn't work. Miniature landscapes are so much more complicated than you might think."

"The original location was all third growth," adds Peterson, "So they were all pretty much alike—same height, same age, same shape and the ground was pretty flat." But ILM changed all that. "Dennis suggested adding a dead tree here and there, making some shorter and taller. The tree crew went in snipping branches to create more interesting shapes and added some dead trees." Even the ground surface went through an evolutionary process. It started out flat much like the original location, but, eventually, a slight roll was added, then the trees were put on one level, which sloped down to the bald spot and then dropped off to the valley on the far right of the set."

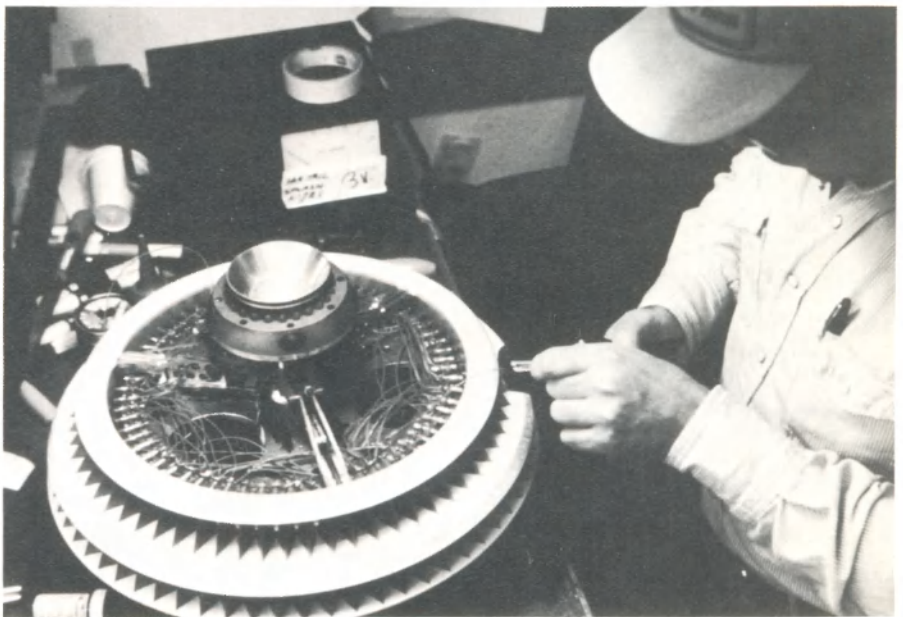
"Finally, it ended up looking like something real," says Muren, "or more real than what we started out using." When the set was satisfactory, Muren borrowed the camera that the *Trek* effects unit was using and got the shot in less than an hour.

Spaceships and Bicycles

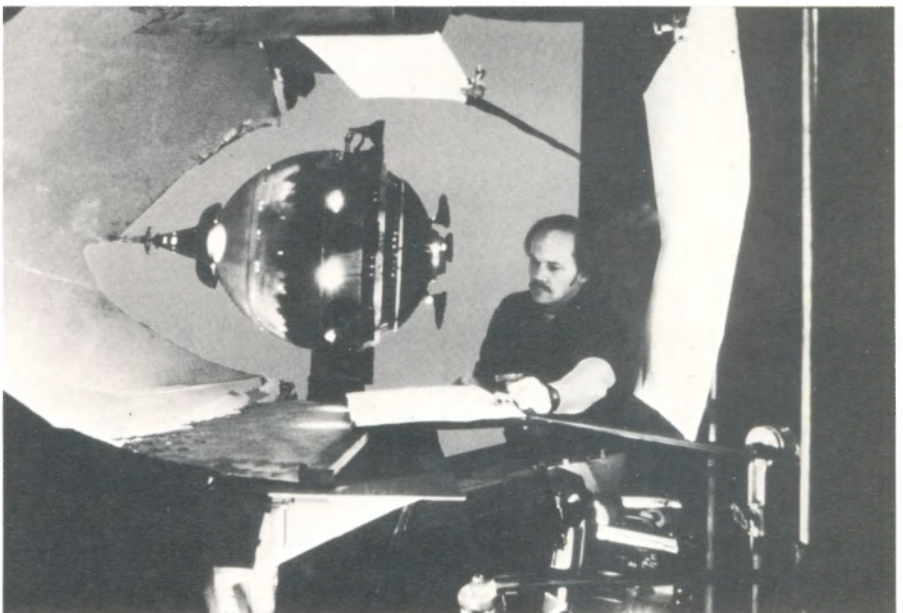
The spaceship, which lands and takes off in that meadow, is a masterpiece of compact engineering. Filled with motors, gears and wires, it weighs in at a hefty 45 lbs and, according to Lorne Peterson, is the most complicated mechanical model that ILM has built to date. The ship has about 261 incandescent lamps, three sets of retractable landing gear and nine operating attitude thrusters—all crammed into a shell about 18 inches in diameter and only about two feet high. The ship's shiny dome is constructed of high-temperature epoxy and graphite with an aluminum plating to give it a shiny, mirror-like finish. Spielberg wanted the ship to



Dennis Muren, Marty Brenneis and Bob Diepenbrock discuss the assembly of the spacecraft's interior.



Charlie Bailey completes the wiring for the interior lights.



Don Dow sets up the complicated series of reflectors before filming E.T.'s ship as a blue screen element.



PHOTO: MERRY NORDQUIST

Bob Diepenbrock works on the shell of the alien spacecraft.

look like it had been sitting in a swamp somewhere so the bottom half is heavily textured. Charlie Bailey engineered and supervised the model, which required 60 man-weeks of labor to complete. The ship, which

now rests on Steven Spielberg's coffee table, is a precision machine. The nine attitude thrusters on the sides withdraw and fold out in concert and the landing gear tripod withdraws and pops out. With all of the lights, it looks a little like a high-tech Christmas tree, which is exactly the look that Spielberg wanted.

Both the landing and take-off were complicated shots since the ship had to be blue-screened into the shot. It was a complex composite with the shiny dome surface reflecting the surrounding forest, which wasn't really there; and the ship's lights illuminating the landscape, which also wasn't really there. It all came together in the optical printer.

A nice touch on the ship's final lift-off was the rainbow contrail. Animation supervisor Sam Comstock created the effect with light, a prism and a rear projection screen. The ILM animation department likes to actually use light, when creating light effects and flares, rather than more traditional pencil and paper techniques. They often create printer elements for the optical department by using scratch filters, gratings,

smearing glass, various lenses, etc. Sometimes they can come very close to duplicating live-action light effects using this system.

One of the first concerns of the cinemagicians at ILM was the two flying bicycle sequences: the initial sequence with Elliott and E.T. at night and the lift-off in the middle of the street with the kids running the police blockade. A number of approaches were considered. First to be discarded was the suggestion to hire helicopters and rig the bicycles on wires and cables and do a real lift-off on a real street. To do that would have required an enormous expenditure of time, effort and at least another million dollars. *E.T.* was supposed to be a low-budget film on a tight schedule. "Steven certainly didn't want to go through all that," affirms Muren. "We thought we could come up with a solution here at ILM. Then, too, if we could do it here, we could add that Disneyish look that Steve likes—it could look better than real.

"It was all done with Go-Motion, the process we developed during *Dragonslayer*, and with puppets and a location background plate.

Special Visual Effects Produced at Industrial Light and Magic, a division of Lucasfilm, Ltd. Marin County, California

Visual Effects Supervisor	DENNIS MUREN	Effects Editorial Supervisor	CONRAD BUFF
Effects Cameraman	MIKE McALISTER	Effects Editor	HOWARD STEIN
Camera Operators	ROBERT ELSWIT DON DOW	General Manager, ILM	TOM SMITH
Camera Assistants	PAT SWEENEY KARL HERRMANN SELWYN EDDY III MIKE OWENS	Production Coordinators	WARREN FRANKLIN LAURIE VERMONT
Optical Photography Supervisor	KENNETH F. SMITH	Animation Supervisor	SAMUEL COMSTOCK
Optical Printer Operator	DAVID BERRY	Animators	PEGGY TONKONOGY GARRY WALLER TERRY WINDELL JACK MONGOVAN
Optical Line-up	RALPH GORDON	Still Photographer	TERRY CHOSTNER
Optical Technicians	DUNCAN MYERS TIM GEIDEMAN BOB CHRISOULIS	Still Lab Technicians	ROBERTO McGRATH KERRY NORDQUIST
Go-Motion™ Figures	TOM ST. AMAND	Supervising Stage Technician	T.E. MOEHNKE
Model Shop Supervisor	LORNE PETERSON	Stage Technicians	DAVE CHILDERS HAROLD COLE DICK DOVA BOBBY FINLEY III PATRICK FITZSIMMONS EDWARD HIRSH JOHN McCLEOD THAINE MORRIS PETER STOLZ
Chief Model Makers	CHARLIE BAILEY MIKE FULMER	Production Accountant	LAURA KAYSEN
Model Makers	SCOTT MARSHALL EASE OWYEUNG MIKE COCHRAN SUZANNE PASTOR MICHAEL STEFFE JESSIE BOBERG RANDY OTTENBERG	Equipment Maintenance	WADE CHILDRESS MICHAEL SMITH
Spaceship Design	RALPH McQUARRIE	Electronic Systems Design	JERRY JEFFRESS
Matte Painting Supervisor	MICHAEL PANGRAZIO	Model Electronics	GARY LEO MARTY BRENNEIS
Matte Painting Artists	CHRIS EVANS FRANK ORDAZ	Optical Printer Engineering	GENE WHITEMAN JOHN ELLIS
Matte Photography	NEIL KREPOLA		
Matte Photography Assistant	CRAIG BARRON		

"We made a test shot of a bicycle riding down the street and lifting into the air that was successful. It required having a fairly dark background and tree shadows, to hide any matte problems. If we had to do the shot at noon or if there hadn't been trees casting shadows on the roadside we wouldn't have tried it, especially in the four-perf format. But I figured we could do it if the street was fairly dark," Muren says.

"Mike McAlister shot several plates of empty streets for us to see. We thought we could play with the alternate shafts of light and dark between the trees and then have the bikes lift off into the light. But, as it turned out, the story was moving along so quickly at that point, all that we had to do was get them into the air.

"Steven picked the location and I checked it out to make sure it would work for us. Originally, I wanted to shoot it the other way around. But Steven wanted them to be backlit instead of being frontlit, which meant all the L.A. smog showed up. The plate ended up being lighter than it should have been and it was a much more difficult shot to do than the early test we did. The animation department was able to add some drop shadows of the bicycles to the background which really made the bicycles look as if they were on the street."

Finding the Magic

The cliff lift-off with Elliott and E.T. earlier in the film was another sort of problem. Steven needed to establish the fact that E.T. could levitate the bicycle into flight, but didn't know just how to set up the precise situation. "Originally," remembers Muren, "he was supposed to go into a fog bank and then come out of the fog in the air. But that didn't seem to be what we were looking for. Then, we thought, maybe a fallen tree. So, he comes out of the fog bank, there's a fallen tree and he flies over the tree. But that's a lot for one shot. We didn't want the thing to last for more than 40 frames before you see him fly or the rhythm of the sequence would be lost.

"Eventually, I came up with the idea of a cliff. Then, it was a matter of looking for the angle. It was a long pan. We start on the cliff, see him come out of the fog, he starts to go over



Steven Spielberg personally directed the actors who were used in close-ups for the flying sequence.

the cliff, but then picks up and goes off into the sky."

Magic.

The puppets for the sequence, built by Tom St. Amand, were about 18-inches high, much larger than the ordinary stop-motion armature puppet, but much easier to detail and photograph. It also made things like hair and clothing easier to scale properly. Mike Fulmer turned out precision miniature bicycles which were rigged to operate with the Go-Motion equipment. Mono-filament line was run around the front wheel in a little groove down to a motor. The front and back wheels were interconnected so the wheels would turn continuously during the Go-Motion shot. Effects cameraman Mike McAlister shot the Go-Motion bicycles. The sequence was shot in front of a blue screen and combined with a background plate. In a few instances, the animation department (Terry Windell, Peggy Tonkonogy) supplied drop-shadows on the background, so it would look like the bikes were really in the shot.

As is the case with so many things when working against a deadline, it takes many people to help meet it. There were quite a few people who made contributions to the puppets. "The number of people required for a given project is usually a function of the deadline you are racing to meet. You're always fighting deadlines. So, you run over to someone and say, 'Do

you have a few extra hours to make miniature shoes for the Elliott puppet?' With three films in here at the same time, we were going crazy," Lorne Peterson admits.

One time and budget-saver was to cut down on the number of puppets and miniature bicycles. There were only three bicycles and three puppets used, but there were five interchangeable heads; all sculpted, built and dressed by as many people as could be pressed into action.

"Everything that's done at ILM is really a group effort," explains Peterson. "Everybody asks around for advice and help and everybody is glad to give it. It's impossible to list in the credits all of the contributions made by all of the people involved."

In the aftermath of all of the furor and with the success of *E.T.*, *Poltergeist* and *Trek II*, it is interesting to note that of those three films, it was the little film, the low-budget "quickie" that won the hearts of so many people worldwide.

Perhaps the story's strength has something to do with that. For *E.T.* is not a special-effects film in the traditional sense. Here, special effects have been used not to create a futuristic world, but a character. But through that character, we glimpse in our imaginations a world that is wholly the creation of the filmmaker and the movie magic of a team of inventive craftsmen.

NEW WORLDS ABORNING

**The visual effects artists at I.L.M.
create new worlds with the Genesis Effect.**

For Jim Veilleux, it was a chance to play god. As one of the effects supervisors for *Star Trek II*, he faced the task of transforming a dead planet—cratered, airless, desolate—into a lush growing world complete with atmosphere, vegetation, water—a primeval Garden of Eden.

In the film, the machine which is supposed to do all the work is a shiny, glowing device which produces something called “the Genesis Effect.” Effects supervisor Veilleux relied on the modern magic of optical and computer special effects imagery to create the required illusion.

The lush Garden of Eden settings for the planet’s surface were created with a series of matte paintings and sets, but the visualization of the Genesis Effect on the entire planet as seen from space required something more complicated, less traditional.

Only a few steps away from George Lucas’ famous Industrial Light and Magic special effects facility is his computer graphics research team, also part of the Lucas complex in San Rafael.

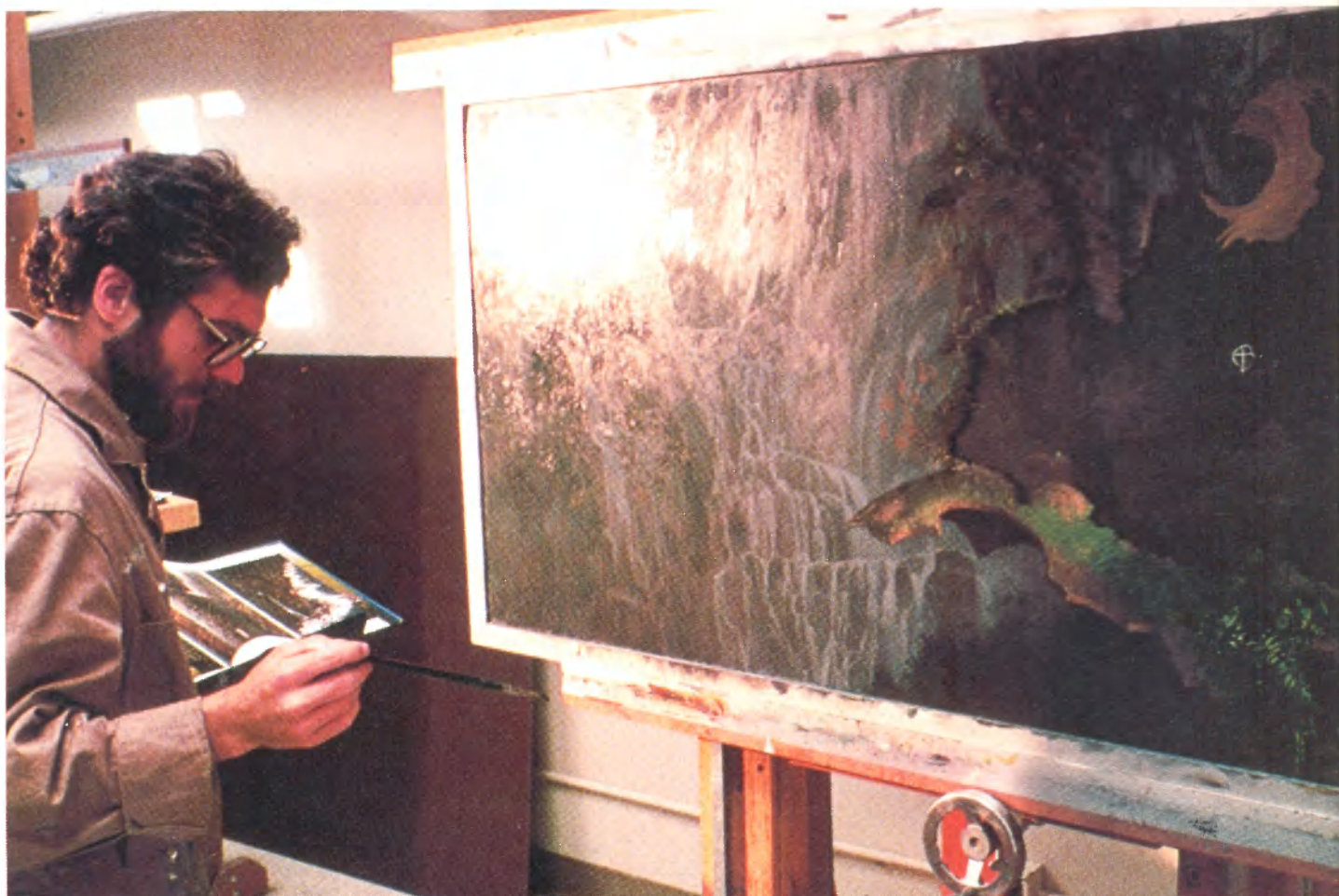
Veilleux was aware that the computer graphics team was essentially involved in research and development as opposed to production, but he thought that the team members might be able to make an unusual contribution to the effects on *Trek* and simultaneously advance their own research efforts. The sequence Veilleux had in mind for the young computer team involved the demonstration of the Genesis Effect that Kirk displays for himself, Spock, McCoy and, of course, the audience.

Jim Veilleux explains what he had in mind: “The film’s producers wanted some way to demonstrate the terrible power of the Genesis Effect; the demonstration had to be of such a nature as to motivate Kirk setting off across space with a crew of raw trainees. It was important to convince the audience how powerful and potentially dangerous this Genesis Effect was and to cast the situation with a sense of urgency.

“Originally, the script called for a small scale laboratory demonstration in which an inorganic block of matter

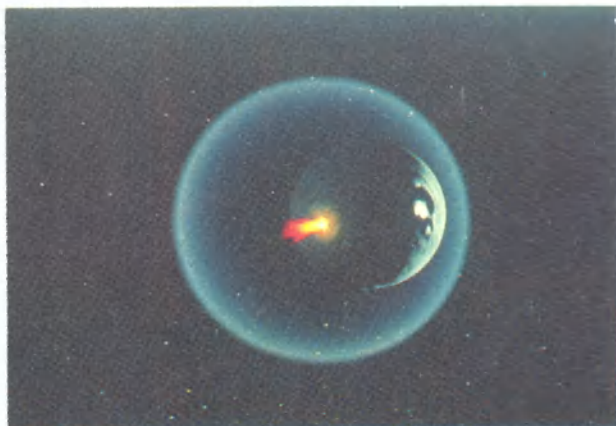


Above: Stage 5 at Paramount was the site for the lava bubble set, which ILM matte artist Chris Evans extended considerably with a matte painting. **Below:** Chris Evans at work on the painting for the above set. The ILM artists occasionally use different media on a single painting; the basic painting is usually laid out in acrylics with details being worked in oils.

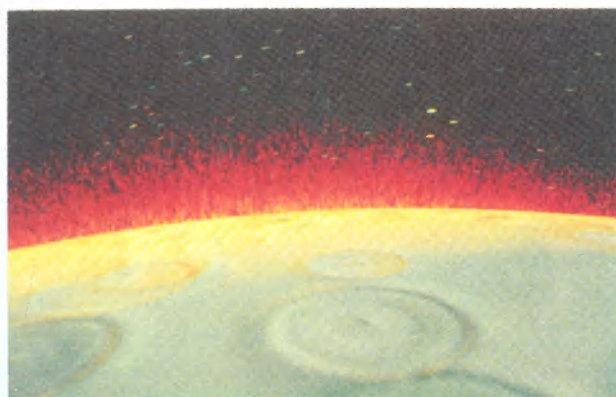




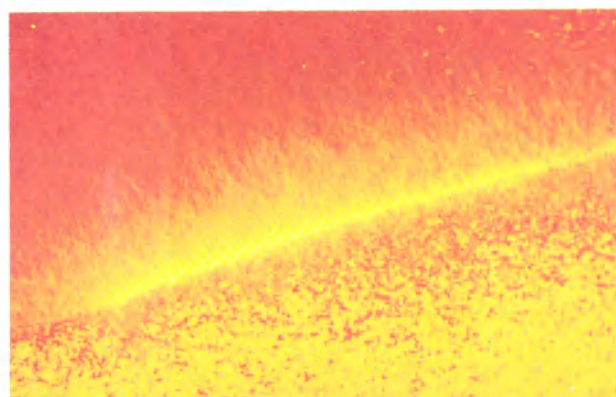
1. Genesis projectile heads for deserted moon.



2. Impact and shock wave.



5. Firestorm raging around planet.



6. Entire surface becomes molten.

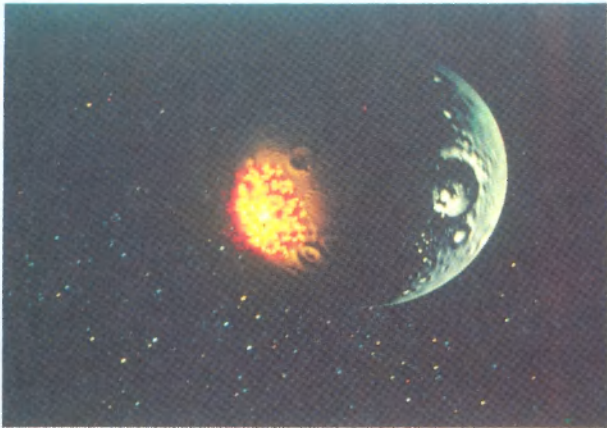


9. Seas and greenery develop.

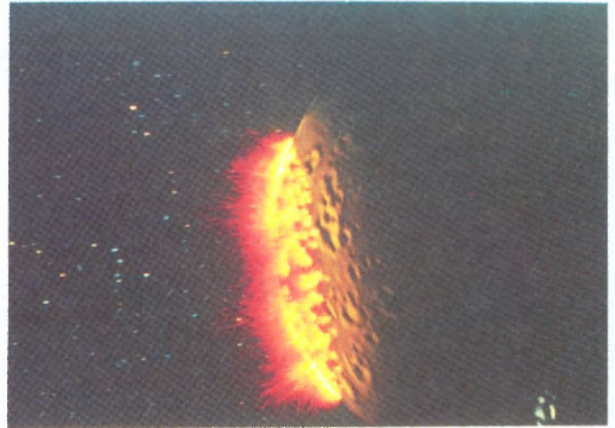


10. Valleys deepen and mountain tops whiten.

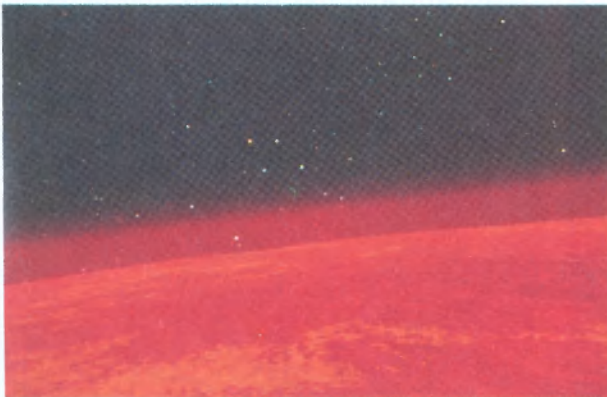
THE GENESIS EFFECT



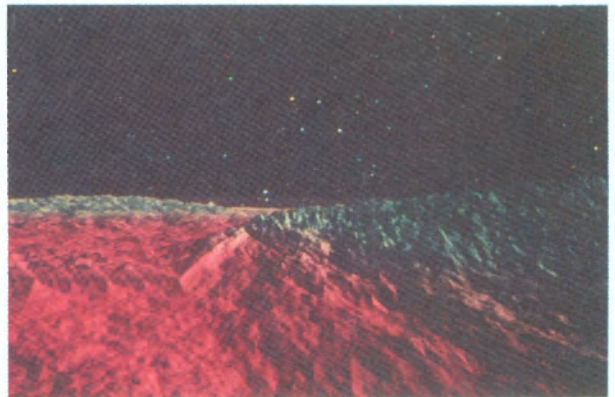
1. Firestorm starts.



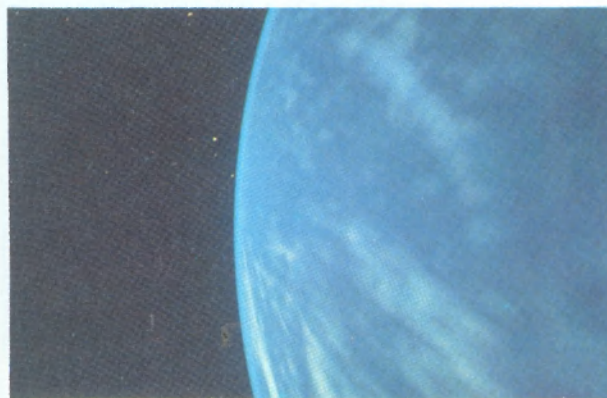
4. Crater grows and spreads across surface.



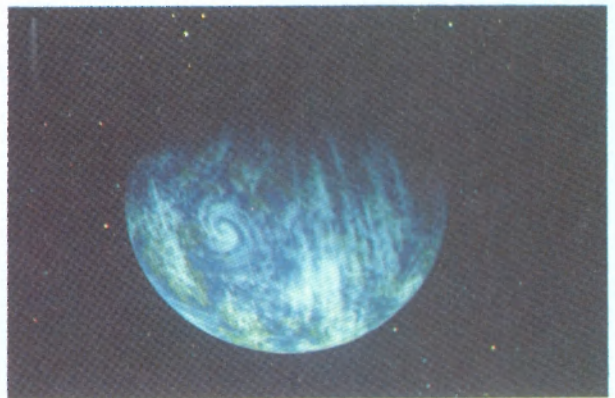
7. Cooling process begins.



8. Surface cools and mountains grow.



11. Camera begins to zoom away into space.



12. Finished planet—computer painting by Chris Evans.



Above: The Eden Cave paintings. The top and bottom paintings are “full” paintings, the middle painting has a black area for the insertion of the live action plate (see page 63). **Inset:** ILM matte artist Frank Ordaz.

PHOTOS: © 1982 PARAMOUNT PICTURES

would be transformed into a life form, such as a flower.” But this demonstration just didn’t have the dramatic impact to do the job required.

“We discussed any number of alternative visualizations, but it was very difficult to come up with something that was visually interesting without being ludicrous. So, like most people today with problems that are hard to visualize, we thought that a computer graphics simulation might be the answer.”

Genesis Demo

Veilleux met with Ed Catmull, Alvy Ray Smith and Pat Cole—all members of Lucas’ computer graphics research team—and asked them to consider doing the following scenes for the Genesis Effect demonstration sequence:

1—A molecule sequence showing the transformation from crystalline inorganic molecules to DNA-type organic molecules, illustrating the Genesis Effect in a “schematic” form.

2—A planet-size demo, showing the transformation of a dead planet—cratered, airless and desolate—into a lush growing world complete with atmosphere, vegetation, water, etc.

3—A voice recognition sequence for positive identification of Captain Kirk, that would gain him access to the Genesis Effect demo.

4—A retina recognition sequence for further identification.

Alvy Smith suggested that the molecule sequence be turned over to Bob Landridge of UCSF, who had already created a computer graphics simulation of DNA molecular bonding. Veilleux contacted Landridge and the sequence was created by manipulating the program that Landridge had on hand. Paramount dropped the voice recognition sequence early on, leaving ILM with sequences two and four. It was decided to keep the retina sequence as simple as possible and focus the real razzle dazzle on sequence two—the Genesis Effect demo.

It started out fairly simply. The storyboards called for a very elementary sequence of moving in on a Moon-like planet, firing the torpedo and having fiery energy form shock waves over the planet’s surface.

Then, after a white-out transition, the camera moves across the planet’s surface and pulls back to reveal the finished surface. “It started as a fairly simple shot,” recalls Veilleux, “but once people like Alvy Smith and Loren Carpenter got into it, they came up with their own ideas. The Lucasfilm computer research team isn’t just a group of programmers, these people are very gifted designers and artists in their own right. So, it was very natural to expect them to embellish the sequence and in the end, they made it just that much more interesting.”

Genesis Flyby

And embellish they did. Carpenter believed that audiences had become quite familiar with the JPL planetary flybys which had been generated by James Blinn at JPL and shown frequently on national television as part of the news media’s coverage of the Jupiter and Saturn Voyager flybys. And that, therefore, they would be ready for something more complicated.

“The full idea,” explains Carpenter, “was that our imaginary camera would be attached to an imaginary spacecraft approaching the dead, Moon-like planet from below. It would then swing about the planet in a parabolic trajectory near its surface, while the on-board camera would execute a large spiraling move to portray departure from the planet ‘upside down’—i.e. from above”.

As the spacecraft approaches the dead planet, it fires a sperm-shaped projectile at its surface to bring it to life and then flies over the resulting ‘Chaos’ and eventual mountain-building process. The portion of the trajectory near the planet lasts long enough and is close enough to show off Loren Carpenter’s mountain-building program on its surface and then pulls away, revealing a live Earth-like planet.

Jim Veilleux was pleased with this idea, but still the plan developed further. “The principle alteration when I presented the plan to the rest of the graphics team was to invert the camera move so that we approached the planet from above and departed from below. There was quite a bit of

debate as to whether this motion was too dramatic or not. I argued that what would be happening on the surface was so overwhelming that the long twisting camera move would only be icing on the cake for those who chose to notice.”

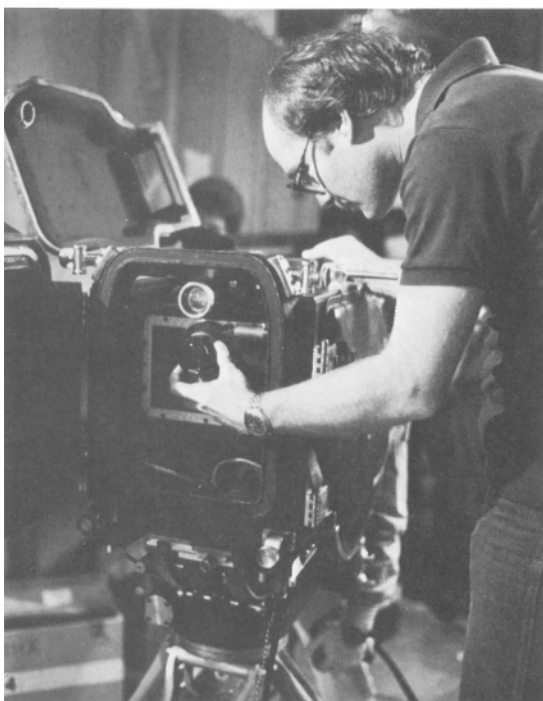
The entire flight path was tested in black and white vector graphics (black and white outlines) to preview the speed and determine the sequence’s length. The next step was to develop full raster graphics—texture, lighting, color, etc.

Veilleux picks up the story. “The work was split up between eight people who worked on the sequence over a period of five months. Of course, most of that time was spent developing techniques that they didn’t have.” Among the requirements to produce this sequence were: a texture mapping program, a paint program, a compositing program for combining elements and motion-blurring programs. Many of these programs were already in development. One of the most interesting is a technique that Loren Carpenter has been working on that deals with a branch of mathematics called *fractals*. Working with fractals, Carpenter has been able to produce some startlingly realistic landscapes, entirely with mathematics. You can see his mountains in the sequence’s middle. They are created strictly mathematically—inside the computer without any visual reference at all. In fact, everything in the sequence is mathematically generated except for the final shot of the finished planet which is a computer painting by Chris Evans.”

Accurate Stars

The project was broken down and tasks were assigned. Tom Duff did the cratering program. Pat Cole generated the projectile. Bill Reeves came up with a fire-rendering program. Carpenter created the fractal mountains. Carpenter and Cole worked together on the shock wave. Rob Cook and Duff colored and texture-mapped the planet. Tom Porter developed the paint program and Carpenter worked on the star field.

Incidentally, the stars are not just random points of light. That star field was developed from the Yale Bright



Jim Veilleux replaces a lens on the VistaVision camera used to shoot the live action special effects plates. Note the field view lens at the top of the camera, used by the cameramen to line up a shot with this non-reflex camera.

Star Catalog of 9100 visible stars. "Loren converted the data base into xyz coordinates and deduced the colors of the individual stars," says Smith. "He had the notion of choosing a location for the Genesis planet in a part of the heavens which would place recognizable constellations in the background. He and I perused one of my astronomy books and came up with the five nearest stars for which there is some hope of having planetary systems. For one of these, Epsilon Indi, Loren determined that the Big Dipper would be visible in a form not too distorted from our Earth view of it. Furthermore, our Sun would appear as an extra star close to this constellation!"

As far as Paramount was concerned, it wasn't necessary for the stars to be accurate, but the Lucasfilm computer graphics team is a research and development group and they have the luxury of being able to take the time to please themselves as well as merely deliver the goods.

With the flight trajectory determined, Bill Reeves' fire-rendering program developed and Carpenter's fractal landscapes working well, Alvy Smith was still having problems with the "chaos" scene. Smith knew that he wanted to use Bill Reeves' fire-

storm program, but how...?

"I sat down with Loren to brainstorm a solution," Smith recounts. "We did away with the exploding volcanoes idea and came up with the notion of an expanding ring of fire which would spread like a prairie fire from the point of impact, melting the planet's surface in its wake. I added the notion of losing the fire for a moment behind the rim of the planet, because of the camera move, and then having it dramatically reappear, very close and very large, swooping across the screen conveying great heat and fury—enough to melt a planet. Loren suggested using this racing wall of fire to sweep our attention across the planet in a swooping pan to the mountain-building portion. This was to be our transition sequence. It required Loren's adding a fire indication to his flight-path program to allow us to choreograph the spread of the fire and time its sudden reappearance from behind the rim of the planet. As it turned out, Bill required a quite complex 10-step matting process, using Tom Porter's matting program to achieve the effect.

"Loren solidified the fractal sequence into its final form—a cooling of the red-hot liquid surface caused by the wall of fire, cooling through the yellows, reds, oranges, to gray, while the mountain began to grow through the haze which was created by the fire. This haze would later become the atmosphere of our final Earth-like planet. The imaginary spacecraft was speeding at 50,000 to 100,000 miles per hour across this forming surface. As the mountains reached their final altitude (Everest-like), oceans rose to sandy shores, greens spread across valleys and slopes and snow appeared on the peaks. Rob Cook supplied the color coordinates of these natural elements and found atmospheric models from which Loren later derived his atmospheric generation program."

Painting Computer-Style

Months of work was finally coming together in the early months of 1982. The sequence was to be finished by March 19. Several tests had been shot and shown to both Jim Veilleux and producer Bob Sallin, who were pleased with the progress and offered

encouragement. With final touch-ups and tweakings underway to complete the sequence—motion blurring, coloring and other program refinements—it came time to call in the ILM matte artists to unveil Tom Porter's computer paint program.

The paint program is a wonder of flexibility and ingenuity. Sitting at a computer tablet, an artist can "paint" electronically onto a video screen. The Lucasfilm paint program enables the artists to select different types and styles of brushes and brush techniques or even air brush. Using the computer tablet, the artist can work in water colors, oil technique, dry brush, or even finger paint. You can do Chinese brush effects, flat brush, round brush, scumble... and there is the color palette. The paint program enables the user to select something like 16,000,000 different colors. A good microcomputer system might supply 256 colors, but the Lucasfilm program leaps far beyond that.

ILM matte artist Chris Evans tackled the job of painting an Earth-like texture map at the computer, which was then mapped, using Tom Duff's program, onto the surface of a sphere to create the final live planet.

The completed sequence is a masterpiece of computer graphics art, complex moves, thousands of colors, smooth lines and shadings (no "aliasing"—stair-steppy or jagged lines). Graduated shaded ramps along the lines eliminate the "jaggies." The final filming was done by a crew from ILM using the Empireflex Vista-Vision camera. ILM wanted to simulate a videotape effect so the Evans and Sutherland monitor was over-focused to make the raster lines stand out.

Today, the Computer Graphics team is hard at work with the hardware staff (headed by Rodney Stock and including Gary Newman and Adam Levinthal) designing the Pixar—the Lucasfilm digital printer. The Pixar is really more of a picture computer than a digital printer. Loren Carpenter explains, "Once the Pixar digitizes a frame of film, we can go in and combine images, hand paint, change shapes... tasks far removed from the simple matting and printing chores of the standard

optical printer." David DiFrancesco is constructing the laser scanner input/output devices, which will enable the team to work at very high resolutions.

What do all of these new tools mean to the artist, animator or filmmaker? Alvy Smith is quick to point out that the new computer hardware and software systems are tools.

"Computers don't paint, artists paint," he says. Computers don't replace people, they *require* people. These new tools are the hope of future filmmakers to bring down the ever-escalating cost of high quality production while enabling more work to be produced for less money with even greater production value. They are the tools of tomorrow, but like any tool they require the human mind to operate them. As designer Alvy Smith puts it, "Computers create the motion, we create the emotion."

The Mattes

It's the most difficult situation imaginable for a matte artist. It's the moment in *Star Trek II—The Wrath of Khan* when the interior of the Eden Cave is revealed to Admiral Kirk. The camera homes in on Kirk's face alive with light and wonder as he surveys

the newly born Eden Cave—life created from inorganic matter. The next shot reveals the Eden Cave to the audience. The awe that is projected from Kirk's face should now be felt by the audience as they see what he sees.

But what the audience sees doesn't *really* exist. It can't. The Eden Cave is a special effect—in this case, a painting. And that's where the difficulty lies. A matte painting is a flat, static piece of artwork. Bringing that painting to life so an audience can accept it as reality is one of the most demanding tasks that a special-effect artist faces. But it is central to the art of special effects and the absolute measure of an effects artist's skill.

For *Star Trek II*, the matte department at George Lucas' effects facility Industrial Light and Magic, created paintings for the sand planet, the Genesis planet (Gamma Regula) and several paintings of nebulae and colored gas clouds (though not all of those nebulae shots were generated in a tank as one might think). They even created the moon Ceti Alpha V as a model. Assigned to the film were matte artists Chris Evans and Frank Ordaz, matte cameraman Neil Krepela, and assistant Craig Barron. At the time, ILM's staff and facilities were divided among *Poltergeist*, *E.T.*

and *Trek*, and the matte department was also working on six shots for *The Dark Crystal*. Of all the paintings that were produced for *Trek*, the most problematic featured the Eden Cave.

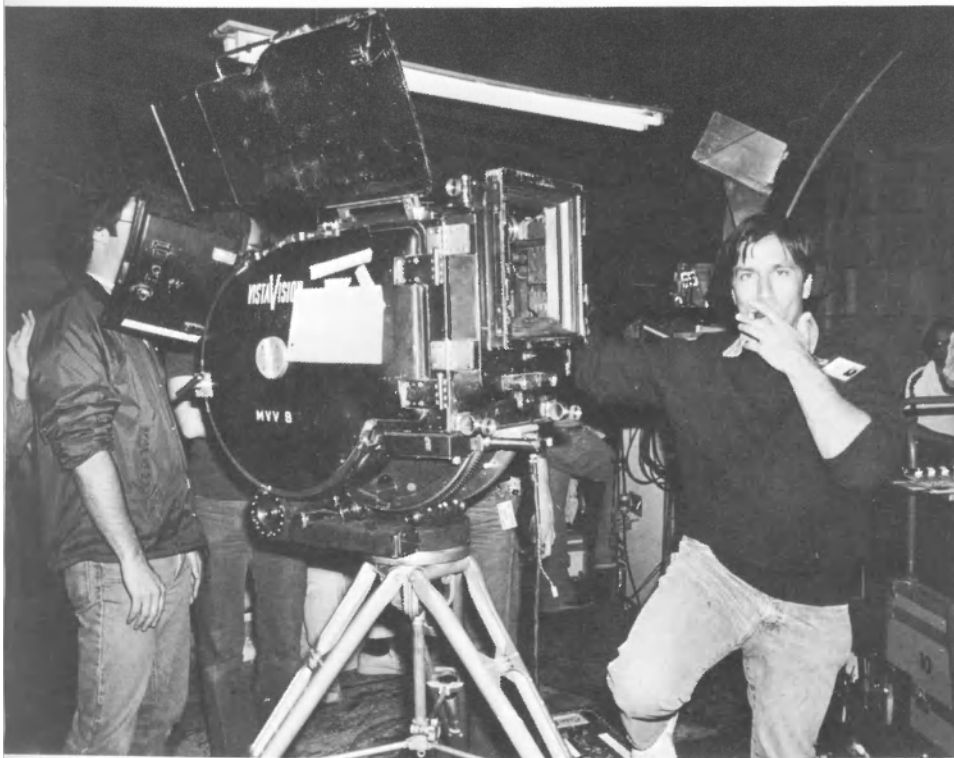
Into the Eden Cave

In the film, the Eden Cave is created as a test of the Genesis Effect. The Genesis Effect has the power to produce organic molecules; in a matter of a few hours or days, a dead, barren rock or a world can be transformed into a lush, living planet. Production Designer Joe Jennings and Art Director Mike Minor created the visual concept for Eden Cave—a sight which lights up Kirk's face with awe and wonder.

"The concept for the Eden Cave was hammered out by Joe Jennings and myself," begins Art Director Mike Minor. "In the script, Dr. Carol Marcus [Bibi Besch] explains that the cave was created in a day ['The matrix formed in a day. The life forms grew later—at a wildly accelerated rate. Can I cook or can't I?']

"I mentioned to Joe Jennings that I remembered enjoying as a kid the caverns in William Cameron Menzies' classic *Invaders from Mars*. The cave passages were created by the heat of alien ray guns. The rock bubbled and melted under the rays of the invaders' guns. I remember reading somewhere that the bubble effect was created with condoms—they were pumped up and stuffed all over the place!

"Joe laughed and then suddenly got a wild look in his eyes. 'Hey,' he said with a slow grin. 'You know what we can do? Suppose we took that effect and enlarged it. Supposed this whole cave forms in a moment—the rock bubbles and bursts, small and large bubbles form, burst and instantly cool. This Genesis Effect is supposed to be an accelerated process—millenia going by in seconds—suppose in those seconds, the rock *doesn't* reconstitute into other forms, but maintains the shell form after the heat goes away? We had a great time bouncing ideas back and forth and decided that the cave formed of bubbles—from a mere few inches to hundreds of feet wide—would make a fantastic cave. So, we did some drawings and



Director Nick Meyer pauses beside one of the huge VistaVision cameras used to shoot the special effects sequences. This is the same type of camera used for such film spectacles as *The Ten Commandments*.

created some models. I brought in a glass globe which had broken into a very interesting pattern and used it to model some storyboard sketches which later went to ILM."

It was a fantastic idea. Supremely unearthly in concept and design. Carol's line in the script suggests something of the spirit to be invoked when she tells Kirk, "Let me show you something that will make you feel young—young as when the world was new." She takes him by the hand through a tunnel leading into the Eden Cave formed by the testing of the Genesis Effect. A small portion of the Eden Cave was built on the Paramount lot to serve as a backdrop for close-ups of the actors and as background set for the piece of live action to be inserted into the matte paintings.

Live-Action Work

The photography of the live-action plates for this effects sequence was supervised by Jim Veilleux of ILM. "Paramount set aside part of a day for us to get the live-action shot for the plate," remembers Veilleux. ILM prefers to use a large format negative for their effects work and, for this shot, they had one of the old Vista Vision cameras—the same type used in such Paramount spectaculars as *The Ten Commandments*.

"The camera is just enormous," Veilleux says. "Just to move it requires two large pipe batons and four people. The pipes are inserted through clamps in the camera's front and rear which four grips use to hoist the camera into a new position. It weighs about 400 lbs. and isn't very quiet when it's running. The sound man had some trouble with it. Normally, you don't attempt to record sound when you are shooting plates, but we wanted to save money on the production and then too, we were operating on a very short schedule.

The plates for the Eden Cave mattes were shot on platforms 30 feet in the air, to show that the cave extends far above and below Kirk's position. The set was lit by Gayne Rescher to suggest a single light source, since Eden came equipped with its own artificial sun. Further, the lighting had to be arranged to keep the contrast down as

much as possible. "When we go through the matte process," explains artist Chris Evans, "the plate is duped; in fact, it gets duped twice before it shows up in the theater. If the lighting ratio is too high, the contrast will really kick up when the shot is duped.

"Frank Ordaz and I did the three paintings for the Eden Cave," Evans admits. "Frank did the reverse shot of the full cave, and I did the first one [Kirk's point-of-view] and the painting with the sparkling water and moving light, and also the closer shot with the waterfall." The paintings were photographed and composited by Neil Krepela and assistant Craig Barron.

"The photography of the paintings is very important," explains supervisor Veilleux. "Painting is very static by nature so, over the years, matte artists have developed a number of techniques to introduce motion (surely the essence of life) into paintings—animated light effects or camera moves to create the illusion of motion and life where there is only a flat painting."

Among that bag of tricks are such techniques as multi-plane paintings which allow the illusion of perspective changes and give the camera the ability to move through a painting; silhouette effects with live action in which shots of moving branches, for example, are bi-packed in the matte camera to create the effect of a live moving foreground element; animation effects such as light sparkles, moving clouds and reflections which are usually filmed in a separate pass; or even such individually photographed elements as smoke and fog which can drift across a matte painting to add life and interest. Several of these techniques were used for the Eden Cave mattes.

Cave Paintings

"We felt the first painting, which had painted foreground trees, would be enhanced if the foreground trees, were moving," explains assistant matte cameraman Craig Barron. "So, we went all around the building, collecting people's potted plants, set them up on a stage, and shot them back lit, so we could use them as a

moving foreground element. This film is then used bi-packed in the matte camera when the painting is photographed and achieves the effect of a dark moving tree silhouette in the foreground. Hopefully, this movement can distract the audience from staring at the matte painting or concentrating on any one element until you can get off the shot and move on to the next, probably before they're aware that they are looking at artwork.

"We also had these shards of light hitting the cave's wall and giving the impression of a sunrise from the cave's artificial sun. For this effect, Chris created a separate painting of the highlights, which I double-exposed as a separate pass. This additional pass was set up with a black card in front of the highlight painting, which was then used to 'wipe on' the highlights across the painting.

"Also, we added sparkles to the water. Chris carved tiny holes through the painting of the water. These holes passed bright light reflective off of aluminum foil placed behind the painting. A separate pass through the camera for these little highlight kicks suggested the sparkling water effects."

"I painted in the waterfall a bit darker than we wanted it to appear," begins matte artist Chris Evans. "The moving effect was created by scraping away some of the paint to reveal a motorized roller which was covered with cotton. Neil Krepela separated the different tiers in the cascade, exposing them separately so that each tier would seem to fall at a slightly different speed. We tried to get the effect of water just dropping over the top and gaining speed as it fell. Unfortunately, it came out a bit overexposed and a little too diffuse. It was not a very subtle effect; it could have been with a bit more time, but time was very short."

This moving cotton technique was first made famous by Albert Whitlock who used it to create the enormous sandstorm in *Bound for Glory*. Whitlock is something of a legendary hero-of-the-art to the members of the matte department. "Albert Whitlock gave a seminar on matte painting and effects at the Academy. His shots



The *Star Trek* cast rehearses a scene on the Eden Cave set on Stage 5 at Paramount.

PHOTO: 1982 PARAMOUNT PICTURES

were flawless and very well integrated. Many times you wouldn't even have thought it could possibly be a matte shot," says Evans.

At one point, it was suggested that live-action plates of lush tropical greenery be used instead of matte art for the Eden Cave. But the script refers to an "iridescent light . . . blindingly beautiful with color . . ." And then of course, there are those other lines ("Can I cook . . .?").

Art Director Mike Minor remembers Production Designer Joe Jennings' reaction to the suggestion of location photography rather than matte art. "It is bad science fiction, in my estimation," says Mike Minor quoting Joe Jennings, "to postulate a brand new environment and then,

present something to an audience that looks like anywhere on Earth—something that has erosion, age, overgrowth, and all the details of an ecological system that has been evolving for millennia."

It's a unique advantage that painters have over photographers. A cameraman can record reality, even manipulate it, cut it apart, and reassemble it into new forms, but a painter is limited only by his brush, skill and imagination.

Technical Challenges

Although ILM is equipped for both front and rear projection compositing of matte paintings, rear projection was used on *Trek II*. Generally, the plate is a low-contrast print which

is rear-projected into the live-action area of a painting. If there are problems, the plate is broken down into black and white separations—a technique which has been successfully used at the Disney Studios.

Full matte paintings are always a challenge. It's an entirely different matter when the matte artist has only to add a roof to a live-action set or continue the perspective lines established on a location. But it's another matter entirely when the *entire* frame is painting and there is no place to hide. Then, an artist must only paint what's in the script. "Of course, it's the art director and production designer who decide how things are supposed to look," affirms Evans, "and it's our job to match his vision."

THE World of THE DARK CRYSTAL

Jim Henson, Frank Oz and Brian Froud create a magical world of life and mystery in which no human dwells.

It's another time and another place . . . a world not ruled by science, but by magic and sorcery. None of its inhabitants are human and some of them resemble our worst nightmares. It is a world torn by unfulfilled prophecy. Welcome to the world of *The Dark Crystal*.

This fantasy/adventure film, which has been some four years in the making, represents for Jim Henson, the culmination of 28 years as a puppeteer and the next evolutionary step in puppetry.

Henson, born in Greenville, Mississippi, grew up fascinated by the likes of *Kukla, Fran & Ollie* and Bill Baird's marionettes. Building his own puppets at age 17, he entered the world of show business on a local television station—only to have the show fold on him in three weeks. A year later, he began a long-running show, *Sam and Friends*, which took a local Emmy award in 1959. Two years before, Henson's first version of Kermit the Frog debuted on *The Tonight Show* with Steve Allen, and, soon Muppets populated prime-time variety shows such as *The Ed Sullivan Show* and *The Jimmy Dean Show*.

Working alone at first, Henson quickly took on Jane Nebel as a fellow performer and after four years, they were married. They continue to work together today. The pair developed puppets which went beyond the usual sort of puppets seen in George Pal's *Puppetoons* and Gerry Anderson's supermarionation shows. It wasn't long before the name Muppets became accepted and the band of characters grew, and grew.

In 1969, Henson worked with the new Public Broadcasting System on a children's show that became the award-winning *Sesame Street*. Bert and Ernie, Big Bird and Oscar the Grouch soon became household names, along with Muppets. A few years later, after having been turned down by all three networks, Henson began *The Muppet Show* in England with Lew Grade which, after five years, became the most successful syndicated show of all time. In reruns now, the show still commands high ratings.

Henson, who was looking for new ideas during the last year of *The Muppet Show*, decided to create a new story starting from the visual stand-

Facing page—

Gelfling Jen, crystal shard in hand, makes a desperate leap at the climax of *The Dark Crystal*. This scene and a few other shots were performed with a small actor dressed as Jen rather than a puppet operated by Jim Henson.

PHOTO © 1982 TANNIANT





One of the Skeksis gets a quick touch-up for one of his many pairs of glasses that are arrayed on his beak.

PHOTOS BY MICHAEL BENTLEY

point. The idea was eventually refined while all that was needed was the time and technology to pull it off. At about the same time, Henson and partner Frank Oz were approached to help create Yoda for *The Empire Strikes Back*. The duo met producer Gary Kurtz, who struck up a friendship with the two men. The trio began talking about *The Dark Crystal*.

"The project was Jim's from the very beginning," explains Kurtz. "He has dreamed about this for a long time—since before the first Muppet movie. He had been working on ideas for creatures for some time before he asked Brian Froud to join the project. Jim wrote the story. We all worked with the screenwriter, David Odell, but, basically, it was Jim's project."

Henson sought out British fantasy artist Brian Froud to help develop the fantastic world and its inhabitants. Since the entire film was to be made without human actors, everything had to be worked out on paper first. Froud, best known for his *Faeries* and *The Land of Froud* volumes, brought Henson's ideas to life. Meanwhile, Henson, Oz and Kurtz began working on the logistics of constructing and operating the various characters needed for the story.

Sherry Amott was brought on as Creative Supervisor for the Animatronics Department. New mechanisms were developed, tried, discarded and refined for each new life form—some 70 species in all were created. More than 900 pounds of foam latex were used to help fashion the creatures, who were given such exotic names as Skeksis, Gelflings, Fizzgigs and Landstriders. Makeup

effects wizard Dick Smith was called in for some consultation once serious work began.

Dozens of performers had to be trained to use the new devices and the animatronics process, since it was so far advanced from Muppets, or even Yoda—a breakthrough creature itself. It took up to five or six people to manipulate some constructs, while others required only a remote-control operator. Everyone was working with video cameras and screens to watch how the various pieces fit into place. Unlike most live-action filming, this was a long, slow process.

When all the characters were designed and an initial story developed, screenwriter David Odell was brought in to prepare a shooting script. By then, Henson and Oz had decided to co-direct. Production was scheduled for London so the two could continue *The Muppet Show*.

"Once the preparation phase was more or less completed," continues Kurtz, "and we got into the actual shooting, I felt it was my job to take all the producer-type problems away from Jim so that he and Frank could concentrate on directing. I insulated them both from dealing with laboratories, any crew problems, and things from outside the studio. That's



Jim Henson conducted a workshop twice a week during production for prospective puppeteers. Some of his students performed as background characters in the crowd scenes. As you can tell from the photo, a puppeteer has a strong right arm. Most of the Pod villagers and slaves are standard hand and rod puppets, usually only requiring one person to manipulate them, though several persons were needed to operate the Pod musicians. Sherry Amott oversaw the construction, fabrication and realization of these characters.



Celebration at the pod village. Frank Oz facing forward has his eyes glued to a TV monitor which gives him a camera-eye view of the action.

generally what a good producer is supposed to do, freeing the director to concentrate on the day-to-day work which really needs to get done during the actual photography.

"Jim originally invited me to join the project when I first went to him to discuss Yoda for *The Empire Strikes Back*. The challenge of making *The Dark Crystal* was intriguing. I was excited at the prospect of a film in which there are no human beings, in which fantasy creatures must come alive for the audience. It's one thing to have a Yoda or E.T. inter-reacting with several human actors, where you can hide the problems: you can always cut away, you don't have to show very much, you can keep the creature in the dark. There are many ways to avoid those technical problems and we use them all the time normally. But, when you've got 90 minutes with just creatures—no people—they must be believable on the screen or you won't enjoy the story. I thought it was a unique

problem."

But how can filmmakers know when they have reached that level of believability?

"It's difficult to say," Kurtz admits. "Some people will probably like the finished film and some people won't—just as they would with any film. In making a movie, you use your own judgment really—you satisfy yourself, what works for you. Some people in the audience will disagree. I go to see films all the time and say, 'Why did they do that? Here's a really great scene, but this other bit here undercuts it for me.' That's just my personal reaction. Obviously, the filmmaker felt it was fine for what he wanted.

"An interview of any audience will result in many different opinions. There are things in *Star Wars* which are just marginally acceptable, and yet, no one seemed to notice them. Audience members complained about other things that we thought were terrific. You can't be too wor-

ried about it; it's just personal opinion, although obviously audience reaction is important since you must recoup your investment. So, you give the audience peripheral consideration, but everything is filtered through your own value judgments. That's what you rely on first. Some-



Frank Oz directs a background character.



An early model of Kira. The Gelflings went through a long process of development. Very subtle movements, necessary for the puppets to look real, were extremely difficult to achieve.



An early life study of Jen. Great care was taken with the anatomical detail of the main characters. This is particularly true of Jen, since originally the film opened with a nude swimming scene.

times it's good, sometimes it isn't. Sometimes, you can do a film that you really like and feel good about, but the audience just isn't there in sufficient numbers. There have been some very good films which have never been popular as well as some terrible films that have been very popular. You never know. It's like rolling dice. The gods up there who deal with movie distribution either smile on you or they don't."

Screening for Changes

When a producer is working in new territory, preview screenings are frequently held to obtain some measure of an audience's reaction. Such screenings often result in critical changes. For example, after a pre-release test of *Close Encounters of the Third Kind* in Texas, Steven Spielberg deleted a closing vocal of *When You Wish Upon A Star*, deciding that the tune left audiences with the wrong feeling about the film and its climax. *The Dark Crystal* was tested in Washington, which resulted in a major change in dialogue.

"One problem in fantasy film is that everybody speaks English, or if the movie is set in a foreign country,



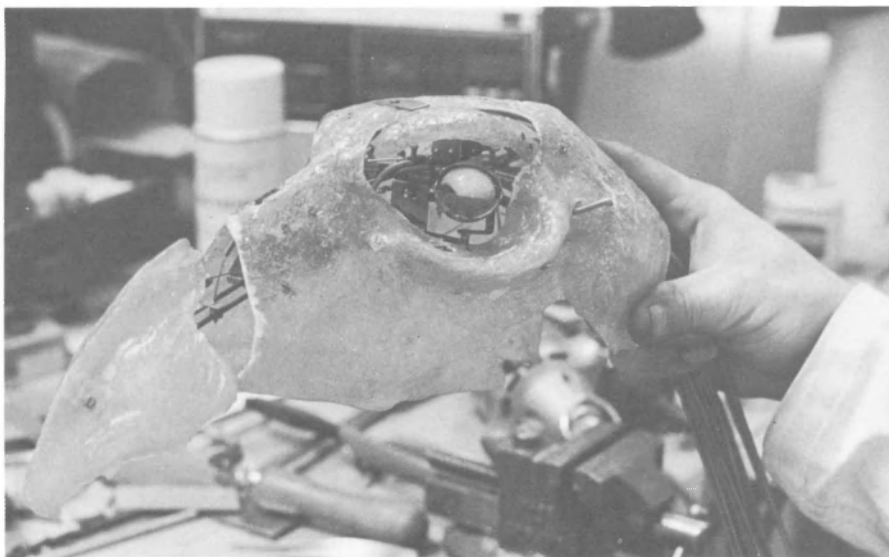
Behind-the-scenes view of the sequence with Jen (operated by Henson and assistants) discussing his destiny with one of the Mystics.



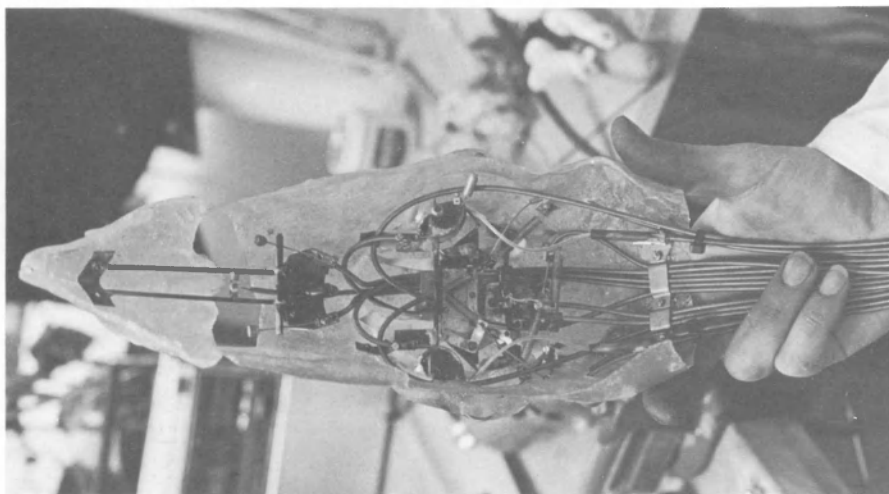
Single tears are added to Jen for the filming of the climax scenes in *The Dark Crystal*. As seen in the film, Jen holds brave Kira in his arms as the evil Skeksis close in.



Jen, Kira and Fizzgig are seen in a boating sequence midway through the film. Henson puppeteers can hold their breath for a long time!



A view of the basic Skeksis skull.



The Skeksis were more complicated to operate than the other creatures as their view of the inside of the skull shows. Up to 21 cables operated the different facial features.



Lyle Conway sculpted the Skeksis.

everybody speaks English with an accent. It's a convention of the medium. The only film to break away from this tradition in any significant way was *Quest for Fire*—and on a lesser scale, *Caveman*. The *Dark Crystal*'s script specified languages other than English for some characters.

"We did spend a great deal of time creating several non-English languages. Alan Garner worked up some quite helpful suggestions for us based on some ancient languages. A version of ancient Egyptian was selected for the evil Skeksis, but when we previewed the picture, we discovered that the audience was unhappy with it.

"There wasn't anything in the scenes that you missed by not understanding the dialogue. Everything that you perceived visually—the attitudes of the characters and the intonations—conveyed the scenes' meaning. It was very much like watching a foreign film, except that you instantly knew what was happening even without understanding the dialogue. That's the way the scenes were structured in *The Dark Crystal*.

"But the audience felt that they were missing something, that maybe there was something else in the dialogue that they weren't seeing visually. It bothered them. So, we relooped the dialogue and changed it into English.

"The Pod People still speak a foreign language—a version of Serbo-Croatian. It's not an exact language that they speak, but people who are fluent in Polish, Russian and other Eastern European languages, all say that they can recognize words, but not understand sentences.

"The idea of creating a language is tricky. Certainly, it's much easier to make up nonsense sounds, but you can sense it if it doesn't have any basis in reality. In a real language, there are certain repeatable phrases and a structure which makes the sounds mean something. You can sense this even if you can't understand it. It adds to the reality."

The Logic of Fantasy

Working in fantasy demands a great deal of homework from the filmmakers. In order for a fantasy world

to seem real, it must operate in its own logical fashion. If the world seems arbitrary or self-contradictory, it becomes totally unbelievable. Mountains can move, trees and shrubs can talk to one another, but there must be rules in order for filmmakers to build a believable story.

The production notes for *The Dark Crystal* describe a setting of pure fantasy: "... A world where no human intrudes. Each plant, tree, and bush has intelligence. Mountains move and rivers whisper songs of long ago." Although little of this background reality is specifically dramatized in the story, the filmmakers still had to go through the process of determining how things work in this fantasy world in order to make it a real universe for the audience.

"We knew from the beginning that this world had to feel right within the story's context," says Kurtz. "There had to be some sort of logic to the environment, but every detail isn't dramatized. The basic premise—the whole world is organic, everything is alive, the mountains move and talk—isn't dramatized in the finished film, because there's no time to deal with that within the story.

"In any film that I do, I always like to let the audience feel that there is life going on *outside* the frame—that we aren't showing everything. In real life, you may walk down the street and see a traffic accident. You focus on this little story, but you're aware that life goes on around that scene. The same thing happens here. Brian Froud created a religion. We never talk about it or deal with it all. Occasionally, you see its symbols—the sandpainting of the Mystics, for example—it just adds more density and depth to the environment. That type of detail can be crucial, especially in this kind of story."

Stereotyping the Genres

Fantasy stories are making something of a comeback, as producers realize that "fantasy" doesn't necessarily mean "kiddie show time."

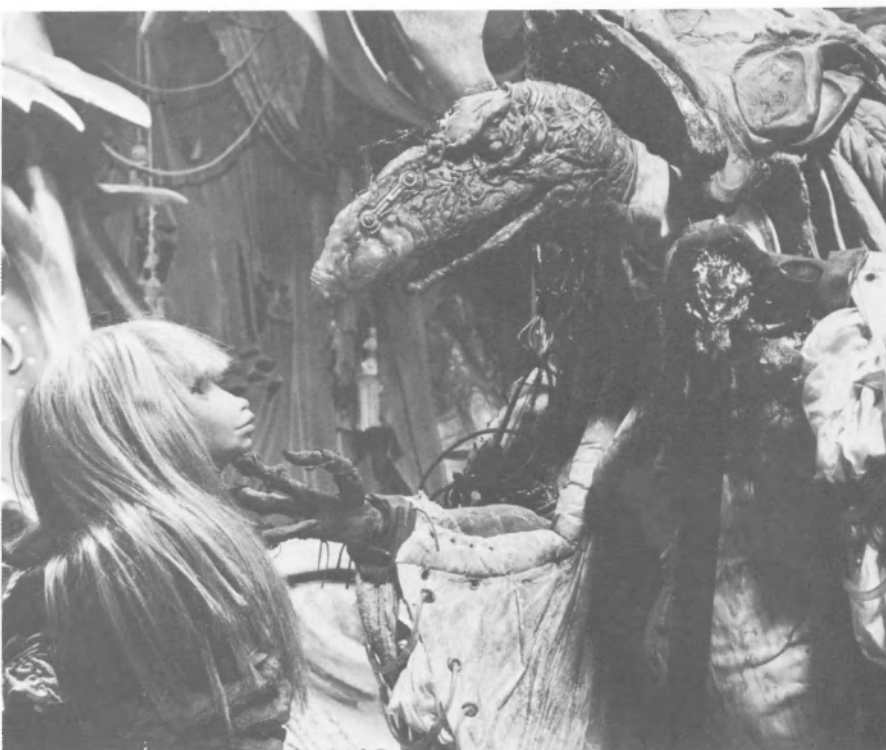
"E.T. is a case in point," smiles Kurtz. "Several people read it and turned it down, because they thought it was *only* for little kids. They saw a script in which the principal characters were not only an alien, but three



A model of the Skeksis creature. They were pretty ugly with or without clothes.



The Chamberlain was the most complicated to operate. He was even required to smile, evilly.



Skeksis with captured Gelfling Kira



The Landstriders were sculpted and developed by Valerie Charlton. An actor tries out the stilts so the sculptors can begin.



Sculptors have molded the basic form of the Landstrider to fit a human operator. The creature has a moving skeleton—a flexible spine, rib cage and pelvis.



Aughra's home under construction—a whirling orrery dominates the set.

children. The immediate reaction from most studio executives would be: "Well, there's no adult main character, therefore, there's no one for an adult, sophisticated audience to identify with, and therefore, they won't like it." The same thing happened with *Star Wars*.

"Many people who say that they don't like science fiction, went to see *Star Wars* because their children took them, and then, found out that they enjoyed it. Fantasy and science fiction must overcome a lot of negative prejudice.

"But *Star Wars* worked negatively, in a way, on the industry. Suddenly, everyone wanted to make a picture

just like it. So, what we saw were movies with spaceships and robots. Most of them weren't very good. The producers had a very narrow view: science fiction is spaceships and robots.

"I know when Warner Brothers was going to do Isaac Asimov's *I, Robot*, they had several scripts. Harlan Ellison did one which was quite good. I read it. It combined several of the short stories into one master story. But Warners kept saying they wanted laser gunfights; *I, Robot* is not that kind of science-fiction story. They had narrowed their focus on just what science fiction should be.

"That happens a lot with fantasy, too. People say that *Snow White* and *Sleeping Beauty* are fantasy stories—and they are, fairy tales—and that fantasy stories are only for little kids. Actually, there's quite a large adult audience for the early Disney animated work, because they are superbly produced and adults enjoy the stories as much as children do.

"But the field of fantasy is very broad. Fantasy uses rich characters. The genre has great story potential and power. You can deal with characters in situations which could not possibly occur in real life, though they concern real-life problems."

The same narrow-mindedness which has dogged science-fiction and fantasy film seems to be tagged to different artistic mediums as well: live-action films are for adults; animated films, for children; puppets, for infants.

Producers forget that audiences are moved by a story's dramatic power, not necessarily by the medium chosen for its presentation. Each medium has its own potential for magic, and *all* movies are magic.

Animated films are not an inferior storytelling medium, just because the networks grind out endless Saturday morning schlock for the kiddies. The Disney empire exists today because of the great power of the animated film. Puppets face the same prejudice.

"You say 'puppets' and people think of the fellow who comes to a child's birthday party and puts on a show," Kurtz explains. "The art of puppetry has a great history. In Japan, for instance, they do really marvelous things with puppets in the theater. Puppetry techniques were well-received in both *E.T.* and *The Empire Strikes Back*."

Kurtz seems confident that the story of *The Dark Crystal* is powerful enough to break through this prejudice blockade in the same way that *Star Wars* broke down similar barriers. Audiences have learned that different media offer their own magic potential and one is not necessarily "better" than any other. Once such prejudices are swept away, an audience's willing suspension of disbelief can transport them into realms unknown.



Aughra, keep of secrets, performed by Frank Oz.



Artist Lyle Conway works on his sculpture for the face of Aughra.

"I've always had a great love for fantasy and science fiction," admits Kurtz. "I enjoyed it, both in film and in literature, when I was growing up. Also, my generation is part of the first space generation—beginning with George Pal's *Destination Moon* in 1949 right up to seeing man land on the Moon.

"As far as fantasy goes, I think the cinema is an ideal medium for presentation of fantasy material—it's a way of visualizing something that's really impossible to see in real life."

It's easy with live-action films. Everyone knows that those people up there on the screen are only actors getting paid for saying lines on a cardboard set. Animated films don't show us real people, but paint on celluloid. And, of course, Gary Kurtz hasn't gone to Central Casting to hire a pair of out-of-work Gelflings. Those concerns are irrelevant; what's important is that this particular medium has been selected because it provides the most exciting, captivating, and fascinating means of telling a timeless tale. *The Dark Crystal* represents a landmark achievement for a type of film and storytelling medium whose enormous potential has been largely ignored in years past.



● Swift-moving Landstriders on the march. Their eerie walrus-like faces gave them a rather benign appearance.

GHOSTS AND GOBLINS by THE SCORE!

A phantasmagoria of spectral
hauntings is summoned up for
"Poltergeist."

It was made the old-fashioned way — the way films used to be made back in the '30s and '40s. Eighty-five percent of *Poltergeist* was shot on soundstages at MGM's Culver City Studios. Producer Steven Spielberg and Director Tobe Hooper hoped to create a supernatural tale of terror unlike anything that had ever been seen before. In order to create a visual extravaganza on such a scale every element had to be precisely controlled. They demanded mastery over all the elements of nature—sun, wind, rain . . . even life itself. To do this, the filmmakers shot the film the old-fashioned way—inside a studio.

Production Designer Jim Spencer created both the interior and exterior of the Freeling house, plus the backyard and swimming pool on MGM's Stage 12. Spencer also had to match the exterior of the house to the one that served as the principal dwelling during the company's eight days of location shooting in Simi Valley, California.

The upstairs bedrooms were constructed on another stage and equipped with a device that could trigger a

special effects earthquake. The entire master bedroom was built on a giant gimbal for the sequence in which Diane Freeling (Jobeth Williams) crawls across the walls and ceilings while being attacked by an unseen force. This is the same technique that was used so successfully in Kubrick's *2001* and even earlier in *Royal Wedding*, which featured Fred Astaire in his famous dance across the ceiling. Of course, even Spielberg has used the technique before—in *Close Encounters* with Roy Neary experiencing "zero-gravity" inside his truck parked at the railroad crossing.

But even the main set was very elaborate. "These sets were unique because we had to install a swimming pool and needed a crawlspace for special effects," Spielberg explains. "Since we couldn't dig through the concrete floor of the soundstage and had to construct another set on the stage with a removable floor, we had to build the key set 15 feet above the ground.

"What you see on the screen is a typical suburban household," says

Bob Hill, Ray Gilberti and Peter Stolz in front of the blue screen with the model record and compass mounted in its pylon.

PHOTO: 1981 LUCASFILM LTD.



Spielberg, "but when you see the number of special effects that had to occur, you'll see why we had to go to Hollywood and shoot it the old-fashioned way." Production Designer Jim Spencer worked very closely with the special effects department to create sets which would make the always demanding special effects work possible and yet not look like sets in a studio.

Producers Spielberg and Frank Marshall assembled a team of effects artists that included Mechanical Effects Supervisor Michael Wood, Special Effects Foreman Jeff Jarvis, Visual Effects Coordinator Mitch Suskin and Special Effects Makeup Artist Craig Reardon.

At the core of the massive special effects effort was George Lucas' Industrial Light and Magic facility in San Rafael. Academy Award winner Richard Edlund was the Visual Effects Supervisor. Edlund and ILM previously worked with Spielberg and Marshall on *Raiders of the Lost Ark*.

The filmmakers earmarked a full one-third of the production budget for special effects. "Believe it or not, there are over 100 optical effects

shots in this movie," affirms Spielberg. "In *Raiders of the Lost Ark*, we only used about 40 throughout the entire film."

Production began on May 11, 1981 with the dark cloud of a possible Director's Guild strike looming ominously over the shooting. Two weeks of location filming in Agoura and Simi Valley got many of the location plates in the can, so that ILM could continue working even in the event of a strike. As it happened, the production was not interrupted and filming continued at MGM.

Poltergeist Pranks

Supervisor Richard Edlund remarks that he has said it before, but it is doubly true in *Poltergeist*. "If an effects sequence doesn't work, if there are matte lines, grain, color problems, jiggles or whatever, then the audience is distracted and they lose track of the drama that the director is trying to build into the picture. *Poltergeist* presented the double challenge of creating new and unusual visual effects in a very familiar environment—the here and now of everybody's bedroom. It's a

familiar environment that everybody recognizes, unlike the fantasy of outer space or alien worlds. People know what objects in a bedroom are supposed to look like, even if they are flying around a room."

The bedroom-of-flying-objects sequence was the only sequence that relied on techniques that ILM had previously developed and were familiar with. After all, ILM has been making things fly since *Star Wars*. The only problem here was that the objects were not in space, the objects were flying around a real room. "It wasn't a fantasy situation," explains Edlund, "it had to look real. You couldn't stylize the shot in some way to make it work for you. The shot had to be flawless."

"It proved to be our most difficult blue screen sequence to date, mostly because all the action was happening in the middle ground. The objects had to appear to be flying in between the back wall of the room and the three people watching, so we made a sandwich of the shot."

"First, the room was shot with a 20mm lens in VistaVision format using our motion control camera. The

Frame blow-up of the children's bedroom with 15-20 objects flying around.



people (Dr. Lesh, Marty and Ryan) were not in the shot, they were filmed as a separate blue screen element. With the people in the shot, I wouldn't have been able to hold depth of focus.

"So, the room was shot with a pan and tilt, using our motion control camera. Then, the actors were shot in front of a blue screen with the motion control camera on the same pan and tilt. The actors were reacting to nothing but the blue screen. Then, I had to make a shot of the door jamb with a blue screen behind it again with the same pan and tilt. Then, the scene was put together in the optical printer.

"Beatrice Straight was standing directly in front of this bright closet door, but Richard Lawson was against a darker area and Marty Casella was further over on the side. When Bea looks over at him, the camera pans over slightly. It's a sweetener. I think it's worthwhile to introduce motion into an effects shot to avoid the usual static locked-down look of traditional effects sequences."

Effects cameramen Bill Neil and Rick Fichter handled the blue screen photography for each of the flying objects. Quite a lot of thought went into the rigging of each object so that it would actually appear to be flying and not supported in some obvious manner. For example, the light bulb that screws into the flying lamp had a special power cord. The multi-strand wire carrying the electrical power for the lamp was spread out into individual fine wires. These fine wires were then covered with clear plastic. The clear plastic allowed the blue screen to show through the wire so that it would disappear in the matting process, but all of the original wire strands were still there so the lamp could be lit to full power.

The horse and Hulk rider were toys that were rod-mounted for Ken Ralston to apply a little stop-motion animation to. Steve Gawley from the model shop constructed special steel strap springs for the laughing books. Bill Neil photographed them with the high speed camera, while Rick Fichter used an old Technicolor 3-strip camera that had been converted to Technirama format and mounted on the motion control rig.

The task of assembling Richard



Set and camera rotate together to produce this eerie reverse gravity effect in *Poltergeist*.

Edlund's on-set elements with separately blue-screened flying objects (the Hulk on horseback, the spinning records, laughing books, table lamp, etc.) fell to Optical Photography Supervisor Bruce Nicholson.

"It took us about nine months in optical to achieve the perfection you see on the screen in the room-of-flying-objects sequence. The most difficult shot in that sequence wasn't accepted until the very last day of work on the film. Most of the difficulty was with the nature of the background," explains Nicholson. "You had a background with a wide range of tonalities in it. There were intensely bright areas and there were much darker areas. Also, the objects were traveling all the way around the room. The intensely bright areas will tend to show a transparency in your matted objects. And also, you are pushing the quality of the lens to its maximum by having the objects move from one edge of the frame to the other. So, you have to deal with the distortion problems of the lens system and in certain instances, the distortion problems of the taking lens. The environment was familiar to everyone so if something was wrong, people would know it. Some shots had 12 separate blue screen objects to be composited into the shot. Often times we had composites that were perfect except for one object. Of course, that means re-

doing the shot in the printer. Richard Edlund is a perfectionist and would not find a shot acceptable until every element worked. It was probably the most difficult matting sequence that I ever worked on."

Down the Throat

Many of the optical effects in *Poltergeist* required extensive "massaging and finessing" (to use Richard Edlund's words) by Bruce Nicholson's optical department. A case in point was the esophagus sequence near the end of the film.

In this sequence, the closet door in the children's upstairs bedroom implodes, revealing a giant "esophagus," presumably the throat of the "Beast." Interestingly, this "throat" was never part of the set; it was a miniature, filmed separately and combined with the full size live action. The scene is a masterpiece of optical compositing as no seams are evident and the miniature looks as though it is actually part of the live action set.

"Originally, Steven had wanted the esophagus to be a full size practical that was part of the set," reveals Nicholson, "but Richard Edlund dissuaded him."

"It was too great a technological problem for a live action situation," explains Edlund. "You can't afford to have actors and an enormous stage

crew hanging around waiting for the thing to work right. Even as the half-scale miniature that Chief Modelmaker Paul Huston supervised, it was an enormous contraption and the most expensive single set piece that we had to build. It was controlled by a keyboard system operating a bank of vacuum motors and air bladders that would suck and blow as you played the keys to make the entire contraption undulate and ripple, to come alive for the cameras. We filmed the miniature maybe two or three months before it was scheduled to be composited. At one point I had to say, 'O.K., we've got the shot, strike the set.' Well, that was \$250,000 worth of set going out the back door in pieces. If the shots didn't work, it would have been very costly to re-do it.

"Later on down the line, if we see that a shot doesn't work, then we have to fix it. In the case of the esophagus, we had to juggle the density of the mattes and resort to all sorts of optical techniques — dodging, burning-in, flashing — to get it to work. We even had to hand rotoscope some very tricky mattes to allow one of the characters to jump up in front of the thing. All of which, of course makes it look like it's really in the scene.

"If you put it off in one corner of the frame and nobody ever gets in front of it, it's not only pretty obviously an ef-

fects shot, but usually the composition doesn't work either.

"When that sequence was going together in optical, at first it looked like a postage stamp was stuck on the shot, and only after much finessing did it just drop right into the scene and became part of the full size set."

In order to make many of the optical composites in *Poltergeist* work, Edlund and Nicholson employed many of the techniques that still photographers use in their darkroom enlargers. "We stuck little pieces of diffusing filters and neutral density filters in the optical printer to alter different areas of a scene so the composite would fit together better. It's a technique that Bill Abbott was very fond of using."

Optical Supervisor Nicholson explains the process: "Since Steven had wanted the esophagus built on the set and Richard Edlund talked him out of it, we *had* to achieve that same look optically with a miniature. The miniature was shot in a double pass with the matte pass against black. We experimented with little bits of dodging and flashing, since we found that in certain cases the lighting on the esophagus did not match the lighting in the room. We were able to change the lighting in the room in certain cases by dodging or holding out certain areas where there was lots of

light. We cut out little neutral density filters and put them out of focus in the printer so they would hold out a certain proportion of the light. We also used some flashing techniques where we wanted to enhance the light. Eventually it all fell together and even Steven said that the esophagus looked like it had been built on the set."

Once the decision had been made to build the esophagus as a half-scale miniature, the model staff at ILM and Richard Edlund spent some time figuring out just how it was going to be done. In order to get a handle on the engineering problems, Chief Model Maker Paul Huston made a small conceptual model.

"Generally, with a model," begins Huston, "what you see is the outside of a model and all the operating mechanisms, the motors, the cooling lines, the fiber optics—all the things that people don't normally see are on the inside. This model was just the reverse. All the mechanical works were on the outside and the area to be photographed was on the inside, except the conceptual model was designed just to work out the mechanical problems so it didn't look like an esophagus or anything remotely like it.

According to ILM Model Shop Supervisor Lorne Peterson, early mechanical concepts of the

The spectacular imploding house in the finale of *Poltergeist* required four months of research and development.



esophagus were quite innovative and probably a bit too avant-garde for the time and money allowed. It was thought that it might be possible to build the 'esophagus' inside out, but to photograph and light it so it looked right-side-out. The principle is an old illusion that Disney and a few others have used. Arrayed along a wall in The Haunted House at Disneyland are a number of sculpted faces. As you walk past them the eyes eerily seem to follow you. Actually, the sculpted faces are negative molds—like looking at the inside surface of a mask. Your mind tells you they are not concave, but convex, so you see them that way. It's a very disturbing illusion.

"I designed the support structure with transparent materials and the esophagus of translucent materials so that we could light the model from the outside," begins Huston. "It was very easy to control lighting and color this way. The differing densities of the esophagus wall created a very organic look with its patches of dark and light. It even had veins with juice pumped through them.

"When the thing was up and running it made a tremendous noise. Those 32 vacuum motors sounded like the whine of a jet. Everytime you hit a key on the control board, four solenoids would open; it was like running a factory from a keyboard. Steven Spielberg happened by and begged for a chance to play with it. Apparently, it was more fun than a video game."

The Imploding House

Another of the model shop's expensive problems was the spectacular imploding house which climaxes the film. "At first," remembers Lorne Peterson, "it was thought we could work the gag by reversing the principle of the old magician's trick with a bouquet of flowers produced from a wand, except that we had to get the bouquet back into the wand."

From that simple conceptual image proceeded four long months of research and development to devise a method for folding the Freeling house into a tiny point of light.

"In the script," Edlund begins, "is what producer Frank Marshall calls the \$250,000 sentence: 'And the



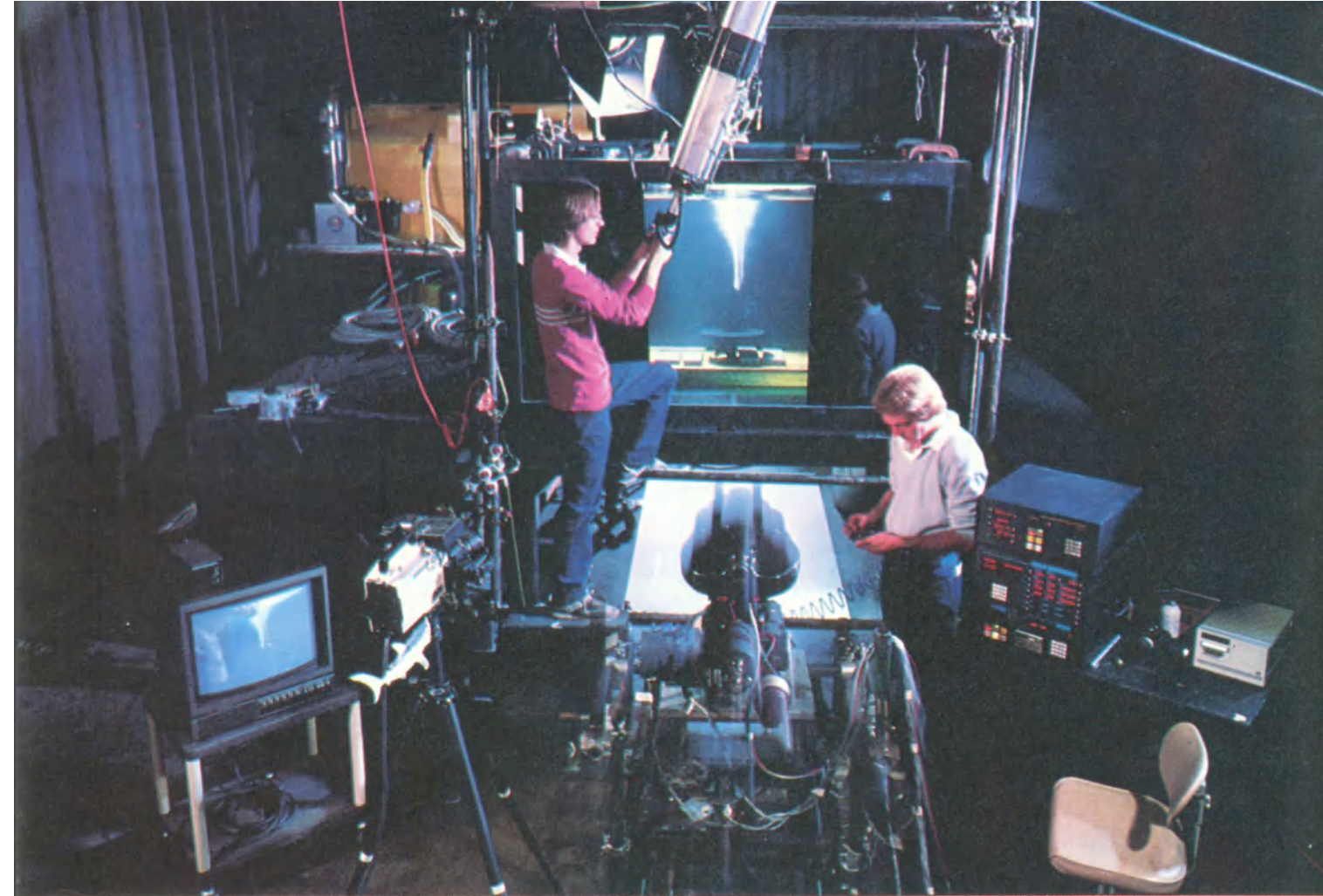
Top: Oliver Robbins' worst nightmare comes true as he is slowly devoured by a demonic tree.
Above: Craig T. Nelson rescues his son from the kid-eating tree before a cyclone whisks it away.

house implodes.' That sentence required the combined expertise of the model, matte, stage crew, animation, editorial, and, of course, the optical departments at ILM. We had to demolish a house and draw it through a small orifice leaving only light behind. Ease Oweyung, working with Lorne Peterson, began experimenting with materials until we had something that looked like building materials breaking up. Only then could Oweyung begin to build the five-foot wide model, rigged with the maze of wires which would break up the house and pull the debris through a small black funnel. After many months, it was ready to shoot."

The miniature house, which was a

model about five-feet across, was very detailed with two-by-four studs, rugs, lawn furniture and even miniature equipment in the garage. "We couldn't be sure what was going to show up as the model broke up," explains Peterson, "so there are even little trash cans that go shooting across the floor of the garage as the house breaks up."

The difficulty of the shot centered around the way the model had to break up. It couldn't just collapse into a pile. It had to actually implode—to break up into pieces and pull into a tiny hole. So how do you get a five-foot model to disappear into a small hole only inches wide? That problem required months of testing and develop-



Gary Platek and Garry Waller create a twister in the water tank for the tornado sequence at the beginning of the film. Also, one of the tornado shots involved a 30-foot whirling cone of cotton similar to the technique used by A. Arnold Gillespie for *The Wizard of Oz*. This technique was used for the shot looking up inside the tornado funnel.

ment supervised by Richard Edlund and Ease Owyneung, a trained architect accustomed to building things up rather than tearing them down. Still, his architecture schooling put him in good stead since he had training with stress and load factors of various materials.

Eventually, a number of techniques operating in unison were devised to achieve the effect. Hundreds of very small steel cables were rigged to every part of the model—rugs, walls, doors, windows. These cables were fed down through the center of a funnel-like construction through which the model was supposed to be pulled. The model was a perfect match of the real location in Simi Valley, down to the miniature glass in the windows which had been fabricated out of thin microscope slide glass.

At first, it was thought that a lever system would be adequate to pull the cables through the funnel, but eventually a forklift truck had to be used to pull the cable. Richard Edlund even

suggested hitting it with a couple of shotgun blasts as it was being pulled through the hole in order to help it break up. Additionally, a venturi vacuum system was used to pull up tiny fragments and dust. The entire effect was filmed with assistance of the late Bruce Hill and his high speed camera (300 frames per second) working in anamorphic format, since the VistaVision cameras are not capable of such high speeds.

Meanwhile, Michael Pangrazio made a matte painting of the vacant lot that is visible after the house disappears. Bill Neil, working with Edlund, had the camera position lined up to the foreground plate and had the miniature lit to match the full size shot.

The model was placed over a large rectilinear funnel, with the face of the house pointing straight up at the high speed camera. It was a one-take situation, but it worked. The shot was slightly underexposed, which gave Bruce Nicholson's optical depart-

ment a bit of difficulty extracting a matte from the shot.

"Terry Windell animated light reflections from the 'closet light' onto the house debris. Finally, a frame-by-frame rotoscope matte was made of the entire shot. With these elements completed, it went into Bruce Nicholson's optical department," says Edlund, "where we used a lot of photographer's darkroom techniques, such as dodging, burning-in, diffusion, flashing, etc. to get the shot married together. In many cases, the images looked 'pasted on' until after several test composites were made to work out the densities and blends. Bruce and I spent many hours in the screening room kicking around new ideas to solve the myriad of problems in this picture."

Richard Edlund admits that he would have liked the opportunity to re-shoot the sequence, but that would have cost another 50 or 75 thousand dollars and the shot had already cost over one hundred thousand dollars.

Simple Tricks

But not all of the ghostly doings required such an outpouring of time and labor in the model shop or optical lab. Early in the film is a piece of movie magic that delights filmmakers in particular. Jobeth Williams has just finished putting the breakfast things away while Heather O'Rourke sits on the counter watching. As Jobeth enters the breakfast area, she notices that all of the chairs have been pulled away from the table. She pushes the chairs back under the table while mumbling about the number of times she has asked the kids to push their own chairs back under the table. The camera pans with her as she goes to the cabinet under the sink for something, pauses and then pans with her back to the breakfast area. No cuts. She and the audience are startled to see all the chairs balanced in a pyramid on top of the table. Since the shot has been accomplished without cuts, it is a special piece of movie magic with a delight all its own.

Throughout the film, Spielberg makes great use of light and light effects. In fact, at ILM, he's known as

"Mr. Light!" Whether it is the blinding phantasmagoria of light that blasts its way from the children's closet when Steve and Diane Freeling are trying to rescue their daughter or the chilling color shift during the illusion constructed by Craig Reardon as Marty Casella appears to tear the flesh from his face.

For the closet sequence, enormous theatrical arc lights were employed with whirling mirror fragments and tanks of water casting beams of light through a smoke-filled set. Spielberg's use of light brings to mind the Crescendo Summit sequence in *Close Encounters*. In particular, the close-up shots of people's faces being blown by wind and light. "The difference is that while *Close Encounters* is about awe and wonder," says Spielberg, "*Poltergeist* creates great jeopardy and terror."

Animation

The ghosts in *Poltergeist* were produced by quite a number of techniques, including animation. Effects Supervisor Richard Edlund was looking for a good animator early in the

Poltergeist production schedule. "Someone who understood effects," explains Edlund, "and could create animation that didn't look like animation, which is even rarer. Animation is very difficult to combine with live action and achieve a believable blend."

Edlund was introduced to John Bruno, who had worked on *Heavy Metal* and came very highly recommended by an old friend, Wayne Kimbell. Impressed by Bruno's reel, Edlund took him on. In turn, Bruno brought in a crew of animators, many of whom had worked on *Heavy Metal*.

"As Richard explained the problem to me," remembers Bruno, "we had to create ghosts and ectoplasm-like material. It had to be very controllable, work in perspective, looping back and forth moving under objects, and generally to go where we wanted it to go.

"I spent my first two months here working with a couple of the guys in the camera department trying to come up with the effect. As I saw it there were only two approaches open to me: make the animation as good as live action, or bring the live action

Cameraman Rick Fichter, Modelmakers Jeff Mann, Paul Huston with actor Craig T. Nelson rehearse the effects shot of the beast coming through the closet door.





The esophagus set under construction.

down a little. I started with bottom lit mattes and multiple pass animation—laying down light as color. The shots of the ectoplasm coming out of the TV screen involve maybe ten passes through the camera; each pass working at a different density. Once it was properly exposed so that it looked like smoke, we printed it further and further back into the scene, so it's almost not there at all. In fact, most of the time, I still think that there is too much. Basically, what I was trying to do was to make a smokey sort of light.

"That TV sequence was very difficult, since it was the first time anything ghostlike is seen in the picture and it had to work. Steven Spielberg said that he wanted a live action hand to come out of the screen blending with the animated ectoplasm. But I didn't want my animation to have to compete with live ac-

tion. Still, though we wanted the effect of the TV screen reaching out to the little girl (Heather O'Rourke).

"We shot a number of tests. Richard Edlund shot some footage of my hand reaching out with TV screen snow projected onto it. But that didn't give us what we were looking for. So I went back to animating the hand. We shot some study footage of Animation Assistant Supervisor Renee Holt's hands which are very long and thin. We added another joint on each of her fingers to accentuate the look. In the meantime, modelmaker Scott Marshall poured silicon into the mold of Renee's hand that had been made earlier for the finger extensions and produced a clear 'glass' hand.

"I thought it looked neat. I shined a flashlight behind it and noticed how it illuminated itself from within. A new approach suggested itself. I thought that maybe for the few frames that

the hand comes out of the set we could sculpt the hand as replacement animation pieces and illuminate the hand from behind the TV screen. Steven wanted the screen to actually come out, so, I reasoned, let's actually do it. Highlights, specular reflections and kicks are very difficult to hand paint; this clear 'glass' hand would solve that problem.

"So, I went in to see Richard Edlund with the hand behind my back. First, I asked him if he was in a good mood. He said he was, so I showed him this hand with the light shining behind it and asked him what he thought of it. I explained what I had in mind, saying that I would sculpt the first few frames of the sequence as replacement animation so that the hand would actually be coming out of the screen.

"He didn't say anything, but he took the hand and the old footage we had used to project TV 'snow' onto my hand as a test onto one of the stages. He set-up the hand and projected the filmed TV snow through it and looked at the result. He didn't say anything for maybe five minutes. Finally, he said, 'I think it's going to work, but we'll have to talk to Steven and find out how much it's going to cost.'

"It turned out to be pretty expensive and it would take a lot of time since we were re-thinking and re-doing the shot from scratch. But a proposal was sent to Steven and he thought it was worth trying."

About this time, Richard Edlund had to go to England to shoot matte plates for *Jedi*. John Bruno was left with a difficult problem on his hands.

"Terry Windell and I began sculpting the hands. We did the first seven poses as a test. That worked, so we went on to 22 frames and sculpted 22 replacement animation hands. We carved them in wax, capped them in plaster and melted the wax out to leave us with plaster molds. Unfortunately, the entire set of wax hands was in the same room as the oven that we used to melt the wax out of the molds. While a couple of molds were 'baking', the heat melted the wax on the rest of the hands that were stored in the room.

"Terry and I freaked! We worked like crazy trying to put them back into their proper shape. We were under a

Film clip of completed composite with esophagus matted in.





Camera, Model and Stage crews in front of the esophagus model. Left to right are: Peter Stolz, Ed Hirsh, Patrick Fitzsimmons, Ray Gilberti, Harold Cole, Grant Smith, Rick Fichter, Sean Casey, Paul Huston and Barbara Gallucci (seated).

Frame blow-up of the matted-in ceiling area where the bilocation flashes occurred.





Director Steven Spielberg makes a final adjustment on one of the bodies for the coffin sequence at the end of the film.

lot of pressure—the deadline was very close, there was a lot of work to be done and it just *had* to work. Finally, we got them all cast. Effects Cameraman Rick Fichter set the stage up for us on a Friday. We had to shoot it then or we wouldn't be able to do it at all. It was getting too late in the schedule.

"So, Terry and I went in there and worked eight hours straight on the replacement animation. The next day the dailies showed that it worked perfectly. Then, it was off to optical. I spent another six hours with Visual Effects Editorial Supervisor Conrad Buff plotting the lap dissolve of the live action hand with the screen. We had shot another screen to replace the TV screen. Then, we had to mask off the girl (Heather O'Rourke). We were trying to get it together on the first time through. Finally, it all went into optical. When it came out the next day, it worked perfectly... and I came down with the flu."

And yet, this is *not* the scene we see in the finished film. "Richard Edlund liked the shot, so we ran it for Steven. Steven didn't think it was scary. 'I remember the drawing,' he said. 'The drawing scared me more.' So, I spent the next three days, sick with the flu, but still hanging in there, replacing what we had done with effects animation and that's the way you see it in the finished film."

Throughout the film there are numerous touches of animation effects. John Bruno explains a few of them briefly: "There is the long shot of the kid's room when the ectoplasm starts to crack through the door—that first scene is animation. The very first scene in which the lights start to crack under the door. That was another situation in which I wasn't sure if it was going to work. I tried to use light flares to cover up the animation. We had done these intricate little paintings of shadows. It was about 60 frames and we painted the shadows frame by frame. I did a small matte painting of the door crack. What I was doing was animating a long shot and this was the quickest way we could do it. We had inked these little feeler veins. Bruce Nicholson spent some time with it to make sure that it was the proper color.

"The fingers coming out of the door in the long shot were one piece of animation. Then, there was the little matte painting of the door crack and another small element of veins moving and growing, slime dripping, and then a few passes for light effects and flares."

"The close-ups were miniatures that were shot half scale," puts in Edlund. "They were pretty complex set-ups. We built a doorway half scale and made up some veins on the door-

way that were translucent urethane. The whole set-up was backlit for the first shot in which it was throbbing. We used syringes to pump juice through the veins. We also had a bellows which caused the whole doorway to pulsate:

"For the second cut, we had to implode the door with a very bright arc light behind it. I made up a special filter pack to create a horizontal flare, which we called the *Poltergeist* pack. The animation crews used the same filter pack on their cameras.

"The door had to be specially rigged by the stage crew who, I must say, did an incredible job throughout the entire picture. The door had to pull apart and splinter very precisely. The first door had to crack and allow a certain amount of light through, but the second door had to just suck in."

Ghosts of Light

The look of the ghosts and how much was going to be shown and not shown changed throughout the production. "At first, the descent of the ghosts down the stairs," explains Bruno, "was just going to be a number of globular balls of light that were floating and constantly changing as they came down the stairway with little ectoplasmic fingers jutting out from time to time. Richard obtained a photograph of the first millisecond of an atomic blast for us to use as a starting point. But on one of Steven's trips up here, he decided that we should try to create actual ghosts. He remembered *The Haunting* as having a very good ghost. Well, we got a print of the film and it wasn't very good, so I sat down and tried to conceptualize the ghosts in a few drawings—the ghosts that I thought everybody had always wanted to see.

"Steven wanted a feminine presence that would be slowly transforming between four and five different images. This was supposed to be an animated effect, but I didn't think it was possible in the time that we had. It was supposed to be quite a long sequence. What is on the screen is about half of what we originally thought. The ghosts were designed with a number of long floating streamers. Richard Edlund thought that it would be interesting if they preceded her wherever she went."

Richard Edlund and Bill Neil shot these sequences with Paula Paulson suspended from a flying rig. Paula has played Peter Pan on stage and is very comfortable hanging in the air for hours. The sequence was shot in 16mm at high speed (500 frames per second) and in reverse so that the streamers would appear to precede.

"Steven loved the footage, basically, as it was," reveals Edlund, "but we had to alter and massage the quality of the footage in optical to achieve the final effect. Then, we had to connect ectoplasmic streamers to her."

"It really got scary for me," admits Bruno, "because we were mixing live action and animation. I didn't think it was possible to do it. It took a lot of experimentation. I must say that Optical Supervisor Bruce Nicholson and his crew really saved the day."

Finally, the ghost spins herself into the ceiling accompanied by a symphony of light which was created by sometimes as many as 70 passes of animated light effects in the optical printer. "It took a long time to do,"



Modelmakers Toby Heindel, Barbara Galluci and Lorne Peterson prepare a section of the door for the cracking and oozing effect.

sighs Bruno, "and it only lasted about two seconds on the screen."

Quite remarkable is the sequence with the moving light sources flowing down the steps from the upstairs bedroom. The light sources move and you can watch the moving shadows on

the walls and furnishings. But when you try to trace back from the shadow to the source, there's nothing there...just light. Supervisor Richard Edlund explains a little of what it took to accomplish that shot.

"We had stagehands holding spot-

Mechanical stage effects were every bit as difficult and important as the optical effects in *Poltergeist*.





Producer Steven Spielberg explains his ideas to Animation Supervisor John Bruno.

lights to paint light onto the set," recalls Edlund. "In certain cases we had to matte out the stagehands who were standing there, holding the lights in the scene. There were wires in the shot, in some cases very heavy wires, that were used to hang lights in the middle of the room in order to get the right shadows emanating from the light ghosts. We had to split-screen the wires out of the shot or use Vaseline diffusion or a 'magic wand' to make them disappear. We really had to pull a lot of tricks out of the hat for that one.

"When we were shooting the scene over at MGM, nobody was sure what these light ghosts were going to look like. The actors had no idea what they were reacting to.

"The shots of the ghosts descending the staircase that were used for the TV monitor 'instant playback' later in the scene were all creatively 'doctored' by Pat O'Neal of Lookout Mountain Films. I brought him in to help with that particular sequence."

The Freelings and the University "spook" staff sit entranced watching

the glowing lights pour down the stairs. There is a particularly nice moment in which one of the floating ectoplasmic streamers appears to push a hanging lamp aside. Such special visual treats add enormously to the total effect of the film.

The shot is filled with brilliant lens flares and "light smears," none of which are in the original photography. Edlund prefers to add such effects optically in post-production. "If you have lens flares in the original photography, then you wind up with what I call an 'impossible sandwich,' because you have a lens flare in the portion of the frame that you will be working with later. If you matte anything over that flared area, your matted element will look like a postage stamp stuck into the frame. Your attempt to place another object in the midst of the scene will immediately become obvious and the shot will not work. Every shot has to be clean to start with, then you can matte in your other elements. If you want flares, they have to be added in their proper order when you are building a

special effects 'Dagwood sandwich' on the optical printer."

Perspective Tricks

Quite a lot of *Poltergeist* evolved as the production was being filmed. One of the sequences to change radically involved the shot of Steve Freeling (Craig Nelson) holding fast to the rope as it disappeared into the blinding light emanating from the childrens' closet. At one point, an enormous gaping skull lunges out of the door. In the film, the head appears to be nearly 6 feet high. In reality, the head is a small model placed close to the camera (a foreground miniature) and lined up with the full size set and actor. Seen through the lens of the camera, the foreground miniature of the head and the foreground door jamb blend perfectly into the full size rear door jamb several feet beyond.

The actor (Craig Nelson) was not able to see the foreground miniature, so a TV monitor was placed in his line of vision, but off-camera, so that he could time his actions properly to the appearance of the head in the

foreground miniature.

The big difficulty in such a sequence is the enormous amount of light that is required in order for the camera to carry focus from the foreground miniature all the way to the back of the full sized set. "We had to use thousands of foot candles of light to get the small f-stop required for maximum depth-of-field," explains Edlund.

"We used a special lens that would tilt and carry the depth of field. We had to shoot at f/8 and be three or four stops overexposed at f/8 to get the effect of blinding light, so you can just imagine the amount of light that required. We had to use theater arc lamps.

"Using this technique enabled us to get the shot in camera and not resort to opticals. We made the shot on our VistaVision format camera and then reduced the negative to cut right into the film.

"Originally, we had thought that the way to do the shot was to bring the head up directly toward the camera as seen from Steve Freeling's point of view, rather than the way it was



Ed Hirsh smokes up the esophagus set.

ultimately shot in profile. It works better dramatically this way," Edlund believes. "It's like the axe that comes through the door in Stanley Kubrick's *The Shining*—now you don't see it, now you do! It pops on. Whereas if you bring it up from very small in the background, you are telegraphing the effect all the way up and the impact is softened."

The Beast

The only other time we see a manifestation of "the Beast," is the shot of the wispy skeleton-like creature in front of the bedroom door. A puppet was built and photographed in a tank to emphasize the wisping floating hair that was fastened to its skeletal structure. It even looked a bit as if it were radiating its own light.

Paul Huston touches up the ectoplasm "fingers" on the closet door set.



PHOTO © 1981 LUCASFILM LTD.



All hell breaks loose at the Freeling house.

Bill Neil shot that sequence. Richard Edlund found it necessary to shoot the creature with a 1.5:1 anamorphic lens on the camera to "skinny it up a bit."

"We had that situation again in which Jobeth Williams had nothing to react to on the live action set," Edlund says, "It was another optical sandwich shot, since the creature had to fit in the middle of the shot between the bedroom door in the background and Jobeth Williams in the foreground."

"We only had about a four-foot diameter circle between her and the doorway to place 'the Beast.' The perspective had to be just right, otherwise, it wouldn't look like the Beast was really in the scene."

At the end of the sequence, she rises and runs down the stairs crossing in front of the Beast. This bit of action required carefully hand roto-scoped mattes from the animation crew to keep the optically inserted Beast behind Jobeth. With so many sequences involving actors and effects work in the same shot, a lot of very interesting and difficult roto-scope work was required throughout the picture.

Early in the film there's quite a number of shots involving rolling storm clouds and one particularly interesting sunset cloud shot. By now, it



Director Tobe Hooper and Producer Spielberg shoot the swimming pool sequence at M.G.M.

is something of a standard technique to create these effects with a cloud tank à la CE3K. This time, however, the technology had to stretch a bit to create a tornado as well.

Some of the shots were created in a tank with a water vortex with micro bubbles injected into it to give it photographic substance. The motion control camera was used to make the tornado look as though it was coming around the edge of the house and towards the audience.

Some of the live action plates of the

house were shot on location and some were shot on the studio set at MGM. "The shot of the house with the tornado breaking up was shot on location, the shot of the tornado moving towards the audience was a huge house set at MGM," reveals Edlund. "It required some finessing to get the plates to match. They were completely different lighting situations—one was a magic hour shot made just as the sun went over the hill and the other was shot on the MGM soundstage. Both shots have their backgrounds painted



Just try to keep producer Spielberg away from a camera!



Effects Supervisor Richard Edlund and Producer Steven Spielberg in front of the water tank with the beast from the hallway sequence.

with cloud tank skies, there are matte paintings and rotoscoping since the girl (Dominique Dunne) ran into the painting area and had to be rotoscoped for that. There is lightning and highlight animation in the shot as well. It was a real jigsaw puzzle.

"One of the tornado shots involved a 30-foot whirling cone of cotton

similar to the technique used by A. Arnold Gillespie for the tornado in *The Wizard of Oz*. The technique is used here for a quick shot in which you are looking right up the eye of the tornado from below."

As a last touch, there are even laser effects in the film. You see them as energy bursts coming out of the

closet during the rope through the bi-location area sequence and as shock waves coming from the house before it finally implodes. "These effects are the work of Gary Platek," reveals Edlund, "who is an innovator, technologist and artist—three qualities which are indispensable in our business. We did some tests with lasers for *Raiders*, but did not fully develop the technique until *Poltergeist*."

More than ever, *Poltergeist* underscores the enormous team effort and mutual support between departments and individual artists that is necessary to achieve such a high level of success. The polish and quality look of the optical effects in *Poltergeist* are undeniably one of its major attractions. "Steven was very picky about the shots," smiles Edlund. "And I really appreciate that. I like to keep working on a shot until it's as good as it can possibly get. But there are always the twin factors of time and money. I suppose it's possible to pour in just as much money as you can find, but the clock still ticks inexorably toward the release date." Still, appreciative audiences can congratulate Richard Edlund and the ILM team for setting new standards in a difficult genre—the supernatural fantasy. ●



Steve Freeling (Craig T. Nelson) defies violent supernatural spirits in an attempt to rescue his wife and daughter from the world beyond.

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