PUPPET ANIMATION COMBINED WITH LIVE ACTION IN FEATURE FILMS

by

Steven Seth Wilson

A Thesis Presented to the
FACULTY OF THE GRADUATE SCHOOL
UNIVERSITY OF SOUTHERN CALIFORNIA
In Partial Fulfillment of the
Requirements for the Degree
MASTER OF ARTS
(Cinema)

February 1977

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

UNIVERSITY OF SOUTHERN CALIFORNIA
THE GRADUATE SCHOOL
UNIVERSITY PARK
LOS ANGELES, CALIFORNIA 90007

This thesis, written by

STEVEN SETH WILSON

under the direction of h..is..Thesis Committee, and approved by all its members, has been presented to and accepted by the Dean of The Graduate School, in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

Harold von Hofe
Dean

Date January 24, 1977

THESIS COMMITTEE

Glen Cav
Chairman

Milvia Sloan

Edward R. Rawlinson

ACKNOWLEDGEMENTS

The writer wishes to thank the following persons for helping to make this work possible:

Newt Bellis, Jim Danforth, Jean De Joux, Linwood Dunn, Ernest D. Farino, Richard Fernandez, John Gale, Duke Goldstone, Gae Griffith, Ray Harryhausen, Bill Hedge, Ron Herman, Ken Holland, L. Bruce Holman, Barry Nolan, Richard Patterson, Miles Pike, Mel Rappaport, Bernard Rosenzweig, David R. Smith, Tom Swale, Dale Tholen, Joel Uman, Petro Vlahos.

Special thanks are due to David Allen, Douglas Klotz, Don Shay, and Gene Warren.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER ONE

Problem and Statement of Problem

Except for the brief popularity of George Pal's Puppetoons (produced during the 1940's), puppet animation work in this country has been almost totally eclipsed by cel animation, which has given us such famous characters as Bugs Bunny, Popeye, and Mickey Mouse. The Puppetoon stars are almost forgotten, and most of America's best-known puppet animation characters, such as Gumby, Speedy Alka-seltzer, and the Pillsbury Doughboy, have been seen only on television.

However, there is one puppet character whose name seems strangely out of place in a list of animated actors, and whose impact was so tremendous that it is still being felt after more than forty years: King Kong. Some thirty-six feature films which combine animated puppet characters with live actors have been released in America since King Kong (1933), but very little has been written about these films.

Howard Beckerman, who writes a regular column on animation in Filmmaker's Newsletter, notes America's

general lack of interest in puppet animation[1] and adds that the only book devoted entirely to the subject is L. Bruce Holman's recent Puppet Animation in the Cinema.[2] However, Holman defines puppet films in a way which eliminates almost all feature films from his consideration. His definition includes only those films in which the puppets are meant to be seen as puppets,[3] just as a ventriloquist's dummy is meant to be seen as a dummy. No attempt is made in either case to conceal the fact that one is watching an inanimate model being manipulated by an artist. Now, puppet animation's usual function in features is to facilitate the creation of creatures or beings which could not easily be created in any other way. While the viewer may be aware of seeing a special effect of some sort, he is not supposed to see a given puppet as representing these things. Rather, he is asked to believe that the puppet character is real, within the context of the film. Thus, King Kong and many other features are not puppet films as Holman classifies them, and are not covered in his book. Holman is aware of this,

---

[1]Howard Beckerman, "Puppets in Wonderland," Filmmakers Newsletter, IX, No. 1 (November, 1975), p. 36.

[2]Ibid., p. 38.

[3]L. Bruce Holman, Puppet Animation in the Cinema (Cranbury, New Jersey: A. S. Barnes and Company, 1975), p. 12.

of course, and he indicates that there is a need to study this specialized branch of puppet animation, mentioning the names of several prominent animators whose works are the main concern of this thesis.[1]

There are two other books which deal exclusively with puppet animation in features. One is The Making of King Kong, by Orville Goldner and George E. Turner.[2] It is a comprehensive work, offering personality profiles of the filmmakers and detailed data on the filmmaking. As important as the book is, however, it covers only three of the many puppet animation/live action features (The Lost World, 1925; King Kong, 1933; and Son of Kong, 1933). Furthermore, the basic methods employed to combine live and animated action in King Kong have been considered too expensive for use in later films, and thus different techniques have been developed which are not explored in The Making of King Kong.

The other book is Ray Harryhausen's Film Fantasy Scrapbook.[3] Harryhausen is an animator and special visual effects expert who has been personally responsible for

---

[1]Holman, Puppet Animation in the Cinema, p. 12.

[2]Orville Goldner and George E. Turner, The Making of King Kong (New York: A. S. Barnes and Company, 1975).

[3]Ray Harryhausen, Film Fantasy Scrapbook (2d ed. rev.; New York: A. S. Barnes and Company, 1974).

the animation and composite work in no less than twelve features. His scrapbook contains many photographs, production drawings, and anecdotes from the films on which he has worked, but it is not intended as a source of technical information.

Only portions of a few other, more general books deal with feature puppet animation, and this scarcity of books is matched by a scarcity of articles in both popular and technical film journals. One begins to get the impression that puppet animation is the least publicized of special effects tools.

On the non-technical side, critical reviews, even those in film-oriented magazines, rarely contain more than a sentence about the special effects. In recent years, reviewers have at least mentioned animation more frequently than in the past, but intelligent critical writing about the quality of the animation is practically nonexistent. Typically, the animation is lumped in with the rest of the special effects, which are rated as bad or good. If rated good, the effects are often said to be the only worthwhile aspect of the film in question. For example, William K. Everson concludes that, for <u>One Million Years B.C.</u> (1966), "it is the monsters that are the be-all and end-all of the film's entertainment

appeal."[1]

In depth technical information is lacking also, even in the best-known journals. For instance, a search was made of the annual indexes of American Cinematographer for the years 1925, 1932-1934, and 1948-1975 (the years in which the puppet animation/live action features under consideration were produced) checking articles on specific films as well as all articles on animation, special effects, trick effects, models, and the like. Only material of indirect relevance (information on traveling mattes, for example) was found. Furthermore, only two articles were devoted exclusively to puppet animation features, one on The Lost Continent (1951),[2] and one on The Wonderful World of the Brothers Grimm (1963),[3] and neither article made any mention of the animation sequences. In the case of the latter film, the omission is all the more significant because special techniques and equipment had to be developed to do puppet animation in the three screen

---

[1]William K. Everson, Review of One Million Years B.C., Films and Filming, XVII, No. 3 (March, 1967), p. 178.

[2]Herb A. Lightman, "Out of this World!" American Cinematographer, XXXII, No. 9 (September, 1951), pp. 350-351, 377.

[3]Herb A. Lightman, "Filming the First Cinerama Feature," American Cinematographer, XLIII, No. 9 (September, 1962), pp. 536-537, 560-565.

Cinerama process.[1] However, the most astonishing find in this otherwise fruitless search appeared in a 1965 article by Eugene Hilchey. The article includes a production still from King Kong showing Kong on the elevated train set of that film, and the caption claims that Kong is a man in an ape suit,[2] which most certainly he is not.[3]

Similar searches of indexes covering a variety of film publications have yielded some scattered information. One excellent article by Don Shay was published in Focus on Film.[4] It documents the career of Willis H. O'Brien, who is heralded by Holman as "the Dean of American special

---

[1]Graham Shirley and Bill Taylor, "Danforth's Dinosaurs," Lumiere No. 25 (July, 1973), p. 8.

[2]Eugene Hilchey, "Special Visual Effects Outside of the Camera," American Cinematographer, XLVI, No. 11 (November, 1965), p. 730.

[3]There is much evidence on this point. Marcel Delgado, who built the animation puppets for the film, has stated that Kong was at no time played by a man in an ape suit (tape recorded conversation with Don Shay, April 3, 1973). Goldner and Turner make this same claim in The Making of King Kong (p. 87). They also indicate the scale of the train set to be three-fourths-inch to one foot (p. 179); and they include a photograph of the set which shows a camera on the train tracks (p. 183). A duplicate of the photo seen in the Hilchey article appears on page 184, and a comparison of the size of the camera relative to the size of the Kong on the same set clearly demonstrates that the ape is nowhere near the size of a man. The puppet Kongs were about eighteen inches tall.

[4]Don Shay, "Willis O'Brien: Creator of the Impossible," Focus on Film, No. 16 (Autumn, 1973), pp. 18-48.

effects animators . . ."[1] (O'Brien was head of animation effects for The Lost World, 1925; King Kong, 1933; Mighty Joe Young, 1949; and other films). Also, a two part article by Mark Wolf, containing a considerable amount of technical information, may be found in issues of Cinefantastique.[2]

Most of the detailed writing in the field appears only in such esoteric, small publications as Closeup, The Movie People, and FXRH. At this writing, only one issue of The Movie People, and two of Closeup are available. FXRH, dedicated to the work of Ray Harryhausen, is defunct after four issues, the first three of which the writer was unable to locate through any source. The former editor of FXRH, Ernest D. Farino, writes that individual copies of FXRH No. 3 have sold for as much as $100.00.[3]

Of course, there is much information which has not been written at all. In interviews with animators,[4] the writer learned of animation and compositing techniques

---

[1]Holman, Puppet Animation in the Cinema, p. 25

[2]Mark Wolf, "Stop Frame: The History and Technique of Fantasy Film Animation" (part one), Cinefantastique, I, No. 2 (Winter, 1971), pp. 6-21; and (part two), Cinefantastique, II, No. 1 (Spring, 1972), pp. 8-17.

[3]Letter from Ernest D. Farino, December 19, 1975.

[4]I have spoken with David Allen, Jim Danforth, Bill Hedge, Gene Warren, and Miles Pike, all of whom have created animation sequences for feature films and television commercials.

which have not been recorded in any of the other sources available. Also, the above-mentioned lack of critical analysis in the area of feature puppet animation itself is keenly felt. The writer has gathered a number of opinions and theories from animators on this and on the broader question of how puppet animation has been and should be used in feature films.

Therefore, it is the goal of this thesis to consolidate the information about puppet animation in features, to present new information, and to compile a bibliography tailored to this special interest.

Limitations

As indicated in the title, this discussion of puppet animation is restricted to feature films which include both live action and puppet animation. Some further limitations should be noted before proceding. The list of films which will be considered is, of necessity, restricted to those films which have been seen in America. This is due to the difficulties encountered in making up the list. It is essentially a word-of-mouth operation dependent on the memories of fans and animators. Plot synopses found in the many fantasy and horror film books almost never comment on the technical nature of special effects, animation or otherwise. Filmographies of well-known animators can account for only about half

the films on the list, the rest containing animation sequences created by artists whose work has never been compiled in one source.

An additional limitation is that this work will cover only those films in which puppet animation is used to create some sort of character or creature. Many different kinds of visual effects are born in an animation camera, but often the use of the camera is necessary only to insure optimum registration of the images. Such effects will not be included here.

Occasionally, puppet animation techniques are used in order to give motion to parts of model sets or portions of matte paintings. In these instances, the intent is not to create a character, but to enhance the overall illusion of reality in the effect. Also, objects are sometimes animated in order to achieve comical or mystical effects. For example, in The Man Who Could Work Miracles (1937), George Fotheringay (Roland Young) cleans up a store via mind over matter. A variety of animated goods are seen climbing into boxes and jumping into drawers by themselves. Again, they are not intended to be seen as characters. Thus, even though these effects involve animation of dimensional objects, they fall outside the scope of this work.

However, it should not be assumed that animation of a simple object cannot be character animation. The

animated chair in Norman McClaren's short film, "A Chairy Tale" (National Film Board of Canada), definitely has a character and exhibits a number of emotions in the course of the film. As far as I know, no feature has exploited this potential for object-characters, but the potential exists.

Terminology

There does not seem to be a universally accepted term available to describe the basic process under consideration. Therefore, an explanation is in order for the choice of the term, "puppet animation."

Most frequently seen in the literature is "stop motion animation" (or, the variations "stop action animation" and "stop frame animation").[1] In spite of its wide-

---

[1]It may be of some interest to note that, in the early days of filmmaking, the term, "stop motion," applied to a broad field of special effects. Substitutions and abrupt disappearances were accomplished just by stopping the camera, making the changes in the scene, and starting the camera again. E. G. Lutz, in Chapter Five ("Trick Cinematography," pp. 99-121) of The Motion-Picture Cameraman (New York: Charles Scribner's Sons, 1927), indicated that split screen effects, double exposures, dissolves and other trick effects were also "stop motion" work, the only variation being the backwinding of the film in the camera. As far as Lutz was concerned, animation was a highly specialized form of stop motion, and as such it deserved treatment in a separate chapter, "'One Turn, One Picture' Work" (Chapter Eight, pp. 161-184). This phrase referred to using the one-frame drive shaft of a handcranked camera to expose one frame per full revolution of the crank. Thus, since nearly all other effects originally done in the camera have been taken over by the optical printer, "stop motion" has come to refer only to what was once a

spread use, however, it is not preferred by professional animators, who condemn it as too vague. Gene Warren (head of Excelsior Animated Moving Pictures) says that he would prefer a general term which would indicate clearly that the animation is done with objects or substances rather than through sequential drawings.[1] Bill Hedge and David Allen are content with calling the process "puppet animation."[2] This term is not completely satisfactory, since the very word "puppet" conjures up a whole history which is unrelated to filmmaking, let alone animation. This aspect of the term makes it objectionable to some. Joel Uman, for example, author of the article, "The Monstrous World of Ray Harryhausen,"[3] dislikes the term intensely. He would much prefer to use "model animation," or "dimensional animation."[4]

"Model animation" is a term which arises from the fact that the puppets used in features are usually referred to as models rather than as puppets. Perhaps this

---

specialty within its general grouping.

[1]Interview with Gene Warren, November 18, 1975.

[2]Interviews with Bill Hedge (November 3, 1975), and David Allen (November 3, 1975).

[3]Joel Uman, "The Monstrous World of Ray Harryhausen," Take One, IV, No. 8 (November-December), pp. 22-23.

[4]Interview with Joel Uman, February 17, 1976.

is because almost all feature puppets have been realistic, meticulous reproductions of insects, prehistoric animals, mythological beasts, and the like; rather than the more stylized, unrealistic figures normally associated with the word "puppet."

At present, the expression, "dimensional animation," is rarely seen. It is sometimes used as "three dimensional animation." In this form the term invites confusion with experiments in holography and stereoptic photography; but, stated simply as "dimensional animation," it seems to be gaining some acceptance. It emphasizes the distinction from drawn animation and yet it does not imply a restriction of subject matter to just puppets or models. It suggests the whole range of object-substance animation, a range which has included animated sand, clay, nails, rocks, and a host of other materials.

However, because this work will be concerned only with animation used to create characters, "puppet animation" has specific applicability and, therefore, it has been selected for use in this thesis. "Model animation," a close second choice, does not imply the element of character, and it also tends to cause confusion when one begins to discuss the model sets and props used in conjunction with the puppets.

Finally, the term "composite shot" will be used to refer to the combination of puppet and live actor in the

same frame, without implying a specific filmic means for obtaining the effect. It should be noted, however, that a composite sequence usually includes non-composite shots (shots of puppets alone, or of actors alone) in addition to composite shots, the action in the non-composite shots being "combined" through the implication possible with intercutting.

Contents of Remaining Chapters

Chapter Two--The Puppets

1. Replacement and displacement puppets, and combinations.
2. Materials used in construction of puppets.
3. Types of joints in displacement puppets.
4. Methods of obtaining refinements such as facial expression and the appearance of breathing.
5. Factors determining puppet size, complexity, and detail.

Chapter Three--The Animation

1. The basic process of dimensional animation.
2. Special requirements for work area; camera; camera controls; camera support; lights; puppet sets, set pieces, and props.
3. Methods for measuring and controlling moves made on puppets.
4. Elements to consider in determining the amount of movement to be made per frame.
5. The time required to complete feature animation effects.

6. The problem of "strobe" in projected puppet animation, and the difficulties encountered in lessening its effect.

Chapter Four--Puppet Animation/Live Action Composites: Film.

1. Definitions of applicable visual effects terms.

2. Use of static mattes.

3. Use of rear projection.

4. The development of miniature rear projection for King Kong (1933).

5. Ray Harryhausen's important variation on rear projection.

6. Use of front projection.

7. Use of traveling matte, and front-and-back-light traveling matte.

8. Methods for implying direct interaction of puppet with live actor and puppet with live environment.

9. Suggestion that combinations of the above techniques usually yield the most successful effects sequences.

10. Cost parameters for composite shots.

Chapter Five--Puppet Animation/Live Action Composites: Electronic.

1. Basic process of instantaneous electronic traveling matte described.

2. Potential advantages of electronic traveling matte for puppet animation/live action compositing.

3. Procedures followed in making puppet/live composites on videotape for television program, Land of the Lost.

4. Major disadvantages which have so far prevented widespread adoption of electronic effects for any theatrical film work.

5. Predictions made by industry personnel for the coming electronic film printers, with emphasis on possible use in puppet animation/live action compositing.

Chapter Six--Dramatic Achievement of Puppet Animation Live Action Films

1. Critical reaction surveyed.

2. Explanations offered for scarcity of puppet animation/live action films.

3. Critical Assessment of King Kong compared to that of the majority of other puppet animation/live action features.

4. Chronic problem of production emphasis on special effects at the expense of good scripting.

5. Examples of the few puppet/live features which have avoided the above bias.

Chapter Seven--Some Aesthetic Conclusions

1. Puppet animation strongly tied to the individual animator.

2. Arguments for and against other methods for producing sequences similar to those which can be created through puppet animation.

3. The question of the extent to which "realism" is a desirable aim in feature puppet animation.

4. The desirability of personality in puppet animation characters whether or not they are anthropomorphic.

5. Suggestion that "rough" animation is less noticeable if the animated action is imaginative and interesting.

6. The importance of the choice of what kind of character or being to animate.

7. Conclusion.

CHAPTER TWO

THE PUPPETS

Replacement and Displacement Puppets

The puppet, obviously, is a primary component of puppet animation. To be usable in animation, however, it must meet one important requirement, and in this it must be quite different from the familiar, loose-jointed marionette or rod puppet. An animation puppet must be able to maintain any position, rigidly and indefinitely. Two basic approaches for meeting this requirement have evolved: replacement animation and displacement animation.

Displacement animation is far more common in feature film character work, but replacement animation sometimes plays a part, so a brief discussion of it is in order. In its most extreme form, total figure replacement, individual puppets are not moved at all during animation. A character is represented by a series of rigid figures, which are identical except that each one has been made as a slightly different sequential phase of a given action. One way in which the figures may be made

is to cast them, in some malleable material, from a mold, and then rework individuals (by heating and bending limbs, for example) to fit incremental steps in the action. Needless to say, such total figure replacement requires that enormous numbers of figures be made in order to accomplish even a simple action. Nevertheless, some work has been done in this way, although not for a feature film.[1]

The appeal of total replacement is that, once the figures are prepared, the animation can proceed swiftly and usually requires little judgemental skill on the part of the person who carries it out. Speed and timing of the action are largely predetermined and guaranteed.[2] With displacement animation, the alternative, a single puppet must be posed and reposed through the desired action, frame by frame. Pre-planning can simplify this work, but

---

[1]Donald Heraldson, Creators of Life (New York: Drake Publishers, 1975), p. 186.

[2]It should also be noted that total replacement is particularly suited to certain kinds of non-character dimensional animation problems. It is frequently seen in television commercials which call for a dimensional object to be transformed in some way. An excellent example, from several years ago, is the Camay soap bar which "melted" into a dish, turning into cleansing cream. The melting bar and the rising cream were, at any given point in the process, a single, solid, hand carved unit. The transformation required about thirty such pieces, precisely matched in color and detail and each representing a minute step in the progressive change (interview with Miles Pike, February 24, 1976).

in the final analysis, a great deal of experience and intuitive ability is required of the person who puts a displacement puppet through its paces. For feature film character animation at least, the cost of creating total replacement figures has been found to exceed practicality[1] and mass production techniques continue to elude puppet animation.

Puppets which combine replacement and displacement techniques have seen some use in feature films. A typical combination puppet has a displacement (posable) body and a set of replacement heads which allow him to speak or change expression. The heads, again usually cast from molds (though hand carving is not unknown), fit onto a peg in the neck of the body so that they each assume precisely the same position. For a speaking puppet, the mouth on each head is modified so that, when the heads are used in varying, pre-determined sequences, the puppet may be made to say virtually anything. Miles Pike, who has been involved in feature puppet animation as well as animation for a great many television commercials, claims that, with about fourteen well-made replacement heads on which the mouths form recognizable speaking positions such as those for "y," "ah," and "oo," a puppet "could do the Gettysburg

---

[1]Letter from Ray Harryhausen, January 18, 1976.

Address--in Japanese."[1]

There are many variations possible with combination puppets. George Pal's Jasper, of the Puppetoon theatrical shorts, used replacement legs in walking; a set of thirteen would complete a step,[2] and the one set could be used over and over to let Jasper walk as far as necessary.

Several of George Pal's feature films have included combination puppets. For example, the "Yawning Man" sequence of 1958's tom thumb (sic) utilizes puppets with replacement faces (instead of whole heads) fashioned by Wah Chang[3] who is highly regarded for his skill in replacement work.[4]

Most of the puppets seen in the features under consideration have no replacement parts, and are entirely displacement figures. Therefore, their parts must move, but they must still meet the requirement of being able to maintain a pose. Ideally, moving parts do not greatly resist movement by the animator, and they do not exhibit any elasticity, that is, they do not tend to spring part way back to their original position after being moved out of

---

[1]Interview with Miles Pike, February 24, 1976.

[2]"Jasper and the Watermelons," Time, XXIX, No. 10 (March 9, 1942), p. 83.

[3]Sam Calvin, "The Comparison Test," FXRH, I, No. 4 (Spring, 1974), p. 66.

[4]Interview with Gene Warren, November 18, 1976.

that position.

Displacement Puppet Armatures

Displacement puppets can be very simple or very complex in construction. Taking the simplest figures first, they might be nothing more than a skeleton of soft wire, perhaps lead or copper or sculptors' armature wire, covered with clay or cloth. The wire may form the entire skeleton, or it may serve as the joint between solid, carved or molded sections of the puppet body. In either case, the wire fulfills the prerequisite of maintaining positions into which it is bent. The animated giant wasps seen in The Monster from Green Hell (1958) were wire jointed.[1] In King Kong, some of the birds which flit through the trees in the Skull Island jungle are tiny animated puppets with carved wooden bodies and thin, posable wings cut from sheet copper.[2]

When a puppet has an interior support structure, such as the wire skeleton mentioned above, this is called the "armature." John Halas and Roger Manvell, in The Technique of Film Animation, have suggested that soft

---

[1]Interview with Gene Warren, November 18, 1976.

[2]Orville Goldner and George E. Turner, The Making of King Kong (New York: A. S. Barnes and Co., 1975), p. 62.

wire is the most desired armature material.[1] However, almost all other sources contend that wire, even when it is strengthened by twisting several strands together, is not nearly durable enough for feature animation work. Any metal fatigues when bent back and forth, and must eventually break after repeated bending. Furthermore, as will be described below, feature film puppet armatures very often are encased in cast or sculpted foam rubber, with highly detailed latex skins covering this. A broken wire inside such a puppet would be quite difficult to repair.[2]

Occasionally wood is used for the armature, with tight joints which will allow the puppet to hold poses. However, wooden joints wear out relatively quickly, too quickly to be depended upon for the extended periods of production encountered in feature puppet animation.

Thus, most puppet armatures for feature films are made of metal, usually steel or, in some cases, an aluminum alloy. These are custom designed and hand-machined (Fig. 1). Wire is used only where it will be readily accessible for repair, and for articulated portions of the puppet which are too small for practical metal joints. The last inch or so of a long tail, for example, might be wire.

---

[1]John Halas and Roger Manvell, The Technique of Film Animation (New York: Hastings House, 1968), p. 275.

[2]L. Bruce Holman, Puppet Animation in the Cinema (Cranbury, New Jersey: A. S. Barnes and Co., 1975), p. 55.

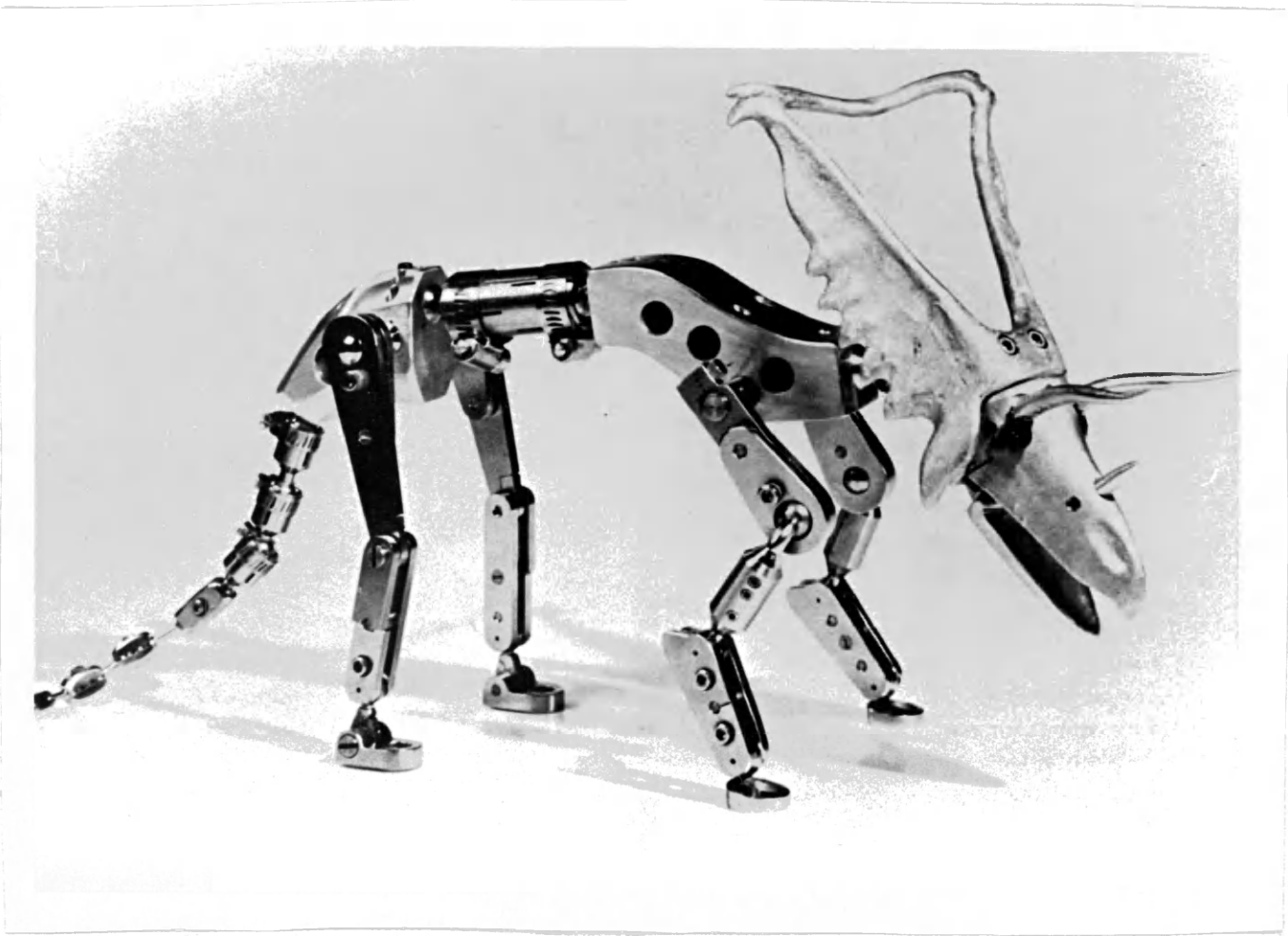


Figure 1. Armature for the Chasmosaurus seen in When Dinosaurs Ruled the Earth. Photo from The Movie People (September, 1975), p. 36.

Slip joints are kept under tension with set screws. Ball-and-socket joints are sometimes held tight with a constricting metal band wrapped around the socket and controlled with a screw (similar bands are often used to clamp rubber hoses to metal fittings on automobile engines); and sometimes the balls are "sandwiched" between two metal, socketed plates which are held tight with bolts which pass through the plates near the sockets. With all the above metal joints, tension may be adjusted within close tolerances, so that they may be kept just tight enough to support their part of the whole structure.

Even with such durable armatures, capable of withstanding much posing and reposing, repairs are necessary. Marcel Delgado, who built the puppets seen in The Lost World, King Kong and Mighty Joe Young, and is perhaps the most widely known feature film puppet maker, was constantly at work during these productions keeping the puppets in repair. Occasionally, the exteriors of the puppet apes, Kong and Joe Young, had to be completely stripped away in order to repair the armatures.[1]

In order to maintain a steady rate of production in the animation, it is often necessary to have at least two duplicate puppets of each major puppet character so that

---

[1]Marcel Delgado in tape recorded conversation with Don Shay, April 6, 1973.

one may be under repair while the other is before the camera. There were six Joe Youngs, for example, four that were eighteen inches tall, one ten inches, and one five; the two smaller ones facilitated set ups of longs shots.[1]

The complexity of the armature is determined by the puppet's role in the film. Relatively simple armatures could provide the movements necessary for the puppets which "stunted" for the live actors on the miniature versions of the fire engine ladder seen in the climax of It's a Mad, Mad, Mad, Mad World (1963).[2] But a puppet which is going to be seen in close ups, and which must be capable of manual dexterity and facial expression will require a much more complicated armature.

A fully articulated armature can be nearly as complex as the skeleton of a living being. It will probably have individually jointed fingers. Its eyes may have hollow pupils to allow for the insertion of a pin with which to move them in their sockets. Small sections of wire may be attached to the skull to serve as the base for eyebrows and lips, so that they may be animated for facial expression. The rib cage area may incorporate an expanding and

---

[1]Don Shay, "Willis O'Brien: Creator of the Impossible," Focus on Film, No. 16 (Autumn, 1973), p. 42.

[2]Linwood G. Dunn, "The 'Mad, Mad' World of Special Effects," American Cinematographer, XLVI, No. 3 (March, 1965), p. 162.

contracting mechanism, or an incrementally controllable bladder, with which to simulate breathing. Teeth, horns and similar protrusions may be carved from balsa wood, painted, and attached directly to the armature.

There are many examples of puppets with such complex armatures. Both King Kong and Mighty Joe Young demonstrate great changes in facial expression. The Ymir, a creature from Venus in Ray Harryhausen's 20 Million Miles to Earth (1957), is remarkably lifelike (Fig. 2). When it is eating, its jaw may be seen moving under the skin, and the front part of its upper lip occasionally dips down in a rabbit-like motion (in a poll taken of its readers by FXRH, the magazine devoted to Harryhausen, the Ymir was voted as his best and most popular model).[1] The tyrannosaurus rex which stars in The Beast of Hollow Mountain (1956) has lips which curl back menacingly from its teeth, and a long, serpent-like tongue. Also, its throat pulsates in a typically reptilian fashion. The 7th Voyage of Sinbad (1958) dragon is breathing quite visibly in the scenes showing it chained to the wall of the evil sorcerer's cave.

Not all refinements need be part of the armature. Some functions may be little-used, or may be more simply performed in other ways. A puppet's eyes might be made to

---

[1] "Poll Tally," FXRH, I, No. 4 (Spring, 1974), p. 77.

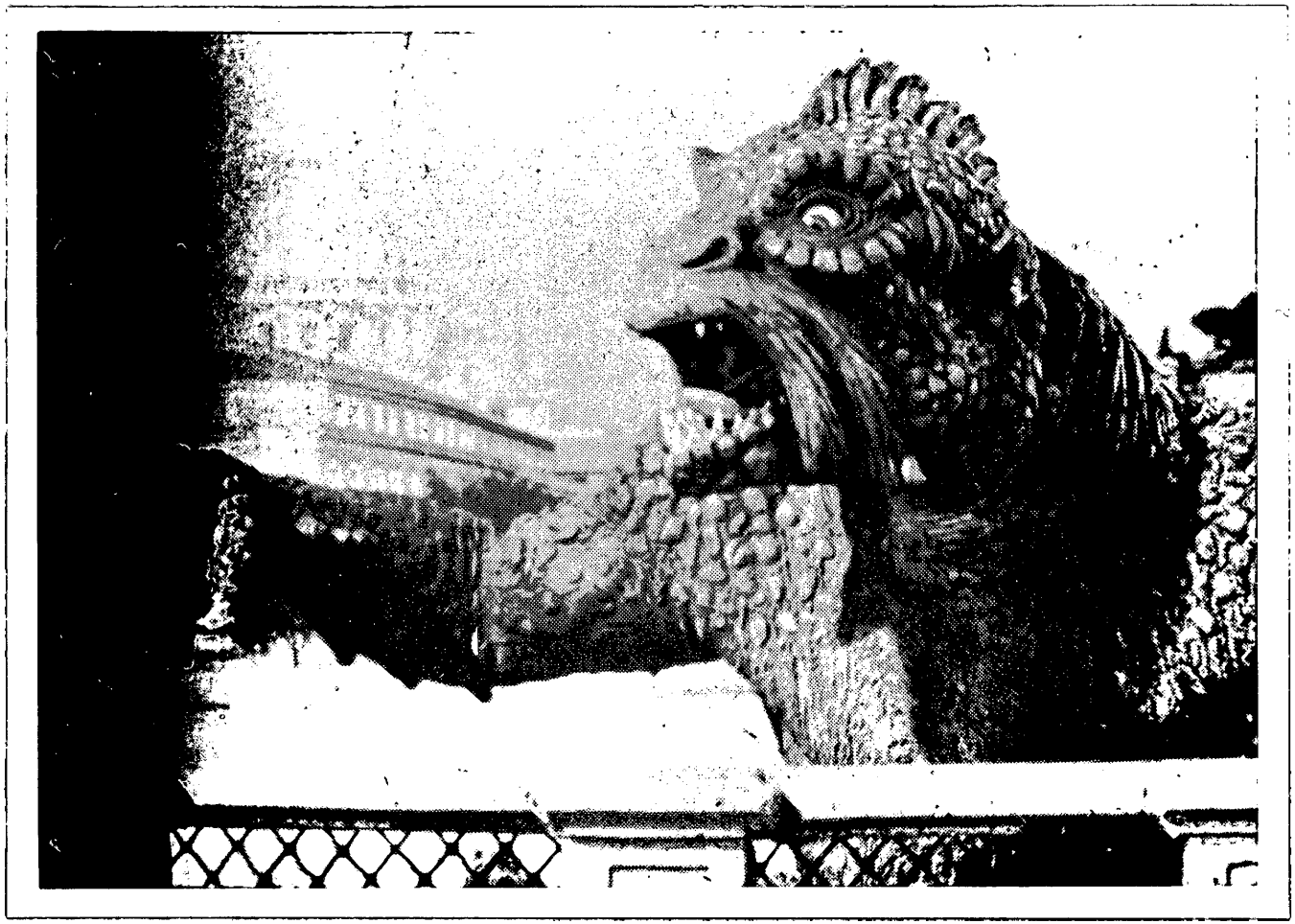


Figure 2. The Ymir, from 20 Million Miles to Earth. Photo from Famous Monsters of Filmland, No. 37 (February, 1966), p. 9.

blink in a long shot, for example, by using a series of replacement eyelids which could be nothing more than three or four sequentially larger bits of appropriately colored clay or paper. The total action is rapid enough to look perfectly natural when projected. Jim Danforth used this method to blink the eyes of the mother dinosaur seen in When Dinosaurs Ruled the Earth (1971).[1] Similarly, if a puppet's tongue is to be visible only once or twice in the course of a film, it may be cut from sheet lead or copper, painted, and placed in the puppet's mouth only when necessary. Even saliva may be suggested by painting a little shellac around the mouth.

Usually, an armature must be designed with the means of support during animation in mind. This is less true of a lightweight puppet, which can be kept standing upright by applying rubber cement, spirit gum, or loops of tape to the bottoms of its feet.[2] Or, if most of the weight of the puppet can be kept to the feet and legs, it may stand on its own, although this makes it highly susceptible to accidental movement during animation.

Heavier puppets require stronger support. Some-

---

[1]Jim Danforth, lecture on special visual effects in class at University of Southern California, Spring, 1973.

[2]Holman, Puppet Animation in the Cinema, p. 51.

times, pins are pushed through the puppet's feet into a stage floor of balsa wood or other soft material. After the pins are inserted, the heads may be clipped off so as not to be visible on the puppet's feet, in which case the pins are discarded after use, or, the feet may be designed to hide the pin heads.

The use of magnetism has been considered for puppet support, in the form of placing electromagnets beneath the stage floor to grip and hold puppet feet which have soles of ferrous metal. Reference to this technique is extremely rare. One source which discusses it in detail reports it to be unsatisfactory in the situation tested.[1] Nevertheless, magnetism was used to support puppets for at least one puppet animation feature (with no live action), 1954's Hansel and Gretel.[2]

The most common technique used to support heavier puppets is to pass bolts up through the stage floor and screw them into tapped holes in the bottom of the armature feet. If a puppet must have both feet off the floor for a few frames, it may be supported on a rod attached to its

---

[1]Everett Burgess Baker, "An Investigation of a Method for Controlling the Posing of Three Dimensional Figures used in Making Animated Model Films," unpublished research project, University of Southern California (Part I, March, 1944), p. 49; and (Part II, 1945), p. 12.

[2]Paul Mandell and David Prestone, "Animator: Don Sahlin," Closeup, No. 2 (1976), p. 15.

off-camera side, which is hidden from view by the puppet's body. This must be allowed for in the design of the armature. Puppets which will be airborne nearly all the time (such as the flying reptiles seen in When Dinosaurs Ruled the Earth, The Valley of Gwangi (1969) and many others) may have wires attached to the armature before the body is added.[1]

Displacement Puppet Exteriors

In a few exceptional cases, putting the puppet body on the armature has been relatively simple. For example, the giant crab of Harryhausen's Mysterious Island (1961) was an actual crab shell, with a custom-fitted armature inside. This is also true of the crab seen in Jim Danforth's When Dinosaur's Ruled the Earth.[2]

Most of the time, though, the puppet body must be designed and built. If a puppet represents a human, padding covered by clothing will usually suffice. But since feature puppets have most often been non-clothes-wearing creatures, it has been necessary to place on their arma-

---

[1]Mark Wolf, "Ray Harryhausen's Aerial Brace Creations," FXRH, I, No. 4 (Spring, 1974), p. 17.

[2]Even more straightforward, a large, metallic, bird-like robot which appeared in an episode of the television show, Land of the Lost, was essentially an uncovered armature. The effect was that of a fantastic and eerily agile machine.

tures elaborate bodies with highly detailed skin textures. Even the Beetle Man of Flesh Gordon (1974), a spindly being which looks like little more than an armature, had a thin exterior covering.[1]

As is the rule for armature complexity, the amount of detail in the body depends on the puppet's role in the film. Puppets which do not play prominent, closeup scenes do not require as much exterior detail as those which do.

The body for a less-detailed puppet may be cast in foam rubber. The usual approach to this task is to sculpt the desired puppet figure in clay first. Sometimes the clay is sculpted directly over the armature to ensure that proper proportions are maintained. A cast is made of the clay figure, and a mold is prepared, plaster being the common material for this step. The armature is removed from the original clay model and placed in the mold. Then the foam rubber mixture is poured or injected into the mold and allowed to set. After the puppet is removed from the mold, additional details may be added, and it may be painted with flexible, latex paints. This straight casting process has the advantage of being relatively fast. The dinosaur puppets in the 1956 film, The Animal World (a

---

[1]Interview with Bill Hedge, November 3, 1975.

feature film which did not include interaction of puppets with live actors) were cast from molds.[1] Closeups, requiring greater detail, had to be made with larger puppets.[2]

When a puppet is to play a prominent part, it is more likely that the "build up" process will be employed in creating its exterior. The build up process is subject to myriad individual variations, both because each puppet presents unique problems in construction, and because each puppet maker has his own favored techniques and materials. To give a rough idea of what is involved, however, the following description is offered of the construction of the squirrel puppet seen in The Great Rupert (1950). For that film, an animated squirrel doubled for a live squirrel in those scenes which called for action beyond the live squirrel's capabilities. Dale Tholen, who built the puppet, provided the following information.[3]

Though typical of other feature puppets in many respects, the puppet Rupert was atypical in having a multistrand twisted armature wire backbone. This was deemed adequate for the amount of bending that would be required

---

[1]Ray Harryhausen, Film Fantasy Scrapbook (2nd ed. revised. New York: A. S. Barnes and Co., 1974), p. 45.

[2]Mark Wolf, "Stop Frame: The History and Technique of Fantasy Film Animation," Cinefantastique, I, No. 2 (Winter, 1971), p. 13.

[3]Interview with Dale Tholen, March 29, 1976.

of it. His legs were more conventional, consisting of metal "bones" with ball joints. Since Rupert had to be life-size, his "hands" and "feet" (Rupert was to be so anthropomorphic in the story that the crew tended to think of him as having hands and feet rather than paws) were much too tiny to allow for machined joints, so it was necessary to use wire again. Unlike the backbone wire, the wire fingers and toes would receive much bending and unbending, and would certainly break often. Thus, the hands and feet were designed as modular, replaceable units. When a hand or foot assembly broke, the skin at the wrist or ankle was rolled back, the broken hand/foot assembly removed and a new one attached. Then the skin was rolled down over the joint and re-cemented in place.

Foam rubber was cut and shaped to pad the armature to the proper proportions. Tholen pointed out that foam rubber presents some problems, in that it does not shift out of the way, as flesh does when compressed. Foam rubber just compresses, and thus builds up resisting pressure which tends to straighten out a bent joint. This problem was particularly acute in the rib cage area, where a relatively large amount of body space had to be built up. Therefore, using the lightest foam rubber, Tholen made up a series of foam disks (each about one fourth of an inch thick) which he "stacked" on the spine, rather like dough-

nuts. Disks which approximated the correct diameter of the body were spaced apart with disks of smaller diameter. This allowed for a fairly large bend in the body before the outer edges of the largest disks contacted and began to resist. In order to keep the larger disks from spreading too far apart on the outside arc of a bend, Tholen laced their outer edges together on the front and sides with rubber dental dam, rubber sheeting which has been described as being similar to balloon rubber.[1]

The final step was to apply the skin to the armature. This was more difficult with Rupert than with most other puppets, because an actual rubberized squirrel skin was used. This made it a matter of making the padded armature fit the skin, and much work had to be done in re-shaping the padding to get a good fit.

The rubberizing of fur referred to above is an interesting facet of animation puppet making. Its development is attributed to a taxidermist, George Lofgren,[2] who performed it on the unborn lamb hide[3] used to cover Marcel Delgado's Mighty Joe Young puppets. Unborn lamb was chosen because it's extremely fine hair was in proper scale with

---

[1]Alan Osborne, "Father of Kong," Cinema Papers, (April, 1974), p. 212.

[2]Harryhausen, Film Fantasy Scrapbook, p. 19.

[3]Don Shay, Focus on Film, No. 16, p. 42.

eighteen inch tall Joe.

Dale Tholen provided a description of the basic process as it was carried out for the puppet Rupert.[1] The fur of the squirrel skin was embedded in paraffin, leaving the skin itself exposed. The skin was then removed with acid. The paraffin protected the fur during this phase, as well as holding it in place. Next, the skin was replaced with liquid latex which dried to form a new, rubber skin, with the fur roots embedded in it. Once the paraffin was removed, the skin was ready to be applied to the puppet.

The reason for the development of this elaborate technique may be found by watching King Kong closely. Kong was covered with ordinary non-rubberized, rabbit fur. During the normal handling of animation, the fur tended to shift and compress into slightly different positions each time it was touched. Thus, Kong's fur seems at times to have an unnatural life of its own. The effect is not often noticed (indeed, when it is noticed, it has often been interpreted as deliberate, i.e., Kong bristling with anger), but it spurred the desire for something better, nonetheless. Rubberized fur diminishes the effect considerably. The individual rubber-mounted hairs tend to spring back to

---

[1]Interview with Dale Tholen, March 29, 1976.

exactly the same position after being compressed, as does the latex rubber skin.

Some of the most famous examples of built up puppets are the work of Marcel Delgado. Delgado was a self taught master of the build up technique even before materials such as foam rubber were available. He used clay models only as a guide to which to refer as he worked on the puppets. He literally sculpted in bath sponge and cotton, among other things, in making the interior padding for the dinosaurs of the 1925 version of The Lost World. For King Kong and Mighty Joe Young, Delgado refined his work, actually constructing rubber muscles which would flex realistically under the skins of his animals.[1] For puppets not covered with hair, many puppet makers cast the skin in thin latex sheets from finely detailed clay models and apply the skin to the built up armature; but for his non-furred puppets, Delgado carried the build up process right on through to the end, sculpting the skin in liquid latex.

As a result of his effort, Delgado's creations, particularly those in King Kong, can withstand prolonged scrutiny in unblinking closeups, a well-known example being the slow trucking shot down the length of the fallen

---

[1]Shay, Focus on Film, No. 16, p. 30

stegosaurus, killed by Carl Denham (Robert Armstrong) and his men during the early part of their pursuit by Kong. Another example of this kind, unfortunately less well-known, may be seen in the surviving test footage from "Creation," an unfinished film on which Delgado was working when production of King Kong supplanted it.[1] A mother triceratops is seen in a series of leisurely, atmospheric shots (themselves a credit to Willis O'Brien's remarkable composite work) while two young triceratops frolic in the foreground. As the mother chews ponderously on vegetation, a fold of skin under her neck sags up and down with the action of her jaw. Her body bulges with thick wrinkles which accurately follow natural lines around joints and at the shoulders. Her head is covered with knobby warts. Questioned about how he achieved such astonishing realism, Delgado is quite matter-of-fact: "Well, everything is fabrication. You use whatever you think is best. . . ."

---

[1]"Creation" was the name of the film that Willis O'Brien had begun at the RKO studios when David O. Selznick took over as vice-president in charge of production with orders to re-evaluate all current projects. Selznick hired Merian C. Cooper to assist him, and Cooper saw in the "Creation" footage talents which could help him realize an idea he had about a giant ape who winds up on the Empire State Building. Work on "Creation" had been suspended, but Cooper convinced RKO executives to let him develop a test reel using O'Brien's crew on this new project. The test reel, which showed Kong tipping sailors off a log bridge into a chasm and Kong's famous fight with a tyrannosaurus rex, was a success, needless to say.

Discussing minute details, he mentions warts: "You cut them and past them on--whatever you think is best."[1]

Such meticulous work is important when the puppet is meant to be seen as a non-puppet character. Failure to incorporate necessary detail can destroy the desired effect, no matter how good the animation and composite work may be. For example, the puppets in Jack the Giant Killer (1962) have been singled out for their lifeless, rubbery appearance.[2] Ray Harryhausen's puppets, on the other hand, are widely praised both for exterior detail, and often for something more subtle, their inherent physical expression.[3] Quite often, a Harryhausen creature's face and eyes have been designed to reflect its role. His Cyclops, of The 7th Voyage of Sinbad, is one example. Every crag and wrinkle in its face seems to reinforce its angry glare, and the effect is not lessened even in close ups (indeed, the puppet remains intimidating even in the extreme close up photograph of its face which may be seen on page fifty-five of Mr. Harryhausen's Film Fantasy Scrapbook). Another example is the allosaurus which attacks the sea-side village in One Million Years B. C.

---

[1]Marcel Delgado in tape recorded conversation with Don Shay, April 6, 1973.

[2]Sam Calvin, "The Comparison Test," FXRH, I, No. 4 (Spring, 1974), p. 62.

[3]Ibid., p. 71.

Its expression is a sort of ferocious leer which contributes much to the success of the highly acclaimed attack sequence.

The actual size of animation puppets depends on the nature of the beast to be represented and on the amount of detail needed. Still, it may be said that puppets seen in more recent films have tended to be smaller than those that were built for King Kong.[1] A large puppet's joints must be correspondingly stiff, in order to support its weight in various poses (even eighteen inch Kong, smaller, on the average, than his prehistoric fellows, weighed in at about ten pounds);[2] and of course model sets and props must be in scale with the puppet. Thus, smaller puppets are preferred. The puppet allosaurus, Gwangi, of The Valley of Gwangi (1969), stood about twelve inches tall. The dragon in The 7th Voyage of Sinbad (1958) was about three feet long and considerably less bulky than, for example, the King Kong stegosaurus. It should be remem-

---

[1]The largest animation puppets which have been reported were dinosaurs built by Herbert M. Dawley, who took out a patent on their designs in 1920. One is said to have been seventeen feet tall (Charles W. Person, "Making Actors of Prehistoric Monsters," Illustrated World [November, 1919], p. 380). Dawley also provided the financial backing for "The Ghost of Slumber Mountain," a short film for which Willis O'Brien animated prehistoric animals seen in a dream sequence.

[2]Shay, Focus on Film, No. 16, p. 10.

bered that these stated sizes refer to the primary animation puppets, and not to smaller versions which are sometimes built for long shots.

In concluding this chapter, it should be made clear that the puppet building techniques described in it certainly are not the only methods possible. They are common in feature film puppet construction, but that field is quite limited, since feature puppets, as has been said, most often are trying to hide their puppethood. Animation puppets who pretend to be nothing more than puppets offer much greater latitude to the puppet maker. Consider the single problem of creating facial expression, for example. Replacement heads and face plates have already been mentioned, and it is often acceptable to use just replacement mouths and eyes. Holman describes another, quite unique procedure used by the puppet animator Ladislas Starevitch:

> Some of the characters in his [Starevitch's] films have faces made from soft leather; to change expression, particularly around the eyes and mouth, the leather is pushed into new positions between exposures, creating wrinkles and displacement of features.[1]

Still another approach is to make puppet heads which have blank spaces where the mouths should be. During animation, the mouths are painted on, photographed, wiped off, and repainted to achieve expression and to follow dialogue. Such techniques, while embodying many possibilities for the

---

[1]Holman, Puppet Animation in the Cinema, p. 58.

puppet-as-puppet film, do not lend themselves to the more realistic puppets which characteristically have co-starred with humans in feature films.

CHAPTER THREE

THE ANIMATION

Motion in Motion Pictures

In 1919 it was declared that, "the motion-stop process [is] so laborious and time-consuming that it is practically abandoned in these days of quick production. . . ."[1] Fortunately, even in these days of quicker production, the process has yet to be totally abandoned. It does, however, continue to be laborious and time consuming.

Most of the written works on animation find it advisable to state a few basic facts about the creation of motion through motion pictures. In keeping with that tradition then, the reader is reminded that motion pictures, animated or otherwise, give us the illusion of motion by flashing successive still photographs onto the screen. The standard rate of projection of twenty-four frames per second is fast enough to take advantage of an attribute of

---

[1]Charles W. Person, "Making Actors of Prehistoric Monsters," Illustrated World, (November, 1919), p. 380.

the eye known as persistence of vision; and the eye sees a constant, non-flickering image. A characteristic of perception, called the phi-phenomenon,[1] causes the viewer to experience the sensation of complete motion when, in actuality, only successive steps of motion are being presented.

Thus, in motion pictures, motion may be either recorded from live action, or it may be manufactured through animation. L. Bruce Holman provides a straightforward description of the manufacturing process in puppet animation:

> The puppet is photographed on a single frame of film, then moved to the next position required for the motion which he is enacting, and photographed on the next frame of film. This process is repeated until the desired motion is completed.[2]

Work Area and Equipment

It has been shown that the puppet must meet certain requirements in order to be used in the above process. The same is true of the equipment and props used by the puppet animator.

The prime pre-requisite of the work area is that it

---

[1]Max Wertheimer, "Experimental Studies in the Seeing of Motion," translated by Thorne Shipley, ed. Classics in Psychology (New York: Philosophical Library, 1961), pp. 1032-1089.

[2]Holman, Puppet Animation in the Cinema, p. 49.

be as free as possible from unnecessary interruptions. Puppet animation requires unbroken attention in order to keep track of the puppet's movements. The importance of this requirement is emphasized in this excerpt from Don Shay's description of Willis O'Brien's animation work for The Lost World (1925):

> When a set was completed, it was transported to O'Brien's shooting stage where walls were built around it to prevent anyone from interrupting O'Bie's [O'Brien's nickname] concentration, since it was imperative that he remember every move his dinosaurs made.[1]

Ray Harryhausen, too, has commented on the problem of interruptions. In describing the animation of the seven-headed Hydra seen in Jason and the Argonauts (1963) he said, "'The phone would ring and I would return from answering it wondering if a particular head was going up or down.'"[2]

Animators on King Kong found it necessary to prohibit anyone from entering or leaving the shooting stage while animation was in progress, lest the inrush of cool air from the open door burst hot lights or disturb delicate set pieces.[3]

---

[1]Shay, Focus on Film, No. 16, p. 25.

[2]John Brosnan, Movie Magic (New York: St. Martin's Press, 1974), p. 168.

[3]Goldner and Turner, The Making of King Kong, p. 128.

Turning from a suitably sealed-off work area to the equipment within, some requirements for the camera and camera mount should be noted. Professional animation cameras are driven with electric motors. Spring powered motors often give inconsistent shutter speeds when used in the single-frame mode, resulting in fluctuation of exposure from frame to frame. In addition to this, animation cameras usually incorporate precise mechanisms for registration (the placing of each frame of film in exactly the same position behind the lens, not allowing it to slip, even slightly, from side to side or to come to a stop higher or lower than the previous frame). Precise registration becomes crucially important when making composite shots.

The purpose of registration is to maintain a steady image that does not jiggle when projected. This purpose is defeated if the camera itself is allowed to move about during animation (unless such movement is carefully controlled as described below). Consequently, the camera's support must be exceptionally solid. It is not uncommon to see an animation camera's tripod chained to its platform, or bolted to the stage floor.

If camera movement is required, in the form of a pan, tilt, dolly, truck, boom, or any combination of these, the movement must be accomplished frame by frame,

just as the puppet's movements are accomplished. This makes it necessary to have very accurate controls on the camera support.

Gear drives for the pan and tilt movement of the support head may be used to gain such control. The bed of a lathe, which is solid and which also provides accurate controls for movement, is a popular puppet animation camera support for some kinds of dolly shots. For very small incremental moves, it may be necessary to modify the controls on devices such as those mentioned above. The modification is usually quite simple, consisting of adding an extension or pointer to the handle of the control, in such a way that the pointer exaggerates the movement of the control. Ernest M. Pittaro, writing in Photo Methods for Industry, makes an example of the lever on a zoom lens. A pointer attached to the lever will describe a much larger arc than the lever itself. A cardboard plate attached to the non-moving portion of the lens barrel may be marked off in increments which can be followed easily with the pointer.[1]

An animator's lighting equipment must be able to provide steady light for long periods of time. The intro-

---

[1]Ernest M. Pittaro, "Pittaro on Stop Motion," Photo Methods for Industry, XII, No. 9 (September, 1969), p. 47.

duction of light sources such as quartz-hallogen bulbs, which maintain relatively constant color temperature over their burning life, has made animation work in color somewhat easier. Incandescent bulbs must be replaced often, well before they actually burn out, to counteract their tendency to grow dim and change color as they grow older. This was true even during the black and white production of King Kong. The light bulbs were replaced at the beginning of each animation shot in order to avoid burn outs. A burned out bulb could not be replaced in mid-shot because the difference in the intensity of the replacement bulb would appear as an abrupt lighting change in the projected animation, making the shot unusable.[1]

Normally, of course, animation lights are mounted on rigid supports, but there are occasions when some lights are set up to be animated. Examples are the spotlights which play over the titular characters of King Kong, The Beast from 20,000 Fathoms (1953), and The Giant Behemoth (1959) as these animated creatures make their respective ways through city streets.

In some cases, the motion picture film itself may become a problem to the animator. In his pioneering work with color puppet animation effects in The 7th Voyage of

---

[1]Goldner and Turner, The Making of King Kong, p. 127.

Sinbad, Ray Harryhausen encountered a problem with the color film available at that time. If a shooting day ended in mid shot, and the film was left undeveloped in the camera overnight, a shift in color could take place between the latent images on the exposed film and the images recorded on the remaining film the next day.

Another kind of color shift which may come as an unwelcome surprise is known as "reciprocity failure." This is a characteristic of film which may be encountered when making long time exposures on each frame, a common practice, particularly in some composite work. Even though correct calculations may be made which ensure that the film receives the correct amount of light, the fact that it receives the light over a long period of time (several seconds or more) may cause the different color emulsion layers to respond unevenly.

Sets and Props

The setting in which the puppets perform, if there is one (in some composite work, no puppet set is required) must, of course, be stable. It must contain nothing which can shift about unnoticed by the animator, for this will appear in projected footage as peculiar, unmotivated motion. Therefore, certain kinds of foliage, for example, may be cut from tin or sheet copper, or foliage may be made up from rigid plastic imitation plants. Remarkable as it

may seem, some live plants were used in the miniature jungle settings for King Kong and The Lost World. Ralph Hammeras, who had a long career in film special effects, tells of planting Red Top grass in some of The Lost World sets. It grew to full height in about 10 days, and was, apparently, stable enough for Willis O'Brien to work around.[1] Less co-operative was a primrose which bloomed, unnoticed, during the animation of a scene for King Kong, to appear in the projected rushes as an out-of-scale, time-lapsed, monster flower.[2] Most of the foliage seen in the King Kong animation sets was either painted or constructed of stable materials.

Long hours under photographic lights can sometimes produce unexpected changes in a set. It is possible for colors to fade or be bleached out. Also, some materials may begin to warp. These changes may not be noticed while the animator is working, but they will be all too obvious when seen in the projected footage. The punishing effect of the lights is such that roughly carved stand-ins may be substituted for puppets during preliminary set up work, to protect those puppets which have delicate skins or paint jobs from unnecessary exposure.

---

[1]Letter from Ralph Hammeras to Don Shay, early 1964.

[2]Goldner and Turner, The Making of King Kong, p. 128.

Like the puppet, the animation set must be designed with the puppet's support devices in mind. If holes are needed in the stage floor (through which to put bolts into the puppet feet), they must be hidden or disguised. Sometimes a low camera angle will make the holes invisible. Shrubbery or other natural terrain features might be used to hide them. Carpeting the stage floor with certain fabrics, and cutting slits for the bolt holes is another possibility. In composite work, the puppet floor is sometimes eliminated from view altogether, which takes care of the problem. Then there are some occasions in which the holes cannot be obscured because of the dramatic demands for the set. Then each hole must be drilled during animation, just before the puppet's foot comes down on a given spot, and then filled in with putty of plaster and matched to the color of the stage floor again as the puppet's foot is lifted from the spot.

What has been said of animation sets is also true of animation props, with the additional proviso that any prop which is to be picked up by a puppet must not be so heavy that it overpowers the tension in the puppet's joints. The danger here is greatest if the weight is only slightly in excess. Then the puppet may be able to support the prop, but may sag imperceptibly after each pose has been set, producing unwanted erratic motion.

Animation in "Mid Air"

When a puppet or a prop must fall through space, or fly, or perform any action which prevents it from being supported through conventional means, it is usually necessary to make use of a device which has been termed an "aerial brace."[1]

Generally speaking, an aerial brace is an animatable unit from which wires are suspended. The wires are attached to a puppet when it is, for example, about to fall over a precipice and can no longer be supported through the floor of the set (unless, of course, the puppet is a flying creature or being, in which case the wires would probably be attached during the entire animation process). The brace provides for incremental movement, often in all three planes.

Wire is the most common material used to hang feature

---

[1]The term was apparently invented by Mark Wolf (Mark Wolf, "Stop Frame: The History and Technique of Fantasy Film Animation," Cinefantastique, I, No. 2 [Winter, 1971], p. 18). However, it almost invariably raises a smile from professional animators, who are more likely to say something like, "I need to make a jig for flying something," (anything being animated in free space is referred to as "flying," regardless of its intended action in the script). Animator David Allen suggests that the reason professionals don't have a name for their aerial support devices is that such devices nearly always are custom designed and built for a specific situation, and "aerial brace" seems to imply a single tool of some kind. Nevertheless, he feels that the term may see wider use (interview with David Allen, January 15-16, 1976). Gene Warren also dubbed the term as suitably descriptive (interview with Gene Warren, November 18, 1975).

film puppets, which tend to be relatively heavy, from their braces. Very fine copper wire, such as that used to wind electric motor armatures, is one possibility. Also available is "piano wire," a strong steel wire, not actually used in pianos.[1] Animator Jim Danforth is quite specific in the type of wire he recommends: 04 or 06 tungsten.[2] For lighter puppets, monofilament fishing line may suffice. Even human hair has been suggested.[3]

Very often, as might be expected, the wires must be camouflaged to prevent their being seen when the film is projected. Just "speckling" the wire with black paint, to break up its linear pattern, may cause it to blend into certain kinds of backgrounds.[4] Dulling sprays and opposed polarizing filters on lights and camera have been suggested as useful tools in cutting down reflection from wires.[5] In composite work where conventional traveling matte is being employed, the wires may be painted to match the matte-producing color and will thus be rendered invisible

---

[1]Interview with Miles Pike, February 24, 1976.

[2]Interview with Jim Danforth, November 3, 1975.

[3]Donald Heraldson, Creators of Life (New York: Drake Publishers, Inc., 1975), p. 184.

[4]Raymond Fielding, The Technique of Special-Effects Cinematography (2nd ed. revised. New York: Hastings House, 1968). p. 335.

[5]Mark Wolf, "Ray Harryhausen's Aerial Brace Creations," FXRH, I, No. 4 (Spring, 1974), p. 16.

in finished composites. Finally, it is often necessary to paint the wires to match the background. This is very time consuming, since the paint must be re-adjusted as the position of the wires changes in the course of animating the sequence.

Another technique which is sometimes used to "fly" an animated subject, is that of mounting it on a glass plate. The edges of the plate extend beyond the edge of the frame, and the entire plate, appropriately mounted, can be animated to obtain certain limited kinds of movement. Again, lighter puppets might be attached via adhesives, suction cups, or a magnet on the off-camera side of the glass. Heavier puppets might require cutting a hole in the glass and mounting via bolt and washers. It may not always be necessary for the glass to be vertical. If it is possible to work with the glass lying flat, the puppet resting on it, and the camera shooting down on this arrangement (or into a mirror mounted above the set up), the animation problems may be simplified.[1]

Controlling and Measuring Movement

Once a puppet animation set has been established, there remains the tehnical problem of keeping track of,

---

[1]Ernest M. Pittaro, "Pittaro on Stop Motion," Photo Methods for Industry, XII, No. 9 (September, 1969), p. 49.

and controlling the amount of movement which has been determined for each frame. Displacement puppet animation differs significantly from cel animation in this, for the cel animator has the opportunity to check the quality of his animation by shooting tests of his drawings, even before these drawings are transferred to cels. If an error is discovered in the tests, it can be traced to the offending drawing, and that drawing can be modified, with no additional work necessary on any other drawings.[1]

---

[1]An interesting experiment was carried out by a University of Southern California student in which an attempt was made to bring the advantages of cel animation to displacement puppet animation (Everett Burgess Baker, "An Investigation of a Method for Controlling the Posing of Three Dimensional Figures Used in Making Animated Model Films," Unpublished research project, University of Southern California, March, 1944 [Part I], and June 1945 [Part II]). Everett Baker developed a system for projecting conventionally prepared animation drawings onto puppets, frame by frame, during animation. The theory was that, by establishing visual registration points, such as the wrists, head, waist, knees, and ankles of the puppets, the animator could follow the drawings and be reasonably certain of achieving good results. The advantage of cel animation would be retained in the sense that the drawings could be checked by projection prior to using them for puppet animation. The system would be applicable to puppets of any shape.

The system was limited in that it required considerable time to line up puppets accurately. Also, it was foreseen that, if a puppet's movements took it over rough ground on a puppet set, the development of drawings which maintained proper position and perspective would be much more difficult (the puppets used for testing were mostly confined to a flat stage).

The possibility of controlling humans seen in the same frame with the puppets was also investigated. This would allow the human to relax between frames, and re-register himself with a projected image just before

The puppet animator, it might be said, must do his animation "live." Once he has moved his puppet, even if he is following a preplanned exposure sheet (which dictates what should be accomplished for each frame), he really has little but his experience to rely on for determining if that move was correct in all necessary details.[1] The problem is more acute if the animator is working to match pre-recorded sound, or, in the case of composite work, pre-filmed live action. Either situation requires the puppet to reach certain points and complete certain moves in pre-determined numbers of frames, while maintaining acceptable animated motion. However, puppet animation need not be entirely a seat-of-the-pants operation. There are a number of techniques and tools which may be brought into play to aid the animator.

Naturally, pre-planning is of utmost importance. The animator may "rehearse" his puppet for a given scene, walking it through to see how many puppet steps are necessary to cover a given distance, for example. Although the animator has the potential opportunity to "ad lib" during animation, exposure sheets are nearly always prepared, particularly for any animation which must match existing

---

the projection lamp was turned off and the next frame exposed. This was found to be unworkable as tested.

[1]Holman, Puppet Animation in the Cinema, p. 50.

sound or picture.

To measure and control the amount of movement made per frame, the puppet animator may use any of a number of techniques. Ernest M. Pittaro, in the informative article referred to earlier, has compiled a comprehensive list of such techniques.[1] Not all of them are applicable to complex figure animation, since Pittaro's article is aimed at industrial and commercial animation, which, more often than not, call for the animation of objects rather than articulated figures. Nevertheless, several of the methods he mentions are worth considering.

For example, Pittaro suggests tracing an off-screen shadow of a figure or object. This provides a record of the movement made, and is one way of measuring the amount of a movement (by comparing the shadow of the new position to the traced outline of its position in the previous frame).[2]

A more complex variation of the above techniqe makes use of a large format view camera with tracing paper mounted on its viewing screen. The puppet's image can be focused on the screen and traced, or drawings may be pre-

---

[1]Ernest M. Pittaro, "Pittaro on Stop-Motion," Photo Methods for Industry, XII, No. 9 (September, 1969), pp. 46-50, 52.

[2]Ibid., p. 49.

pared in advance, placed on the screen, and the image of the puppet lined up with them.[1] Either of the above techniques offers the possibility of being able to realign a puppet which has fallen down or has been bumped out of position.

For keeping track of linear movement, faint marks may be made on the stage floor, or a cardboard scale may be made up with incremental moves marked on it. This can be affixed with an adhesive tape hinge just off screen, tipped down onto the stage floor for making the move, and lifted back out prior to exposing the next frame.[2]

In the final analysis, the most popular tool for measuring puppet moves probably is the surface gauge. It can be very simple (Pittaro suggests making one out of Tinker Toys)[3] and it adds much less additional work to the animation phase than the tracing techniques do. Usually it consists of an articulated pointer arm attached to a weighted base. In only provides the animator with a reference to the immediately preceding frame, but this is usually sufficient for an experienced animator. It is used in the following manner.

After a frame has been exposed, the gauge is placed

---

[1] Ibid., p. 48.

[2] Ibid.,

[3] Ibid.,

near the puppet and the tip of the arm is moved to a position just touching a given point on the puppet, a point which in the course of the desired action will be moving away from the gauge arm. Then the puppet is moved. Since the animator has already determined what the size of his increments should be, he can use the tip of the arm as a reference from which to measure, and make moves with considerable precision. The gauge is removed from the camera's view before the next frame is taken.

When there are several puppets to control in one shot, particularly if the puppets are each performing unrelated actions, it is often desirable to call in additional animators to do the work. Obviously, this will speed up the animation but the primary reason for it is that it is exceedingly difficult for one animator to remember what moves need to be made on the combined bodies and appendages of several puppets.

Determining the Amount of Movement per Frame

Naturally, methods for measuring the amount of movement made per frame are of no use unless one can determine how large those movements must be in order to achieve the desired motion. Here the discussion of animation departs from purely technical considerations. Simple mathematics indicate that, 1,440 frames are required for each projected minute of animation, but the math is really the end result

of dramatic judgements that the animator must make before he can plug numbers into equations. Rarely, for example, does he have the relative luxury of plotting out the straightforward acceleration of gravity for a given puppet fall.

One factor on the mathematic side should be made clear before proceding. Feature film puppet animation is normally shot making a move for each frame. This is pointed out because it is a common practice in cel animation to "shoot on twos," that is to take two frames of each drawing. In fact, it is a relatively common practice to shoot on twos in some kinds of puppet animation such as cartoon style animation and some work in television commercials.[1]

However, most feature film puppet animation has been in a realistic style. Jim Danforth, whose animation in features is very highly regarded, stated that he shoots on twos only when the necessary one-frame incremental moves are smaller than he can measure on the puppet; less than about 1/32nd of an inch.[2] The writer made a frame-by-frame analysis of the animation of the Ymir in Ray Harryhausen's 20 Million Miles to Earth and found that Harryhausen, too, rarely resorted to shooting on twos. Generally, his

---

[1]Interview with Miles Pike, February 24, 1976.

[2]Danforth, lecture, Spring, 1973.

two-framing occurred at the end of very slow movements of Ymir's arms. The last few increments of the moves were sometimes shot on twos.[1]

With this in mind, then, let us consider the judgemental side of determining how much to move in how many frames. A 1916 press release from the Edison Studios concerning the work of their newly-hired creator of animated novelty shorts, Willis O'Brien, sums up part of the problem: "We all know that the gait of a dog is different from that of a goat -- but in just what way is it diffirent?"[2] The continuous, detailed analysis of all kinds of motion is basic to any animator's ability to recreate it, or, better still, to transform it for his own purposes.

Many times, the animator acts out action himself in order to analyze it. Jim Danforth described himself crawling around on all fours trying to get a feel for how his dinosaurs should move in When Dinosaurs Ruled the

---

[1]One reason that very small moves can be difficult to obtain with some puppets is that their joints are not necessarily as easy to move as one might think. The ankle and knee joints of a heavy puppet must be able to support its weight even in off balance positions. Animator Bill Hedge describes the occasional need to "go in there with a pair of pliers . . ." to move such joints (interview with Bill Hedge, November 3, 1975).

[2]Edison Studios press release on Willis O'Brien, ca. 1916.

Earth.[1] Ray Harryhausen reported throwing his hip out in practicing fencing maneuvers for the famous swordfight between Sinbad (Kerwin Matthews) and a sword-wielding animated human skeleton in The 7th Voyage of Sinbad.[2] Through experience, or by using a stopwatch, the animator next breaks the action down into short segments, these into seconds, and seconds into frames. The resultant number of frames is applied to the distance the puppet, or one of its appendages, must travel in order to complete the action, and thus the increments are determined. These increments are seldom all the same size, for experience teaches the animator that slight variations are necessary to get action which flows realistically; for example, the start and end of an action are often slower than the middle, and the increments must reflect this by being made progressively larger and then smaller over the course of the action.

Experience is the key word. The animator must develop a feel for dramatic timing and the characteristics of visually expressive motion before he can effectively apply his technical skills and his knowledge of the mechanical aspects of movement.

---

[1]Danforth, lecture, Spring, 1973.

[2]"Ray Harryhausen and Charles Schneer at the National Film Theatre, London," (Part II), FXRH, I, No. 4 (Spring, 1974), p. 10.

Even the final translation of desired motion into animated motion may depend as much on intuitive skills as on mathematical computation. The most refined subtleties achieved are the result of many subjective factors as well. Consider, for example, what Ray Harryhausen says about animating Mighty Joe Young:

> I had my favorite model of the four [larger ones]. It was the only figure I really felt at home with. and which I could successfully manipulate into the many complicated poses I visualized in my mind. It is really quite fascinating how one can become attached to a mass of metal and rubber. It may be that it was all in my own mind but there was something about this one model that seemed to reflect the very essence of gorillahood. As incredible as this may seem to the layman, this can make all the difference in maintaining character values and their corresponding harmonious action patterns.[1]

Factors in Estimating Production Time

Estimates of the amount of time required for puppet animation production are very difficult to make. Of course, by any standard for live action production, animation takes a long time; during the fifty-five weeks spent in making King Kong, Fay Wray had enough time off to star in two other films, Dr. X and The Most Dangerous Game, while she waited for the animation shooting to catch up with the live action already shot.[2] However, making com-

---

[1]Harryhausen, Film Fantasy Scrapbook, p. 19.

[2]Fay Wray, "How Fay Met King Kong, or the Scream

parisons between the production times for different animation features is of little value because, for each film, different problems had to be solved, different numbers of people worked on the animation, and the amount of screen time devoted to animation differs.

For example, it has been pointed out that there is more on-screen animation in One Million Years B. C., which required nine months' work for its animation effects,[1] than in When Dinosaurs Ruled the Earth, which took seventeen months.[2] A major reason for the difference is that the composites created for the latter film are extremely complex; thus it took longer to design and execute them.[3] This gives a clue to the factor which is most important in discussing the time needed to produce animation and animation effects.

There is a tendency to over-emphasize the length of the actual animation time. However, the number and complexity of set ups is more important than the amount of animation. Gene Warren says that the time required

---

that Shook the World," The New York Times, (September 21, 1969), Section 2, p. 17.

[1]Sam Calvin, "The Comparison Test," FXRH, I, No. 4 (Spring, 1974), p. 70.

[2]Ibid., p. 68.

[3]Ibid., p. 68.

to set up for a shot (particularly a composite shot, which must match the scale, perspective and color of both puppet and live action photography) can be easily six times that needed to perform the animation itself. Warren makes it quite clear that even extremely complex animation rarely brings the ratio of set up to animation down to less than two to one.[1] Therefore, a sequence which played out in just a few basic sets, or camera angles, will probably take less time to complete then a sequence which calls for many sets or a variety of angles, even though the former may contain more actual animation.

The complexity of the animation must be considered of course, both in terms of the nature of the desired movement, and in terms of the number of puppets involved. More frames are necessary for a slow puppet action than for a fast one. Ray Harryhausen averaged three days for every fifteen seconds of screen action on Mighty Joe Young in the slow-paced scenes showing a despondent Joe penned up in a cage.[2] Harryhausen's work also provides an example of the dramatic increase in animation time encountered when several puppets are involved in the same shot. His animation, in Jason and the Argonauts (1963),

---

[1]Interview with Gene Warren, January, 1976.

[2]Harryhausen, Film Fantasy Scrapbook, p. 22.

of seven skeletons engaged in a complex sword fight with three live actors took four and a half months to complete,[1] and the fight is only one of several animated sequences in this film. Barring such exceptional situations, and speaking in the most general terms, an experienced animator can expect to finish between seven and twenty seconds a day, working in one set up with one puppet.

It is sometimes possible to multiply the animation footage by using more than one camera to record more than one view of the puppets. Two cameras were used on The Animal World (a feature which included animated dinosaurs but no live action),[2] and apparently on The Black Scorpion (1957), in which closeup views are seen of animation which has already been seen in long shots.[3]

Strobe

Before leaving this chapter, a unique property of puppet animation should be noted. It is called "strobe,"

---

[1] Ibid., p. 88.

[2] Ibid., p. 45.

[3] It is possible that the closeups were obtained by reprinting and optically enlarging sections of the long shots. Even if this is the case, however, the saving in animation time would be about the same, and perhaps slightly greater since it would obviate the need for setting up a second camera.

or "strobing." The term describes the tendency for rapid puppet animation action to look rough or peculiarly jerky. This effect arises from the lack of blur in individual images of the puppet or its appendages.

Take a simple example. Suppose a normal live action motion picture is made of an actor slamming his fist down on a table. A frame-by-frame analysis of this footage would probably show the action as covering four or five frames, from the fist in the raised position just as it starts to move, to the fist contacting the table. The first and last frames of this action will usually show the fist and arm as sharp, recognizable images, with no blurring. However, in the middle frames, the fist and forearm will photograph as a blur or streak, and will probably be so distorted as to be almost unrecognizable. This is because the fist and arm were moving while the camera shutter was open on each frame.

Now, if the same action is duplicated with a puppet, measuring exactly the scaled increments and covering the same number of frames, the puppet action will nevertheless look somewhat different, due to the fact that the puppet's fist and arm will not be blurred on any frames, since it was not moving when the camera shutter was open. Blurred action looks more natural to the eye.

A cel animator has an advantage in this area. He may draw things to appear blurred, or draw streaks behind

them in their path of travel. The problem is more difficult to overcome in puppet animation.

Ray Harryhausen suggests two methods. One is to paint appropriate blurs on glass mounted between the animation camera and the puppet; another is to move part of the puppet by wire while the camera shutter is open.[1] Harryhausen adds that most methods are too time-consuming to be practical under the constraints of professional production schedules.[2]

David Allen offers a variation on the above painting technique, that of smearing vaseline on glass to distort the puppet's image in a way approximating motion-blur. He concurs however, that any technique which adds to production time is not likely to be adopted.[3]

Jim Danforth has made some use on features of a double exposure technique to combat the strobe problem. For each frame in which he has determined there should be blur, he divides the total puppet move for that frame into two increments, and exposes the same frame twice at fifty percent exposure, once for each move. This would mean, in the example given above of the fist swing, that he would make six moves of the puppet during the three frames

---

[1]Letter from Ray Harryhausen, January 18, 1976.

[2]Ibid.

[3]Interview with David Allen, November 3, 1975.

where the arm would look blurred. When this is done, the eye is presented with a double image on some frames and this helps to overcome the strobe phenomenon. Danforth used this technique on When Dinosaurs Ruled the Earth.[1] In general, however, the strobe effect is considered to be subtle enough, for the average viewer, that it can be tolerated in professional work.

---

[1]Calvin, "The Comparison Test," FXRH, I, No. 4 (Spring, 1974), p. 67.

CHAPTER 4

PUPPET ANIMATION/LIVE ACTION COMPOSITES: FILM

Terminology

The literature on film composite work (whether related to puppet animation or not) tends to use varying terms to describe single processes. For the purpose of this chapter, a single term will be selected and defined for each relevant process as it arises in the discussion. A few terms which will be used throughout this chapter are defined below.

Matte: This word has a way of causing confusion because it is used in the names of several different composite processes, such as "traveling matte," "matte painting," and the like. It may be helpful, therefore, to state the purpose of any matte in composite work. A matte's job is to protect part of the film's image area from exposure, so that this area may later be exposed with desired images from another source (or, from the same source at a different time). Physically, a matte may be nothing more than black paint on a portion of a sheet of glass through which

the camera shoots. When the subsequent exposure is made, it is necessary to prevent the area which was exposed earlier from being double exposed, so an exact opposite of the matte is used; this protects the previously exposed area while leaving the previously protected area open to exposure. Thus, a complete matte, in the vast majority of cases, is made up of two reciprocal sections, although the pair is usually referred to in the singular, "matte." Here the sections will be referred to separately, as the "matte," and its "counter-matte."

Background Plate: A background plate is any motion picture footage (or even a still photograph) used as the primary source for background images in rear projection, front projection, or traveling matte composite work.

Generation: This refers to duplicate printing of film footage. A first generation print is any film footage which has been printed from original footage (original being the footage which actually went through the camera). A second generation print is a print made from a first generation print, and so on.

Definition: This term relates to the subjective judgement of a film image's sharpness and resolution of detail. With each print generation, there is a loss of definition.

Contrast: In the context of this paper, contrast

and grain (see below), are also problems encountered when prints are made. An increase of contrast in a print causes images which were close to black in the original to go completely black in the print, and images which were nearly white to go completely white. Contrast tends to increase with each print generation.

Grain: Grain refers to the individual silver particles in black and white film emulsion, or in color film images which are derived from silver particle images. Ideally, these are not visible in projection as individual particles. However, grain tends to become more visible with each print generation.

Even with those color films which form images solely with color dyes (containing no grain particle structure as such) the image quality is still degraded (by increasing contrast and loss of definition) with each generation.

In the making of most films, the use of composite processes is simply a matter of expedience; it is more economical to combine an actor with a background plate of Angel Falls than to take him and a full crew to the wilds of Venezuela to make a similar shot. However, the realm of the animated puppet and that of the live actor may be combined only through composite techniques, and "this combination of two seemingly incompatible elements produces a

novel and interesting effect."[1]

Editing

Before entering the discussion of techniques for actual composite shots, however, a word is in order about the most fundamental tool for combining motion picture actions: editing. The importance of intercutting to a puppet/live action sequence should not be underestimated. Some sequences have been made with no composite shots at all. In Journey to the 7th Planet (1961), a group of space travelers encounters an animated creature which they refer to as a giant rodent. This event is constructed entirely of juxtaposed shots of the rodent and the space men, with a single brief shot showing a puppet "stand-in" spaceman with the puppet creature. While perhaps not the most satisfying effect scene, it does illustrate that puppet and live actor can be "combined" in this way, and even sequences which include composite shots make use of many intercut non-composite shots.

There are three basic processes used to put puppets and actors together in the same frame: static matte, rear projection, and traveling matte. Following descriptions of these methods will be a discussion of variations and refinements which enhance the impression of direct interac-

---

[1]Alexandr Ptushko, "The Coming of a New Gulliver," Sight and Sound, IV, No. 14 (Summer, 1935), p. 60.

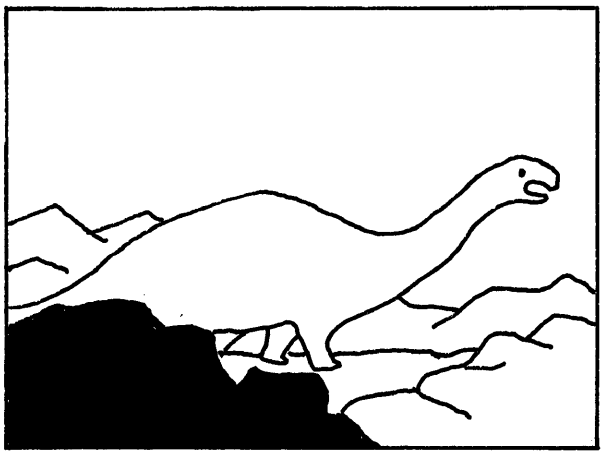
tion between puppet and live actor.

Static Matte

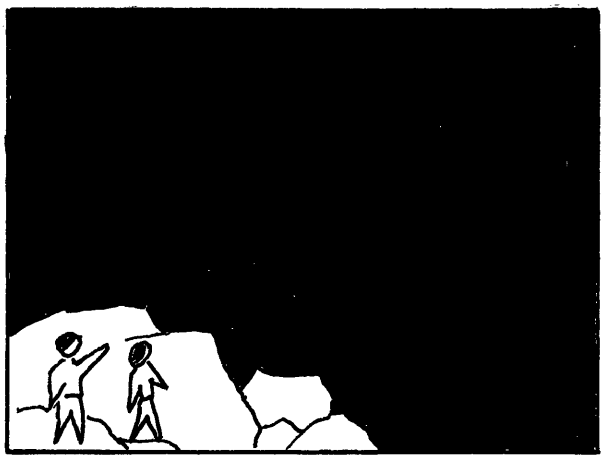
The static matte[1] was one of the earliest composite methods available. As the name implies, it is a matte which does not move. An almost classic static matte shot (seen in both animated and non-animated "monster" pictures) places the actors in a well defined area of the lower corner of the screen, while animated puppets, dinosaurs for instance, perform in the rest of the screen area. The actors might be framed in front of a large boulder which protrudes into the foreground, with the matte/counter-matte line following the edge of the boulder (Fig. 3). The matte (Fig. 3A), being the shape of the boulder, prevents exposure in that area while the puppets are photographed, or printed from previously photographed footage. The counter-matte (Fig. 3B) prevents any re-exposure in the puppets' area while allowing the boulder, with actors in front of it, to be photographed or printed in the boulder-shaped "hole" left by the matte, completing the composite (Fig. 3C).

---

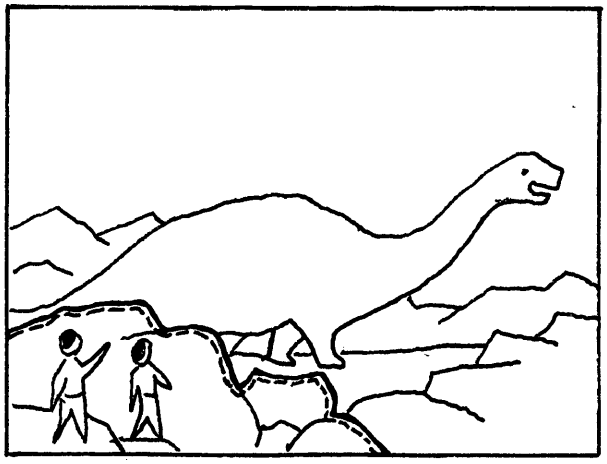
[1]Most professionals would refer to the use of static mattes as "split screen," but to many people "split screen" implies a straight vertical or horizontal line which divides the screen image into two parts. To the professional, "split screen" means any division of the image into one or more parts of any shape. The divisions are accomplished by means of complementary mattes; thus, "static matte" has been selected as a more descriptive term.



A. Puppet photographed (or printed) with matte (black area) in place.



B. Boulder and live actors photographed (or printed) on same strip of film with counter-matte in place.



C. Resulting composite.

Figure 3. Static matte example.

An advantage of static mattes is that the two component images can be of the same generation, and thus the amount of grain and contrast should be about the same in each. Differences in grain and contrast would spoil the effect of the composite by causing the matted areas to stand out from each other.

The chief limitation of a static matte is that neither actor nor puppet can enter, or, more accurately, cross in front of the other's domain. In the above example, puppets who cross the matte line will appear to go behind the boulder, and actors who cross it will simply disappear. It is difficult to suggest any physical interaction between the puppets and the actors when a static matte is the composite means.

As a result of this limitation, poorly designed static matte shots often look constrained, with actors and puppets rather obviously huddled in their respective zones. However, a well designed static matte shot can be quite striking. Willis O'Brien is said to have been the first to combine puppet dinosaurs and actors in the same frame for The Lost World (1925).[1] The film was based on the book by A. Conan Doyle and it dealt with a party of explorers who discover a land full of prehistoric animals.

---

[1]Goldner and Turner, The Making of King Kong, p. 48.

An excellent example of composite work in this film, and one which demonstrates the static matte's potential is the scene in which the explorers come upon a brontosaurus mired in a mud-filled pit. The dinosaur stretches across the lower part of the frame. The wall of the pit rises to the middle of the frame, and the explorers enter the upper part of the frame, walking up to the edge of the wall to look down on the struggling animal. The matte line is perfectly hidden along the edge of the pit, and exposure, lighting angle, and perspective are duplicated in the two halves of the shot. For nearly all puppet/live composite work, perspective and set construction must be worked out and precisely matched in two scales; full scale for the live actors and sets, miniature scale for the puppet performers and sets.

Of course, situations arise in which it is desirable for the action to overlap, for actor and puppet to occupy the same screen area in the same shot. The common tools for effecting these combinations are rear projection and traveling matte.

Rear Projection

Before discussing its relationship to puppet animation, some general facts about rear projection should be noted. Sometimes it is called "back projection," or "rear screen," or "process work." All of these terms describe

the same method. A background plate is projected on the rear of a translucent screen. The image shows through clearly on the opposite side, and may be re-photographed from that side (Fig. 4). Of course, when viewed through the screen, the image is "flopped," that is, reversed left to right; so the film must be flopped in the projector in order to maintain the correct orientation of the projected image. Actors, or puppets, and set pieces may be placed in front of the screen and photographed with its image, yielding a composite which shows them with the background plate footage. This system requires that the screen be shaded from all stray light coming from the foreground area. Any light striking the screen has the effect of severely washing out the image.

Rear projection has been replaced, to some extent, by traveling matte in the general field of non-animation effects work. As film production began to shift more and more to color, rear projection light sources were found to be inadequate to the exposure needs of color film in live action photography, and traveling matte became a desirable alternative. However, when live action footage is used as the background plate (which is nearly always the case in puppet animation/live action composite work), the rear projection image can be smaller, and therefore brighter because it only needs to be large enough to accommodate the

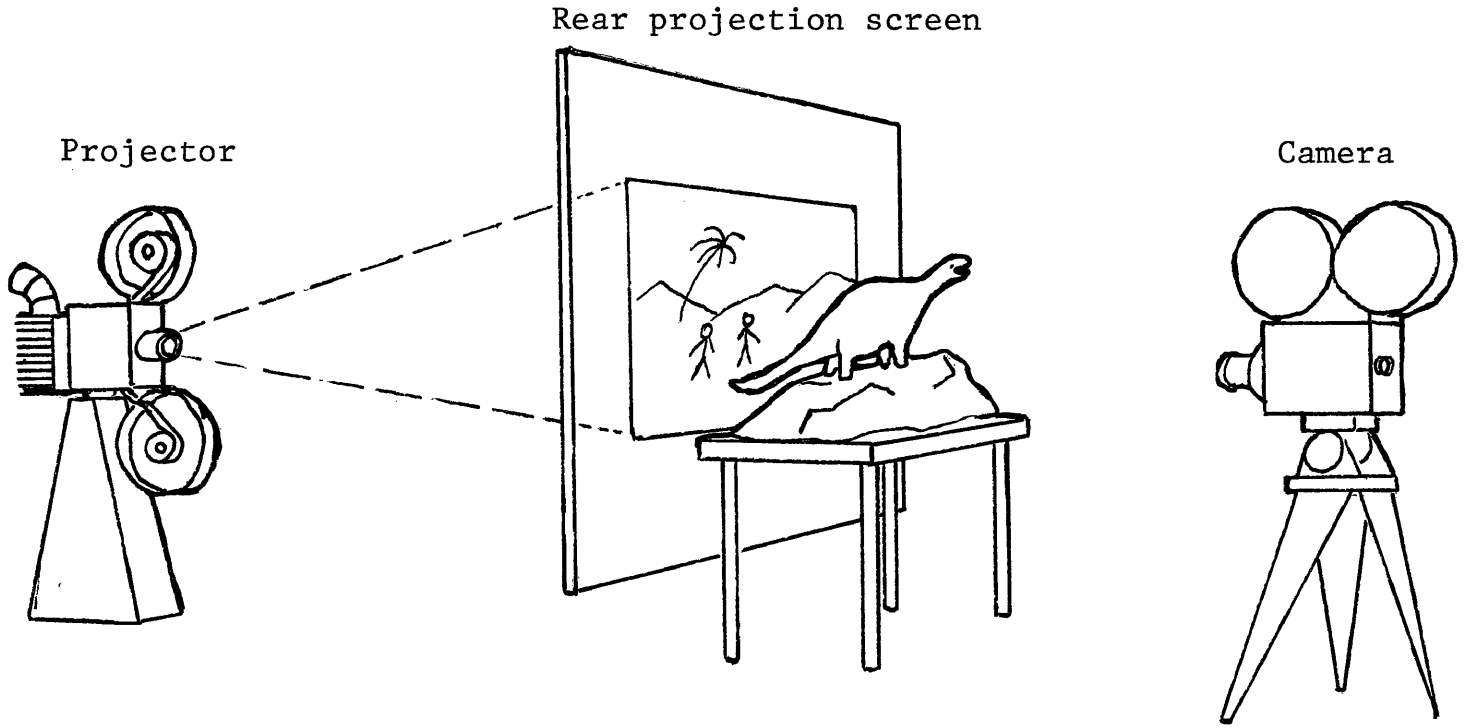


Figure 4. Basic rear projection set up. This drawing is simplified. Lighting equipment and other paraphernalia are not shown; and, in actual practice, the puppet would be farther from the screen in order to keep lighting from spilling onto the screen.

puppet. Also, the puppet animator has the advantage of being able to lengthen his shutter speed to compensate for low light levels from the rear projection screen. Working one frame at a time, he is not limited to the shutter speeds imposed by live action photography at twenty-four frames per second. Rear projection is, therefore, still common (indeed, almost basic) to puppet animation/live action composite work, and will be discussed in some detail.

In any rear projection composite, it is important that the background image not jiggle or weave as it is being re-photographed. For this reason, the cameras used to make background plates and the projectors used to show them commonly have registration systems similar to that found in an animation camera. Some very thorough effects technicians go to the trouble of making sure that the projector uses the same sprocket holes for registration as the camera which recorded the plate, selecting from the four holes available for each 35mm frame one which fits snugly on the registration pins.[1]

Once the background has been photographed, a positive print must be made from the original negative for projection, and one of the most serious drawbacks to rear pro-

---

[1]L. B. Abbott, "The Cameraman and Special Photographic Effects," American Cinematographer, LVI, No. 10 (October, 1975), p. 1151.

jection results from the fact that the background footage is a first generation print. When this is re-photographed it becomes essentially a second generation print. However, the subject in front of the screen is being photographed for the first time. Therefore, when a first generation print is made from the composite footage, the subject is of first generation quality while the background is of third generation quality.

This disparity is quite difficult to deal with and sometimes is quite conspicuous, particularly in color films. Care must be taken in every step of the preparation of a background plate to hold down the negative effects of duplication. Ray Harryhausen comments on the contrast build-up problem encountered during the making of The 7th Voyage of Sinbad:

> The lighting, particularly on interiors, had to be carefully adjusted to allow for secondary negatives. This means making sure the dark areas and highlight areas will look similar to the intercut original negative after duplication for the addition of the special effects. Today, new fine-grain raw stocks have been developed, that help enormously to overcome this problem.[1]

A difference in contrast between composite and non-composite shots may be seen during the first part of the dance of the animated Snake-woman in The 7th Voyage of Sinbad.

In spite of improvements in film stocks, contrast

---

[1]Harryhausen, Film Fantasy Scrapbook, p. 68.

build-up is still a problem. Each background plate has its own idiosyncracies and an effort must be made in the printing stage not to exaggerate them. Opinions differ, even among experts, on the best approach to printing given background plates for rear projection.[1]

Matching color is as important as matching contrast, and just as difficult. Many times, the area on which a puppet is standing must be painted to match a similar area being rear projected on the screen behind it. The problem here is that film emulsions do not record color in exactly the same way that the eye perceives it. Therefore, when the puppet's floor area has been painted so that it will match the rear projected image in the final composite, it looks incorrect to the eye. Often, many test shots must be made before a match which looks good on the screen is achieved. Often, too, limited production time cuts testing short, and less-than-perfect matches result. Even in Ray Harryhausen's most recent feature, The Golden Voyage of Sinbad, some "floor inlays," as Harryhausen calls them,[2] are evident if one looks closely. In the sequence involving the six-armed statue, goddess Kali, some of them appear as irregular, discolored areas around the puppet's feet.

---

[1]Interview with David Allen, November 3, 1975

[2]Letter from Ray Harryhausen, January 18, 1976.

This problem is compounded by the fact that even the strictest quality control in the processing and printing of film leaves room for variation. For example, two prints made on different days from the same original may have a slightly different color and contrast characteristics. These differences will be intensified when the prints are re-photographed from a rear projection screen. Thus, composites made with each print may look noticeably different, in spite of all efforts to ensure consistency.

Grain is less a problem than color and contrast, but it is still a problem. Ironically, grain is greatest in the original negative itself, and current printing stocks do not add much of their own.[1] One reason for this is that printing stocks, because they need not have the fast exposure characteristics of films used in live action photography, have very low ASA ratings.

Many possibilities have been considered for reducing visible grain. One is to shoot the background plate in a larger film format, such as 65mm, spreading the image over a larger film emulsion area. The problem one runs up against here is a very common one, the lack, or scarcity, of dependable equipment. For instance, there is little

---

[1]Jim Danforth, lecture on special visual effects in class at the University of Southern California, May 26, 1976.

enough demand for 35mm projectors which project one still frame at a time and incorporate a registration mechanism. There is far less demand for 65mm projectors with the same refinements. The only reason such specialized devices come into being at all is that they are hand made for specific, big-budget productions. Several 35mm "process" projectors were built for the rear projection work in Mighty Joe Young, and most of those machines are still in use.[1] The budgets for most films prohibit such expensive design and development work.

Another possible way to minimize grain would be to shoot the background plates on reversal (positive) film instead of on standard negative film. This would allow one to project the camera original, instead of a first generation print. The same problem as is discussed above is met with here. Standard negative is the standard, and to use anything else is to run the risk of receiving inconsistent results both in photography and in processing. The most important objections, however, are that original film would be irreplaceable if damaged and the flexibility possible with prints would be lost. Original negative may be printed again and again until a print of optimum color and contrast is obtained and, of course, the negative is carefully handled and is always available for replacing

---

[1]Interview with Bill Hedge, November 3, 1975.

a damaged print.

The standard procedure, then, for getting the highest quality first generation print is to shoot the background plates "full aperture," that is, using the largest available area of each 35mm frame by expanding the picture so that it fills the space normally reserved for the optical sound track and the proportionate frame line area. This is equivalent to shooting in a slightly larger film format because, when the print is made, the full aperture area is optically reduced to Academy aperture (which does not take up the full 35mm frame area). This process yields roughly a twenty-five percent decrease in perceptible grain.[1]

In some cases, a special print can be made which makes grain even less prominent. The original footage and the print stock are run through the printer twice. Each pass is made at fifty percent full exposure, so that the print receives one hundred percent exposure; but on the second pass, the original is shifted one frame ahead or behind the first pass. This means that each frame of the print is actually a blend of two frames of original, superimposing two patterns of grain structure and making them less visible. The technique is suitable only for background plates in which there is no motion, or only very

---

[1]Interview with David Allen, November 3, 1975.

slow motion, lest the double exposures show up as ghostly fringes on moving objects. Danforth used it on the rolling ocean background plate seen with a puppet dinosaur which overturns a raft in When Dinosaurs Ruled the Earth.[1]

The background plate aside, another element which can degrade the rear projected image is the rear projection screen itself. Because the puppet is usually animated in front of the screen, the projected image is small (relative to the image size necessary to accommodate live actors). This means that any pattern in the structure of the screen is magnified, and it may become visible in the composite. When it does, it looks similar to the grain pattern which may be seen in film emulsion. Again, it is highly noticeable because it affects just the background image, and not the subject in front of the screen, tending to visually separate the two and marring the composite. This effect may be seen in The Golden Voyage of Sinbad; just after Sinbad and his crew have landed on the island of Lemuria, an extreme long shot shows them as they begin a climb up from the beach. The shot pans and reveals the Homunculus (animated creature) watching the group. The screen "grain" which does not move, is particularly evident during the pan.

When the animator determines that the image size for

---

[1]Danforth, lecture, May 26, 1976.

a given shot may be small enough to make screen grain visible, he may arrange his screen so that it can be moved (either rotated or oscillated) in a plane perpendicular to the camera/projector axis while the camera shutter is open. The slow shutter speeds common in puppet animation make this practical, and the effect is to blur out the screen's grain pattern without affecting the projected image. Technically, the image is not improved, but the removal of one of the elements which causes it to contrast with the puppet improves the composite.[1]

It should be understood that it is not impossible to obtain excellent results in color rear projection composites. However, it would seem that a small amount of luck is helpful in making a completely successful shot. David Allen sums it up: "It's kind of . . . an inexact science."[2]

The method for using rear projection in puppet animation/live action work has undergone one major change, for Willis O'Brien's unique version of rear projection,

---

[1]Some thought has been given to eliminating the screen altogether, animating the puppets in an aerial image. However, David Allen suspects that the lenses necessary to form an aerial image large enough would probably be difficult to design and make, and would be quite large and cumbersome. A major drawback would be the extra costs involved in any non-standard operation which demands development of hardware and extensive testing (interview with David Allen, November 3, 1975).

[2]Interview with David Allen, November 3, 1975.

used in King Kong, Son of Kong (1933), and Mighty Joe Young, has been replaced by more economical variations. His process was called miniature rear projection, and O'Brien was the major force in its development.

Miniature rear projection was used to place live actors in the model sets of animated puppets. The sets were designed with holes in them behind which small rear projection screens could be placed to receive images from projectors in back of the sets.[1] The images were of live actors filmed against full scale sets which matched the miniature sets, filling in the holes.

The model sets were enormously complex. In addition to three-dimensional objects, they included scenery painted on sheets of glass mounted vertically in the sets. Much of the lush jungle foliage in the King Kong jungle was painted, an excellent method for getting foliage to hold still for animation, but one requiring the skills of top notch artists.

During animation, the projectors were advanced one frame each time a frame was taken of the puppets, allowing for puppet action to be timed precisely to live action. An

---

[1]The problem of screen grain was very acute when such small screens were used. For King Kong it was necessary to find a substitute for the Saunders cellulose screen material which had just become available. Surgical rubber stretched over small frames proved to be the best replacement (Goldner and Turner, The Making of King Kong, p. 93).

important advantage over static matte composites was that the puppets could pass in front of the rear projection screens. This made possible, for example, the composite shots which show animated Kong reaching "into" a shallow cave where Jack Driscoll (Bruce Cabot) takes refuge. The actor, filmed in a full scale cave interior set and rear projected behind the miniature cave entrance in Kong's set, can be seen dodging Kong's paw as Kong feels around the entrance to the cave.

O'Brien emphasized the importance of production sketches for maintaining coordination of composite elements. A sketch showed the position, scale, and lighting of each section of a composite, and this plan was followed down to the last detail in the designs for full sized and model set construction; and in the painting of the glass elements (occasionally, the sketches were actually projected onto the glass to be copied by the glass artists); and in the lighting, which was emphasized sometimes by appropriate painting of portions of the sets.[1] So critical were the elaborate set ups for Kong that a portable dark room was placed on the stage for the immediate processing of test film.[2] Animation could begin as soon as a test was ap-

---

[1]Willis O'Brien, "Miniature Effects Shots," International Photographer, V, No. 4 (May, 1933), p. 39.

[2]Goldner and Turner, The Making of King Kong, p. 64.

proved.

Willis O'Brien received an Academy Award for his work on Mighty Joe Young, but by the time that film was finished, in 1949, production costs had risen to a point which made his techniques too expensive. Miniature rear projection screens, painted glass, and model sets--and the spectacular, atmospheric effects which could be achieved with them--were to be largely dispensed with in all later puppet animation features.

It fell to Ray Harryhausen, who worked under O'Brien on Mighty Joe Young, to devise a more economical method for combining puppet animation with live action. On his first solo feature, The Beast from 20,000 Fathoms, the budget was about 200,000 dollars,[1] or one ninth the 1,800,000 dollars spent on Mighty Joe Young.[2]

Harryhausen's solution was to put the puppets into live backgrounds, rather than to put actors into puppet sets. The technology remains the same, rear projection, but the reversal in concept is extremely significant.

Suppose an animated creature is to pursue some live actors across the screen. The simplest Harryhausen set up for this shot would begin with a live action background

---

[1]Harryhausen, Film Fantasy Scrapbook, p. 33.

[2]Shay, Focus on Film, No. 16, p. 44.

plate projected on a rear projection screen. The plate, of course, is made specifically for this shot, with the height of the camera, its angle of view, the lens focal length, and the lighting all predetermined, to be matched in the animation photography. The size of the rear projected image is selected according to how large the puppet is supposed to look compared to the actors. The puppet is placed in front of the screen on a utilitarian support floor which will not be seen in the final composite (Fig. 5). The animation camera is positioned so that the puppet's feet are roughly at eye level, relative to the plate image (this is only necessary in a situation where the puppet floor is to be entirely eliminated from view).

It is at this point that Harryhausen's contribution comes into play. A static matte is employed to conceal the puppet floor. Typically, the matte is painted on glass which is mounted between the camera and the puppet, with the matte line just above the surface of the puppet floor, just touching the bottoms of the puppet's feet, and extending right across the frame along the path which the puppet's feet will follow. Naturally, this matte also blots out the portion of the rear projected image below the puppet's feet (Fig. 6A).

Now the animation proceeds, matched to the live action frame by frame. When this phase is finished, the

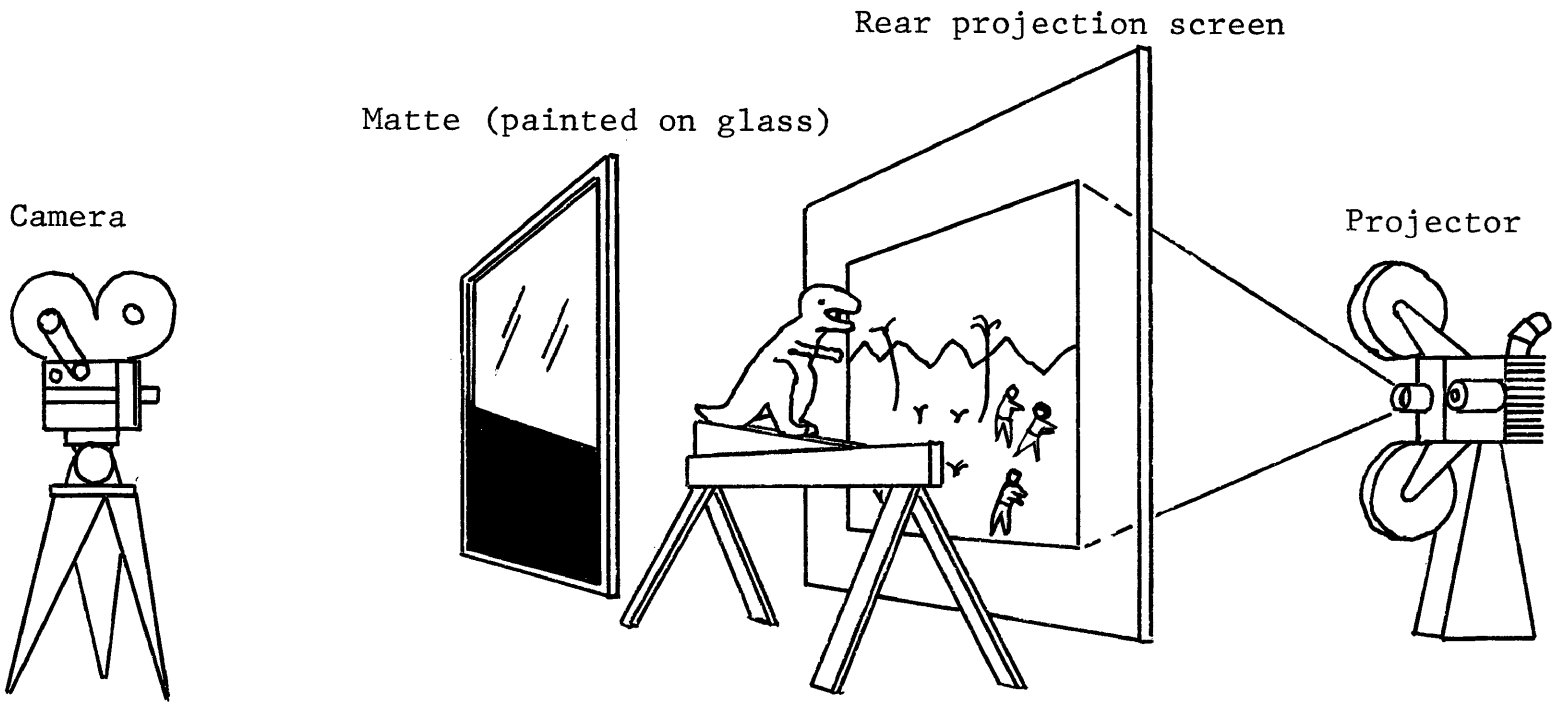
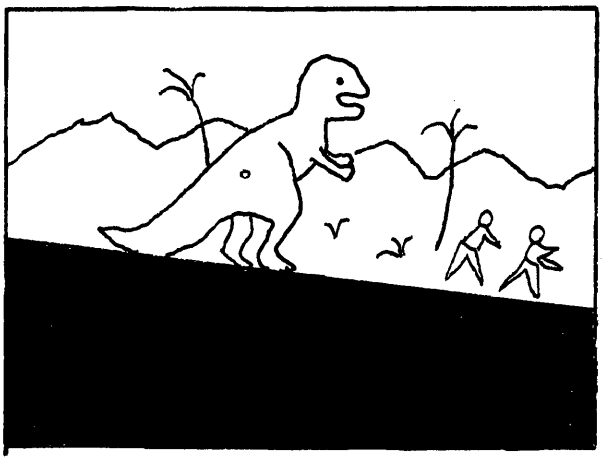


Figure 5. Static matte/rear projection composite set up.

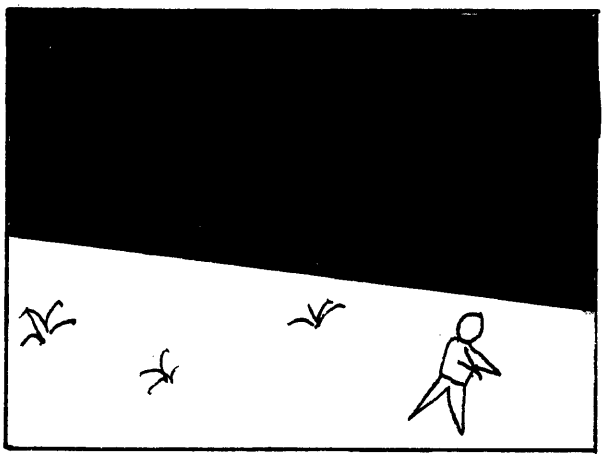
footage in the camera has recorded the puppet in combination with the background plate down to the edge of the matte line. Below the line, the camera has recorded black, or, as far as the film emulsion is concerned, nothing.

The puppet and the support floor are now removed, and a counter-matte is painted between the camera and the rear projection screen, the counter-matte covering everything above the original matte line, and leaving the bottom portion clear (Fig. 6B). The projector and the camera are now rewound to their original starting positions and a second pass is made, advancing the camera and the projector and re-exposing each frame. Since the puppet floor is gone, the camera simply records the remaining portion of the background plate.

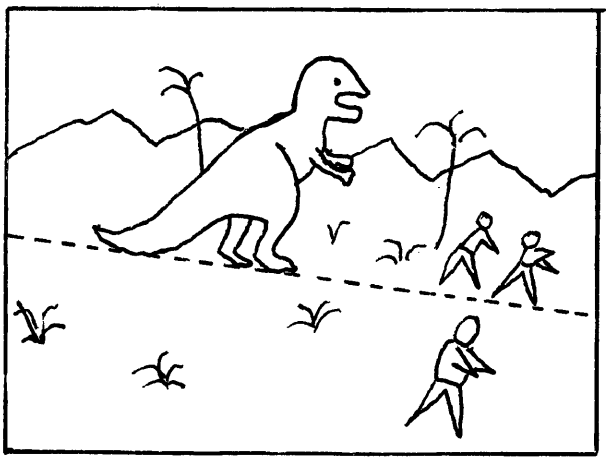
If the above process has been carried out carefully, the composite will show the live actors and the puppet together, and puppet will appear to be standing "in" the background plate (Fig. 6C), since a portion of the plate's image appears to extend under the puppet's feet (the portion that was photographed on the second pass). The overwhelming advantage here is that there is no need for a puppet set full of animation-proof set pieces and painted backgrounds. Trees, smoke, water and other troublesome elements may all appear in the background plate without affecting the animation process. Also, the movement of the live actors is



A. First pass. Camera's view of set up shown in Fig. 5. Matte hides animation support floor.



B. Second pass. Puppet and support floor removed. Countermatte protects area exposed in first pass while permitting exposure of remaining background plate image area.



C. Finished composite. Position of matte line indicated by dotted line.

Figure 6. Static matte/rear projection example composite.

not limited to a tiny portion of the screen area. They may move anywhere on the plate as long as they do not pass behind the puppet at a point where perspective dictates they would be passing in front of the puppet. This does not mean an actor cannot move into the foreground. He can. Theoretically he can walk all the way up to the camera without destroying the effect of the composite, as long as his image on the rear projection screen does not go behind the puppet. Another important advantage to bear in mind is that elements in the rear projected image can usually cross the matte line. When the second pass is complete, the two portions of the rear screen image have been effectively welded back together, and a good matte will be nearly invisible even to the practiced eye. Thus, as long as the frame sequence is identical in both passes, the rear projected image remains essentially unchanged except where it is obscured by the body of the puppet. A disadvantage, which is common to all composite work involving multiple passes of the film, is that minute discrepancies in registration may cause the two sections of the plate image to jiggle along the matte line. In general, this movement is rarely noticed by the average viewer.

In order to avoid the limitation of having the puppet's feet always appear behind objects or at eye level, and to allow the puppet to cast a shadow, it is a common

practice to leave sections of puppet flooring visible and record them as part of the final composite. These are the floor inlays mentioned earlier in the discussion of color matching.

The use of static mattes on rear projected images was titled "Dynamation" with the release of The 7th Voyage of Sinbad in 1958. Harryhausen and his producer, Charles H. Schneer (who has produced nearly all of Harryhausen's twelve features), coined the term in order to differentiate between Harryhausen's dimensional animation and normal cartoon cel animation.[1] Over the years the name has varied. It was hailed as "Superdynamation" for The Three Worlds of Gulliver and Mysterious Island; "Dynamation" again for The Valley of Gwangi; and, most recently, "Dynarama" for The Golden Voyage of Sinbad. There is also occasional reference to the use of "Electrolytic Dynamation" in the Harryhausen film which preceded The 7th Voyage of Sinbad, 20 Million Miles to Earth,[2] although this term does not appear in the titles of that film.

Behind its various names, the process has remained basically the same. This does not negate its importance, however, for in reducing the need for model set construc-

---

[1]Harryhausen, Film Fantasy Scrapbook, p. 66.

[2]One source that refers to "Electrolytic Dynamation" is Dennis Gifford's Science Fiction Film (New York: E. P. Dutton and Co., 1971), p. 89.

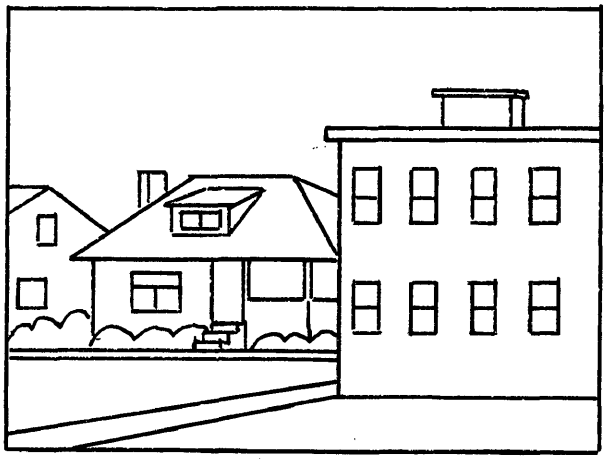
tion, the technique vastly simplifies the rear projection compositing of puppets and live actors. It is also important to note that most composite shots of this type are completed in the animation camera, with no additional laboratory work necessary. Furthermore, the process is extremely flexible. Consider, for example, that of all the many composite shots in The 7th Voyage of Sinbad, only eight were made via traveling matte.[1]

By placing static mattes over different areas of the background plate, a wide variety of composites can be achieved. For example, the puppet may be made to appear to come from behind a building by matting out the building along its edge on the first pass and animating the puppet to come from behind the matte. On the second pass, with the counter-matte in place, the building is printed in to complete the composite. Since the matte line follows the edge of the building, the puppet coming from behind the matte seems to come from behind the building (Fig. 7).

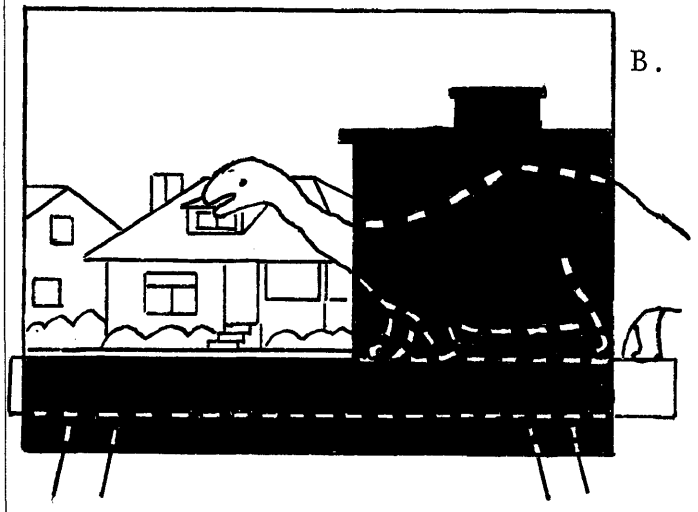
Even camera movement in the background image is possible in certain situations. When the large, flying reptile, pteranodon, carries actress Raquel Welch off in One Million Years B.C., one of the background plates includes a camera pan. The puppet pteranodon (clutching a

---

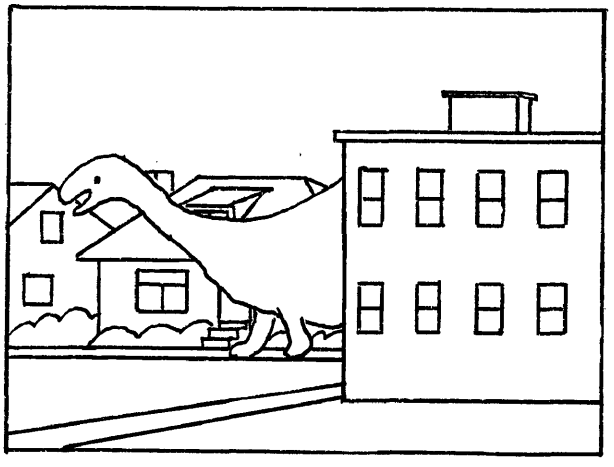
[1]Harryhausen, Film Fantasy Scrapbook, p. 60.



A. Background plate image on rear projection screen.



B. Matte is painted to follow outline of foreground building (and portion of street). Animation is carried out.



C. Finished composite (after second pass with counter-matte, not shown).

Figure 7. Static matte/rear projection example composite.

puppet Miss Welch at this point) is combined with this pan, and the effect is a shot which appears to follow the flight of the reptile when in fact, in terms of linear movement, the puppet remained almost stationary during animation.

Front Projection

Front projection, a relatively new arrival on the visual effects scene,[1] accomplishes the same task as rear projection. It provides an image of a background plate which may be re-photographed with persons or objects placed in front of it. The major differences are that the screen is highly reflective,[2] not translucent, and the image is projected from the camera side. The projector is mounted at right angles to the screen, and its image is reflected onto the screen from a semi-transparent mirror mounted in front of the projector, at forty-five degrees to the

---

[1]As with many "new arrivals" in any field, the concept has been known for years. A kind of "front" projection was described in 1932, the means being to project through a small hole in a large mirror. The mirror, mounted at an angle to the screen, reflected the image from the screen to a camera. Actors and objects placed between the mirror and the camera could be combined with the background image (Ralph G. Fear, "Projected Background Anematography," American Cinematographer, XII, No. 9 (January, 1932), pp. 11-12, 26).

[2]The screen surface is comprised of very tiny glass beads. Light which enters the beads is focused on a reflective resin in which the beads are embedded, reflected, and refracted as it exists, being sent out at the same angle as the angle of entry, back toward the source of light.

projector's beam. A camera, mounted at right angles to the projector, with the longitudinal axis of its lens aligned in precisely the same plane as that of the projector lens, looks straight at the screen through the opposite side of the mirror (Fig. 8).[1]

Much of what may be said of rear projection is true of front projection as well. There are some differences which should be noted, however. One of these is the tremendous light output of the front projection screen. For full sized projection, this is a major advantage over rear projection, allowing for the projection of extremely large background images. But, as has been noted, light output is not a major concern for the puppet animator, who may compensate with slower shutter speeds and who rarely needs a plate image larger than ten feet in width.[2] Thus, this characteristic is of little significance in his composite work.

Front projection requires about half the space for set up as rear projection, because the projector is not be-

---

[1]A semi-transparent mirror allows some of the light which strikes it to pass through it, and reflects the rest. Donald Heraldson has offered a useful analogy for visualizing the function of the mirror. He describes it as working like mirrored sunglasses. They reflect most of the light which hits them, but the eye behind can still see through (Donald Heraldson, Creators of Life [New York: Drake Publishers, 1975], p. 174).

[2]Danforth, lecture, May 26, 1976.

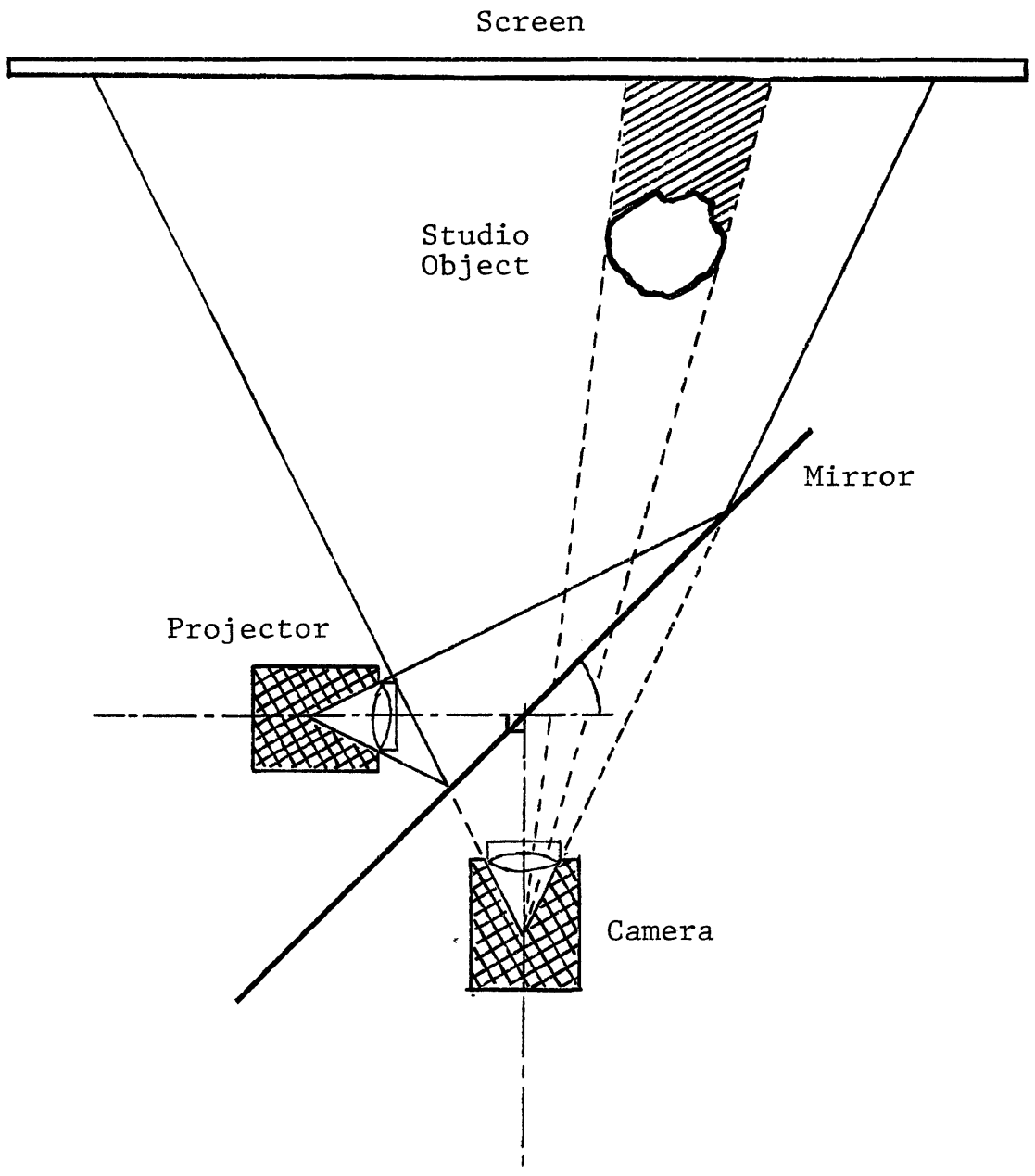


Figure 8. Top view of a basic front projection set up (from Benjamin P. Burtt, Jr., "The Development of a Dual-Screen, Dual-Mirror Front Projection Technique for Application to 16mm Special Effects Cinematography." Unpublished Master's thesis, Department of Cinema, University of Southern California, 1976, p. 16).

hind the screen. Also, the lighting of subjects in front of the screen is simplified; so directional is the reflective surface of the screen that light falling on it from the set lights is reflected back at them. Thus, a certain amount of light may strike the screen without washing out the image.

Gene Warren, who has used front projection to combine pupets with live action in both feature films and television commercials, says that the quality of background plate is slightly improved when it is front projected; subjectively speaking, he judges the improvement to be, in effect, about half a generation.[1]

An interesting alternative to the use of static mattes during re-photography of the background plate has been suggested for front projection. The screen material is supplied in flexible sheets, or rolls, and can be mounted on almost any suitably rigid material, such as cardboard, and cut to match the outline of some object in the background image. This cut-out is mounted in front of the screen. Ideally, it does not noticeably interrupt the screen image, and a puppet may be animated to walk from behind the cut out, just as may be done with a static matte. The advantage here, of course, is that no second pass is necessary to complete the composite, and thus there

---

[1]Interview with Gene Warren, November 18, 1975.

is no danger of faulty registration causing the sections of the background image to jiggle.

Ben Burtt, Jr., who has carried out extensive research with front projection as a source of economical special effects,[1] tested the above process and found it limited. The foreground screen must be quite close to the background screen in order to stay within the projector's depth of field. Also, the nearer screen's image becomes increasingly brighter as the screen is moved closer to the source of light.[2] Burtt's research led to the development of a much more elaborate system for achieving front projection optical effects.

Noting that roughly half the light from the projector passes through the mirror, and is not reflected to the screen, Burtt devised a method for taking advantage of the "wasted" image (Fig. 9). A second screen is set up in the path of this light. The image from this screen is reflected off the back of the reflective surface of the semi-transparent mirror, and thus is also seen by the camera. Using static mattes adapted to compensate for the image

---

[1]Benjamin P. Burtt, Jr., "The Development of a Dual-Screen, Dual-Mirror Front Projection Technique for Application to 16mm Special Effects Cinematography." Unpublished Master's thesis, Department of Cinema, University of Southern California, 1976.

[2]Ibid., pp. 53-54.

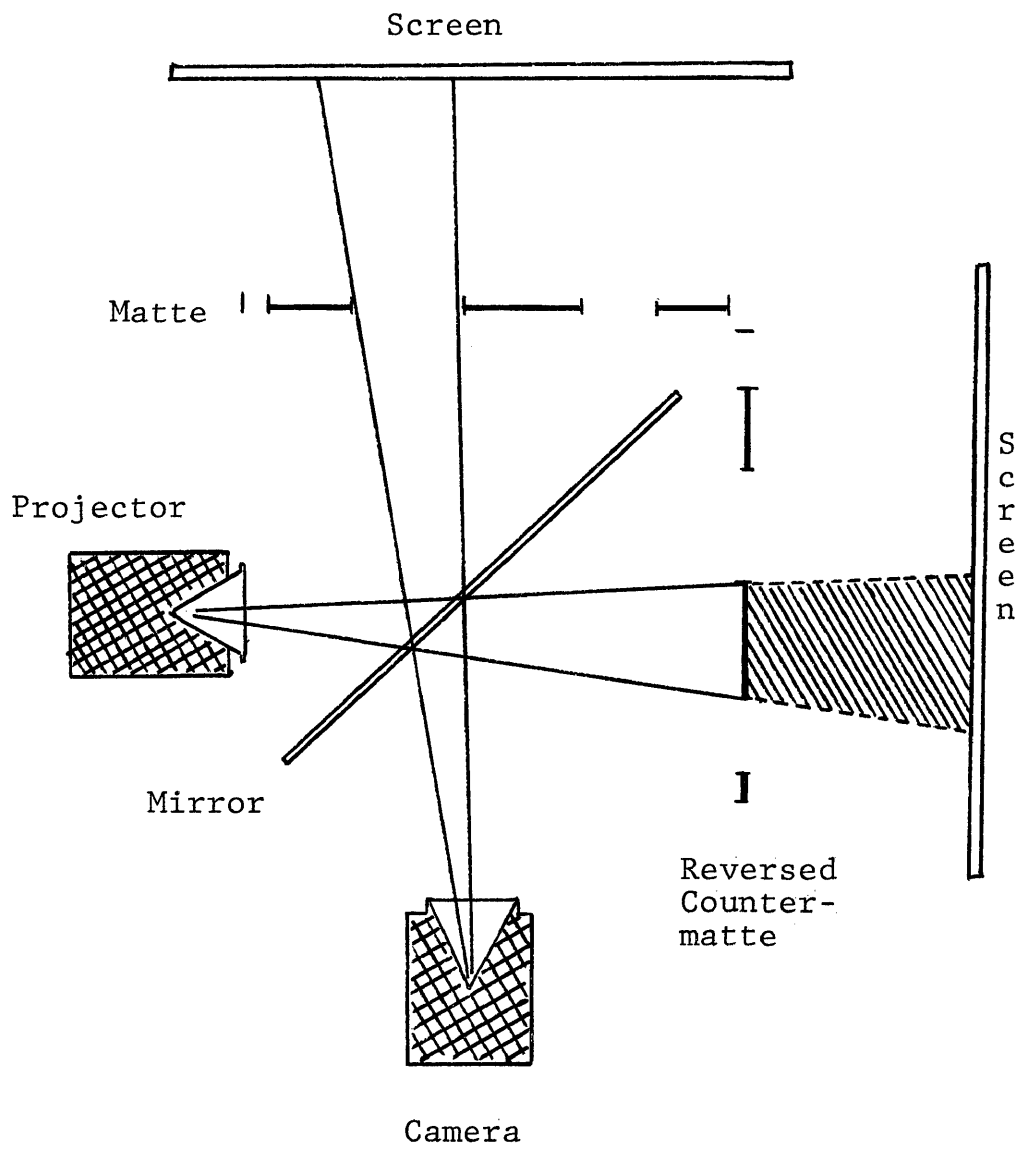


Figure 9. Top view of a dual-screen front projection set up (from Benjamin P. Burtt, Jr., "The Development of a Dual-Screen, Dual-Mirror Front Projection Technique for Application to 16mm Special Effects Cinematography." Unpublished Master's thesis, Department of Cinema, University of Southern California, 1976, p. 56).

reversal encountered with the mirror[1] (the matte in front of one screen, and its reversed countermatte in front of the other) Burtt is able to split the total image along any suitable line, and place studio objects "behind" areas of the background plate in one pass of the camera film.

Gene Warren made an interesting use of front projection to "move" a puppet through the frame. The puppet was Ugly Bird, seen in The Legend of Hillbilly John (1973). In the story, Ugly Bird, makes several angry diving runs at Hillbilly John. Rather than mount Ugly Bird in such a way as to allow for moving the puppet across the projected image, the puppet was mounted on a rigid support affixed to its off camera side and bolted directly onto the front projection screen. The camera, mirror, and projector were all mounted on a single support, and could be moved as a unit. The background plate image was "panned" across the fixed puppet (whose wings, of course, were animated to simulate flight). Since the image remained static, relative to the camera, the composite showed Ugly Bird swooping through the frame.

Warren and his crew at Excelsior Animated Moving Pictures have achieved some excellent results with front projection. There is a striking sequence in The Legend of

---

[1] Ibid., p. 58.

Hillbilly John involving the destruction of a servant of Satan. The actor playing the doomed minion was replaced by a puppet at an appropriate moment and the composite shows the puppet apparently standing, and dissolving, right in the midst of a group of live actors.[1]

The major disadvantage to front projection is that currently there is no equipment being manufactured for it. The mounting mechanisms for projector, mirror, and camera must be custom built, and that in itself is enough to make most producers shy away from the technique. Also, many special effects animators have their own rear projection equipment, and do not relish the thought of having to modify or replace it.

Another disadvantage is that the mounting of projector, camera, and mirror is extremely critical. Camera and projector must be equidistant from the mirror, and their lens axes must be perfectly aligned. There is no room for

---

[1]Exceedingly convincing, too, is Warren's Purina Chuckwagon television commercial which shows an animated chuckwagon and team of horses racing through a house and being followed closely by live dogs. It was desired that the wagon have a shadow, so a puppet floor, visible in the composite, was necessary. The remarkable thing is that sections of the puppet floor were removed during animation as soon as the wagon left them, so that the dogs could follow immediately behind and on the same path (if the puppet floor had been left in place, the dogs' feet would have disappeared behind it). The match between puppet floor and live floor is so good that the puppet floor goes unnoticed, even though sections of it are being "popped off" in full view (interview with Gene Warren, November 18, 1975).

error. This can cause some increase in set up time,[1] and it means that camera movement (a pan, for example, across the image of the background plate) is just about out of the question.

Gene Warren reports that the semi-transparent mirror adds its own contamination to the complex of problems surrounding color matching. It affects the color of the background plate and the color of the studio subject, but not to the same degree. This calls for a filter combination on the projection lens, and the inevitable testing and re-testing.[2]

The above disadvantages do not constitute an overwhelming argument against the use of front projection, nor do the above advantages indicate a universal switch from rear to front projection for puppet animation/live action composite work. Mere inertia would probably forestall such a switch, because animators are familiar with rear projection, and because of the economic committment to that process. In all likelihood, as hardware becomes available,

---

[1]Alignment can be a frustrating exercise in trial and error. However, Ben Burtt has devised a system for elminating the guesswork, and he details this system step by step in his report ("The Development of a Dual-Screen, Dual-Mirror Front Projection Technique for Application to 16 mm Special Effects Cinematography." Unpublished Master's Thesis, Department of Cinema, University of Southern California, 1976, pp. 77-94).

[2]Interview with Gene Warren, November 18, 1975.

front projection will take its place with other compositing techniques as being the most appropriate for certain kinds of compositing situations.

Traveling Matte

This compositing method is referred to variously as "blue screen," or "blue backing process;" and "sodium screen," or "yellow backing process." These terms all refer to the two most common photographic systems for obtaining a traveling matte in color filmmaking. The basic difference between them is that one, "blue screen," requires only one strip of film in the studio camera; and the other, "sodium," or "yellow backing," requires two strips of film running simultaneously in a special studio camera. Each has advantages and disadvantages, but the general term, "traveling matte," is adequate for the purpose at hand.

When a traveling matte is to be created through either of the above means, a moving subject is photographed in front of a special background. From the film of that subject, two new strips of film can be printed which contain, respectively, mattes and counter-mattes[1] for each

---

[1]According to Walter Beyer, in his comprehensive article on traveling matte, the most common terms for the complementary mattes produced in traveling matte processes are "male" and "female" mattes ("Traveling Matte Photography and the Blue Screen System," Journal of the Society

frame of the original footage (Fig. 10). In other words, a traveling matte matches the action of the specially photographed subject frame for frame, and this allows the subject to be printed onto any desired background plate footage (Fig. 11).

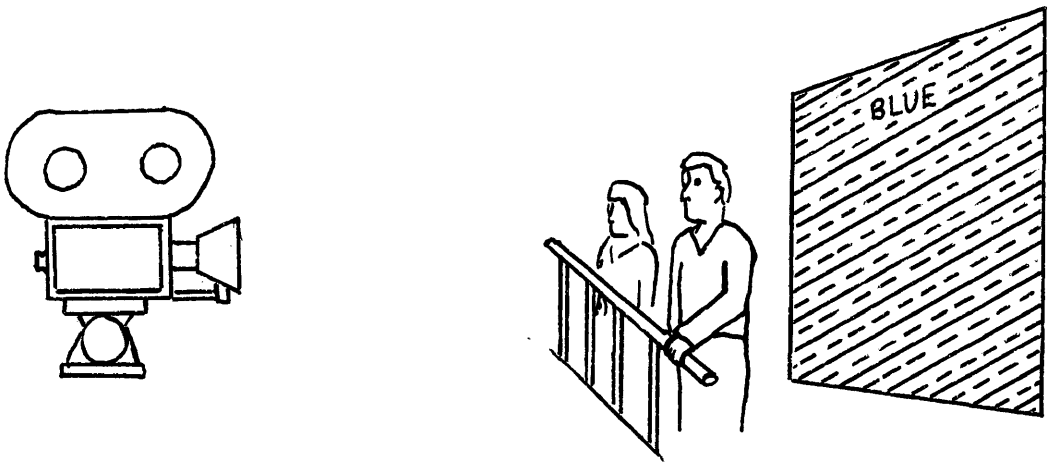
In practice, for reasons which will be discussed below, puppet animators use traveling matte to solve only those composite problems which cannot be solved by rear projection. One such problem arises when a live actor must cross directly in front of a puppet. It is theoretically possible to create this effect with rear projection; one would just reverse the composite elements, using puppet footage as a background plate and photographing a live actor in front of this. Indeed, in black and white production this procedure was followed occasionally. King Kong's battle with a tyrannosaurus rex served as the background plate for medium close shots of Fay Wray perched in a tree top in the foreground (Merian Cooper claimed that the opening shot of this sequence was the first rear projection shot ever done at RKO).[1] Also, in Mighty Joe Young, full

---

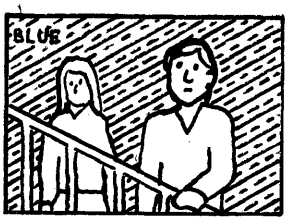
of Motion Picture and Television Engineers, LXXIV, No. 3 [March, 1965], p. 217). Since these terms are specific to traveling matte, and the more general terms "matte," and "counter-matte" are applicable to traveling matte as well as to static matte, it is deemed advisable, for the sake of clarity, to maintain the use of the latter terms here.

[1]John Stag Hanson, "The Man Who Killed Kong," Movies International, I, No. 3 (July-August-September, 1966), p. 65.

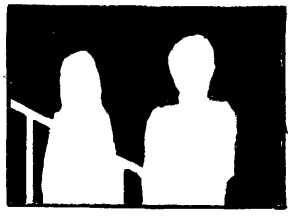
Figure 10. Blue screen traveling matte components.



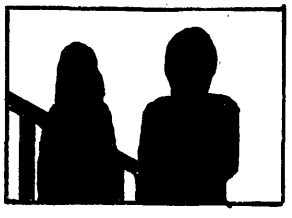
Subjects photographed in front of blue background.



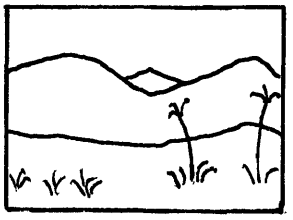
A. Positive print from camera original shows subjects and blue background. Special printing of camera original yields matte and counter-matte footage (B and C below).



B. Matte.



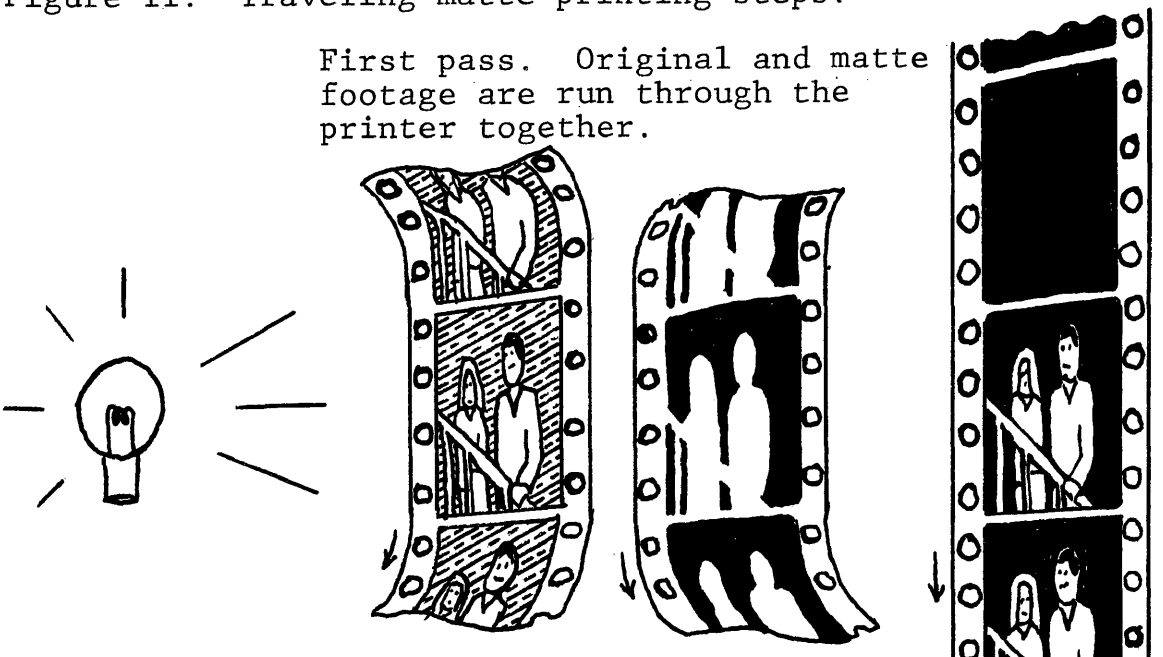
C. Counter-matte.



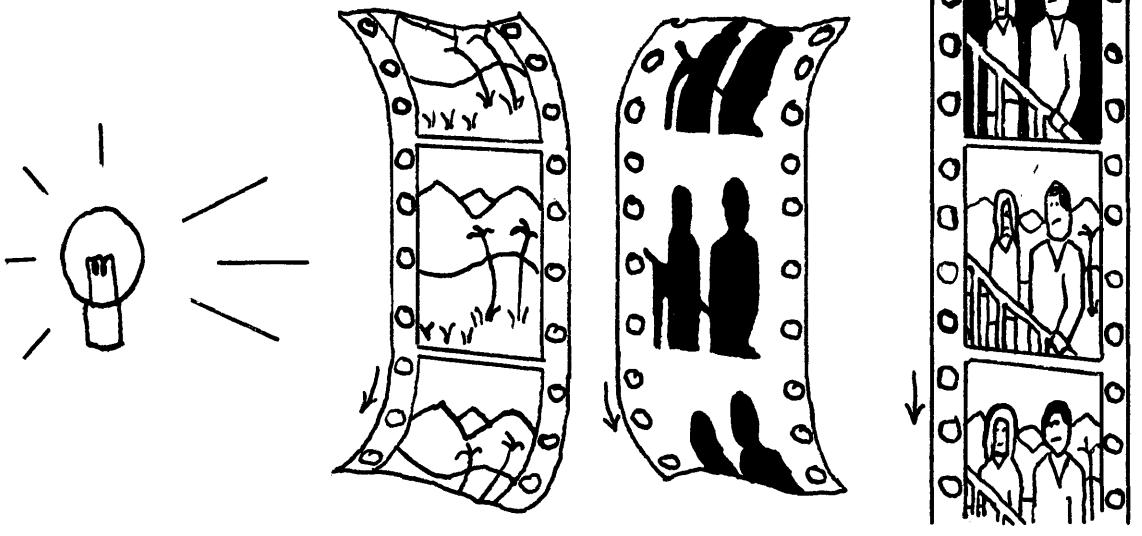
D. Background plate.

Figure 11. Traveling matte printing steps.

First pass. Original and matte footage are run through the printer together.



Second pass. Background plate and counter-matte are run through printer together.



In the first pass, the matte blocks the blue while allowing the subjects' images to print. In the second pass, the counter-matte protects the subjects' image area and allows the background plate to fill in the rest of the frame area. (Original and background plate are shown as positive images to avoid confusion; original negatives are used in actual printing).

sized rear projection was used to put Joe behind three drunken nightclub patrons who harass Joe in his cage.[1]

As has been indicated, the necessity for shooting in color has all but put an end to full sized, live action rear projection because of the proportionately larger screen images required and the restriction to shutter speeds at twenty-four frames per second. Traveling matte, which allows the matted subject to be photographed separately, imposes no exposure problems.

Even in black and white, there are situations which would demand a rear projected image much too large for practicality. When King Kong bursts open the huge doors to the Skull Island native village, he is revealed behind the doors as they open into the live village set. A static matte could not be employed because live actors had to appear in the bottom portion of the door frame in front of Kong's legs, and because the doors themselves crossed over both puppet and live action areas. A rear projected image large enough to fill the door area was out of the question. So, the Williams traveling matte process (a black and white process) was used to place the puppet Kong behind the doors.[2]

---

[1]Letter from Ray Harryhausen to Don Shay, September 15, 1963.

[2]Goldner and Turner, The Making of King Kong, p. 89.

Since rear projection was developed before anamorphic wide-screen systems came into use, it is not easily adapted to them. Thus, wide-screen films present special composite problems to the puppet animator. Most traveling matte processes may be used with any image format (although the dual film systems are limited to standard 35mm film with four perforation pull down), and therefore may be more practical than rear projection for films produced in these formats. Ray Harryhausen had to rely heavily on traveling matte to create the visual effects for the Panavision feature, First Men in the Moon (1964).[1]

Occasionally, an animator may desire to use traveling matte on the puppet, rather than on the actor. It is interesting to note that he has a unique form of traveling matte available to him when this need arises. It is called the "skip frame matte," "alternate frame matte," or "front-and-back light matte."

To produce a traveling matte using this technique, the puppet is animated in front of a background which may be changed back and forth from black to white. The lighting on the puppet itself is arranged so that the lights may be turned on or off without affecting the background.

---

[1]"Ray Harryhausen and Charles Schneer at the National Film Theatre, London," (Part II), FXRH, I, No. 4 (Spring, 1974), p. 14.

Each time the puppet is posed, two frames are taken of it. For one frame, the puppet is lit normally and the background is black; for the second frame, the lights on the puppet are turned off and the background is changed to white, producing a silhouette of the puppet. The resulting footage is printed on two new strips of film. On one strip the silhouette images are not printed (they are "skipped out"), so it just shows the puppet animated against the black background. On the other film only the silhouette images are printed; this is the matte, and a counter-matte may easily be printed from it.

This technique produces an excellent traveling matte, and it can only be used in animation. It is not workable with any subject which moves during photography because the subject will not be in exactly the same position on two consecutive frames. The mattes, therefore, would not line up with the images to be matted. Front-and-back light traveling matte was used in the sequence involving the animated squirrel seen in The Three Worlds of Gulliver.[1]

In addition to being the best tool for certain jobs, traveling matte offers some advantages in the nature of the composite it produces. The relative quality of the composite images is good because the images can be of the same generation. In fact, the original footage of the

---

[1]Letter from Ray Harryhausen, January 18, 1976.

composite elements may be printed on a color reversal internegative stock. This yields a negative image from a negative image, and thus saves a generational step over going from negative to positive to duplicate negative. The puppet animator working with rear or front projection cannot take advantage of the color reversal internegative because he must have a positive image on the rear or front projection screen in order to photograph the puppet with it. Of course, traveling matte also eliminates rear or front projection screens and any adverse effects they might have.

Finally, since background and subject are printed separately (rather than being photographed together), there is an opportunity, during printing, to make color and exposure corrections to help match the composite images. Generally, however, traveling matte is used only where it must be used in making puppet/live composites. There are several reasons for this.

Gene Warren simply dislikes the "look" of traveling matte. He insists that it is easier to get a natural appearance in a rear or front projection composite than in a traveling matte composite.[1]

Another disadvantage to traveling matte is that the mattes must be made with extreme care. Fluctuations in the

---

[1]Interview with Gene Warren, November 18, 1975.

size of the mattes can occur during the printing steps used to produce them from the original footage, and this may cause the mattes to "bleed" in the composite, that is, to leave an outline around the matted subject. Rear projection, of course, is free from any such problem.

Furthermore, traveling matte is comparatively expensive. Barry Nolan of Van der Veer Photo Effects, says that the blue screen traveling matte process can require twelve feet of film for every one foot of finished composite; and the laboratory work takes from five days to two weeks.[1] This time is in addition to that required for shooting components. A rear projection composite is complete with the photography of the second element with the projected plate. Hence, traveling matte uses much more footage and increases the time required to complete both color match testing and a final composite.

Finally, as will be seen in the next section, composites often call for direct, precisely controlled, physical interaction between actor and puppet. Some kinds of implied interaction may be achieved with traveling matte, but they usually must be rather general; the puppet might advance and the actor might retreat, for example, but the two would not come in contact with one another. The reason for this is that the special photography of the matted

---

[1]Interview with Barry Nolan, January 14, 1976.

subject normally does not allow visual reference to the background plate during shooting. When actors are performing on the traveling matte stage, they must be told where to look and when and where to move based on prior study and timing of the animated background plate action. Similarly if a puppet is being animated in a traveling matte set up, the animator cannot see exactly what the finished composite will look like and therefore he is limited in what he can do to match puppet to live action. Steps may be taken to do more precise work in traveling matte, but, since the components are not being photographed together, the chances for error are greater than they would be in a rear projection composite.

Interaction

The discussion thus far has centered on the composite shot, which provides a view of both puppet and actor in the same frame. The composite shot is one of two basic "building blocks" for constructing a puppet animation/live action composite sequence, the other being the intercut non-composite shot. The use of either one can create the impression that puppet and live action are occurring simultaneously. However, much can be done to increase the feeling that the puppet and actor not only co-exist, but are able to interact physically with one another.

There are a number of visual devices which are

employed to reinforce the appearance of interaction. For the purpose of this discussion, they will be grouped into categories: the transferance of objects from puppet action to live action, or from live to puppet action; the use of objects which appear to cross the 117 boundary between puppet and live actor; indications of actual bodily contact; indications of puppet interaction with the live environment and depth cues.

The first two groups are very similar, and, in fact, the same object might be used in both groups in the same sequence. The division is made in order to maintain a distinction between intercut non-composite shots and composite shots. Thus, transferred objects are those which travel from puppet to actor by means of intercutting, and boundary-crossing objects are those which make the transition in a composite shot.

There are many examples of transferred objects. In The Beast from 20,000 Fathoms, the mythical prehistoric beast, Rhedosaurus, crashes through a building. Intercut with this animated action is a shot of a group of people being crushed by a toppling brick wall. Similarly, when Mighty Joe Young devastates a night club, he is seen throwing huge masses of debris. This puppet-thrown model debris is matched in intercut shots with full sized debris which is seen crashing down on club patrons who are trying

to escape Joe's rampage. Another example occurs in 20 Million Miles to Earth when a party of men try to contain the Ymir in a barn. A shot of actor William Hopper poking a pole off screen is intercut with a shot of the Ymir swatting angrily at a matched animated pole coming in from off screen.

To create the illusion of an object making the transition from puppet animation to live action in a composite shot, precise control is necessary, and rear projection is the most common composite technique used to gain this control. Again, there are many examples. One of the finest is the scene in King Kong during which Kong pulls off pieces of Ann (Fay Wray) Darrow's clothing. The actress was photographed being held in the full-sized mechanical Kong hand, and sections of her clothing were pulled away with wires. This footage was then rear projected behind a puppet Kong, positioned so as to make the mechanical hand appear to come from the puppet's off-camera side. Careful manipulation of the puppet's hand and skillfull substitution of matched puppet clothing into its fingers resulted in a convincing shot.

Ray Harryhausen has done a great many composites which include boundary-crossing objects. Spears thrown by Sinbad's sailors in The 7th Voyage of Sinbad fly straight from the hands of the actors and stick in the hide

of the Cyclops, who then plucks them out with some irritation. For this effect, the live action was rear projected and aerially braced scale model spears were placed to cover the images of the live spears in flight and animated the rest of the way to the puppet. Because the substitution occurs when the spears are moving rapidly, it is almost impossible to detect, even when looking for it.

It must be mentioned here that Harryhausen prefers not to reveal how he prevented the live spears from being seen as they continued their flight on the rear projection plate and, inevitably, came out from behind the area covered by the puppet's body.[1] He is well known for his secrecy regarding some of his methods for modifying the background plate image. However, in all probability, he uses some combination of the techniques which have been described, for he has said of his secrets:

> "Oh, they're purely personal. Everybody has a different way of doing things, and certain things are common knowledge. But you'll no longer be interested in a magician if he gives away all of his secrets.[2]

There are many variations on the use of boundary-crossing objects. Different from Ann Darrow's clothing and the sailor's spears, for example, is Gulliver's sword

---

[1]Letter from Ray Harryhausen, January 18, 1976.

[2]"Ray Harryhausen and Charles Schneer at the National Film Theatre, London," (Part II), FXRH, I, No. 4 (Spring, 1974), p. 12.

during his fight, in The Three Worlds of Gulliver, with a Brobdingnagian crocodile. Several times the rear projected Gulliver (Kerwin Mathews) strikes at the crocodile and the sword rebounds from the creature's nose, obscuring part of the nose for an instant. Now, any moving object on the rear projection screen must pass behind the puppet crocodile, which is in front of the screen. Therefore, it is apparent that Harryhausen animated a miniature sword blade to carry the action of the rear projected blade in front of the puppet for the few necessary frames. It adds a great deal to the believability of the sequence, especially in the final shot in which Gulliver stabs the crocodile squarely in the center of its chest.

Even more painstaking work has to be done in order to simulate a continuous physical connection between puppet and live actor in a composite shot. One night club scene in Mighty Joe Young shows Joe being raised on a circular platform while holding above his head a second platform on which his owner, Jill (Terry Moore), is seated playing a piano. The platform on which Joe is standing begins to rotate, and Joe and the rear projected image of Jill go around in perfect synchronization. Willis O'Brien called this the most difficult shot in the film.[1]

---

[1]Letter from Willis O'Brien to Edwin T. Connell (editor of The American Magazine), July 20, 1950.

In The Valley of Gwangi (which was based on an unfinished O'Brien project), Ray Harryhausen staged a sequence in which cowboys try to lasso Gwangi (Fig. 12), an allosaurus (this scene bears many similarities to a roping scene with Joe and cowboys in Mighty Joe Young). The ropes which the live actors hold stretch, without interruption, from them and their live horses to puppet Gwangi. In the course of the many composites which make up the sequence, Gwangi snaps some of the ropes in two with his jaws, struggles hard enough to make some of the horses lose their footing, and is himself tripped by a rope looped around his foot. Here again, animated ropes on the puppet were lined up with the images of the live ropes on the rear projection screen and moved frame by frame to keep the relative action consistent.[1]

Obviously, scenes are sometimes written which call for direct bodily contact between puppet and live actor, with no intervening object to aid in the illusion. There are three ways in which this may be accomplished. One approach is to animate a puppet stand-in with the puppet

---

[1]Here, also, Harryhausen's secrecy about his "hocus-pocus," as he calls it (Film Fantasy Scrapbook, pp. 88, 114), prevents a complete technical description of this extremely complex sequence. He has stated that the ropes handled by the live actors were attached to a fifteen foot pole mounted on a jeep, but he will not say how the jeep was eliminated from the final composite shots (Ibid., p. 114).

Figure 12. A still from the roping scene in The Valley of Gwangi. Photo from Ray Harryhausen's Film Fantasy Scrapbook, p. 117.

character; a second is to build a full scale version of the puppet, or part of it, and shoot this with the live actor; and the third approach is to imply contact through careful alignment of the puppet with rear projected images of the live actor.

Interestingly, Raymond Fielding has stated that miniature humans are exceedingly rare in special effects work, and that they are used only in long shots where they are performing some cyclic motion.[1] While this may be true of special effects work in general, it is not true of puppet animation/live action composite work. Puppet stand-ins for live players have figured prominently in almost all of the feature films under consideration.

There is no doubt that believable human movement is difficult to capture with an animated puppet. Human motion is intimately familiar to us. Therefore, we are more critical of puppet human motion than that of fantastic creatures whose motion is wholly unfamiliar. The effect of strobe is, in itself, enough to make a puppet human's motion look peculiar. Nevertheless, some very convincing scenes have been created with puppet humans. One of the most highly praised is in the barn sequence in Harryhaus-

---

[1]Raymond Fielding, The Technique of Special-Effects Cinematography (2nd ed. revised. New York: Hastings House, 1968), p. 336.

en's 20 Million Miles to Earth. The Ymir, which is man-sized at this point in the film, attacks and savagely mauls one of the men who are trying to capture it. For the bulk of this sequence, the man is replaced by a puppet. The scene is particularly notable because it is not played in a long shot, and required the utmost realism in the animation of the puppet man.

The complexity of the puppets substituted for humans and, occasionally, for animals, varies with their roles Some of the puppet humans used in long shots in King Kong were simple, wooden figures with a minimum of joints and detail.[1] On the other hand, the puppet cowboys seen briefly in The Beast of Hollow Mountain were "incredibly detailed, down to having separate hairs, cartridges in their gunbelts, and beautifully sculpted faces."[2]

Generally speaking, full scale mock-ups of the animated puppet, or part of it (such as the mechanical Kong hand mentioned earlier), are less mobile than their animated counterparts, and for this reason they are usually used only in brief shots. However, they are used frequently. A full sized head-and-shoulders bust of King Kong was

---

[1]Goldner and Turner, The Making of King Kong, p. 122.

[2]Mark Wolf, "Stop Frame: The History and Technique of Fantasy Film Animation" (Part I), Cinefantastique, I, No. 2 (Winter, 1971), p. 21.

used for some closeups in shots which show it grinding hapless humans (live actors) in its teeth. In The Valley of Gwangi, a cowboy grapples on the ground with a downed flying reptile; a full scale model of the reptile was used in closeups, and an animated puppet was combined with the actor in long shots.[1] During a battle with a pleisiosaur in the first animation sequence of When Dinosaurs Ruled the Earth, a full scale version of one of the creature's large, paddle-like feet crashes down on a live actor.

Alexander Ptushko used variations on both the above techniques in combining a live boy with puppets in The New Gulliver (1935). The puppets in this film were Lilliputians, so it was not necessary to change their apparent size in the composite work, but the problem of combining live and animated action remained. Holman reports that Ptushko solved it by using mechanical puppets in some shots with the live boy, and also by using a life-sized animated puppet of the boy in shots with the animated puppets.[2]

The third method of implying bodily contact, aligning the puppet with the rear projected image of the actor, has also been used extensively in feature films. In The Valley of Gwangi, the puppet version of the flying reptile mentioned above makes its entrance by swooping down into

---

[1]Harryhausen, Film Fantasy Scrapbook, p. 115.

[2]Holman, Puppet Animation in the Cinema, p. 26.

the frame to snatch a live actor off a horse. The actor was lifted via a cable hung from a tall crane during photography of the live action plate.[1] In this long shot, the point of contact between the reptile's talons and the actor's shoulders is small enough on the screen that the eye cannot perceive that the shoulders are actually completely behind the talons, rather than being gripped in them. Similarly, Mighty Joe Young exchanges blows with a rear projected muscle man during one of his nightclub act scenes. The shot was set up so that the actor's fists lined up precisely with the edge of Joe's chin, which was of course animated to lurch back with the actor's jabs. The same procedure was followed as Joe "struck" back, curiously prodding the man on the chin with one finger.

One of the most interesting shots of this third type was created by Jim Danforth for The 7 Faces of Dr. Lao (1964), in which Dr. Lao (Tony Randall) is picked up in the jaws of a huge animated creature, the Loch Ness Monster. Lao is seen kneeling next to his rainmaking machine in a comparatively close shot. The open jaws of the monster come down on either side of him, framing him in an inverted "v." He braces his hands and knees against the insides of the mouth, as though trying to hold it open, and is lifted up out of frame. Following shots show a

---

[1]Interview with David Allen, November 3, 1975.

puppet Lao struggling out of the monster's mouth and hanging onto its head.

During shooting of the live action background plates for most of the interaction techniques disscussed so far, the actor usually must perform his part of the action alone, and because of this, some kinds of action may be difficult for him to achieve. If he is directed to receive a blow, for example, he must do the best he can at making the imaginary blow look realistic. However, the animator can sometimes help out when he rephotographs the background plate with the puppet. It is a simple matter to skip frames in the background by advancing the projector without exposing new camera frames. The effect is a slight jump cut which causes the actor to move further and faster than he could in real life, but when this action is timed to an animated blow from a puppet, it looks quite realistic.

Danforth has made use of this technique in a number of shots, a notable one occurring during the scene in When Dinosaurs Ruled the Earth which shows a mother dinosaur discovering actress Victoria Vetri asleep in half of one of her hatched eggs. The dinosaur nudges the egg shell, and it spins part way around as a result of the impact. The shell was mounted on a hidden automobile wheel which was lying sideways. During live photography, the shell and Miss Vetri were spun around by assistants pulling ropes attached to the wheel. This action, however, was too

smooth to look like the result of a blow, so Danforth skipped frames out of the first part of the action to give it more of a lurch, animating the puppet dinosaur to match.[1] This process is, of course, limited to background plates which do not contain other moving elements which would be adversely affected by the jump cut.

The next consideration under interaction, and an important one, is the puppet's effect on the live environment. With the demise of Willis O'Brien's elaborate puppet sets, through which live actors moved in miniature rear projection, the puppet now does most of its performing "in" live action background plates, and steps must be taken to make sure that its effect on the environment depicted in the plate is consistent.

For example, any creature casts a shadow. The earlier description of a simple Harryhausen rear projection set up avoided this problem; it can be avoided in some cases, if the camera's angle of view is such that shadows would naturally be nearly invisible, or if objects in the foreground obscure the area where the puppet's shadow would logically fall (several of the shots of the fighting ceratosaurus and triceratops in <u>One Million Years B.C.</u>, for example, are made without showing the dinosaurs'

---

[1]Danforth, lecture, Spring, 1973.

shadows). Most of the time, however, shadows for the puppet must be provided. Usually this is done through the use of floor inlays, which have been discussed. However, there is at least one other technique for creating shadows which is peculiar to rear projection. Material such as a neutral density gel or fine screen wire cut to an appropriate shape, is placed between the background plate projector and the rear projection screen. This dims the light coming from the projector and, in effect, casts a shadow in the rear projected image. The shadow material may even be animated to match the movements of the puppet. Ray Harryhausen used this technique on some composite shots in It Came From Beneath the Sea (1955) when a giant octopus ravages the San Francisco dock areas; the shadows under its tentacles as they probe city streets are rear projected shadows.[1] As might be guessed, the technique is somewhat limited, but it is valuable when it can be used because it eliminates floor inlay matching problems. Environmental elements which are incompatible with animation, such as dust, water splashes, smoke, and fire either must be controlled during photography of the background plate or added later. When added later, they are often "burned in" to the composite during a separate pass in camera or optical printer. In effect, burning in is making

---

[1]Interview with David Allen, November 3, 1975.

a controlled double exposure. Light images will take precedence over dark images and the ghosting effect obtained with double exposures is acceptable since one can normally see through dust, flame and the like in reality. Many examples of water splashes may be seen in It Came from Beneath the Sea. Each time the tentacles of the giant octopus break through the surface of the rear projected ocean (this being done via static matte), "spray" may be seen printed around the tentacle at the water line. At times the spray looks rather alien, since it is not part of the background plate, but it is very effective in one sequence, in which the octopus sinks a large ship. The background plate is breaking surf, but through careful animation and editing, and with the addition of the added spray effect (which helps to conceal the relatively sharp line of the static matte), Harryhausen makes the breaking waves appear to be caused by the octopus' violent wrenching of the model ship. In so doing, he improved this scene over a similar one in his previous film, The Beast from 20,000 Fathoms. The Rhedosaurus sinks a ship in a background plate of rolling, open ocean; here the addition of the spray is only marginally helpful.

A much more effective environmental interaction shot, involving fire, occurs at the end of The Beast from 20,000 Fathoms. The Rhedosaurus is wounded and trapped

in the maze-like structure of a burning roller coaster. As it thrashes about, its tail collides with a pile of burning wood in the foreground, blasting the pile into the air with a shower of sparks. The pile was placed in the foreground through double exposure, and since it was filmed as a separate element, it could be full scale wood and fire, thrown into the air by some appropriate means. With its action timed to the movement of the Rhedosaurus' tail, the full scale fire greatly enhances the illusion of the beast's size.

An example of an environmental effect obtained during the shooting of the background plate occurs in When Dinosaurs Ruled the Earth. Another of those large flying reptiles makes a very sudden appearance, rocketing past a live actor who dives to earth for cover. In shooting the plate, Jim Danforth arranged for a cloud of dust to be blown up around the actor as soon as he hit the ground. Then, during animation, Danforth timed the swift flight of the reptile to precede the appearance of the dust in the rear projected image. The result is an impressive slip-stream effect.

The suggestion of depth and spatial relationships in composite shots is fundamental to their success. Because the shots are constructed essentially of two-dimensional images, the animator can use the eye's learned con-

ventions of depth perception to his advantage.

The value of using depth cues is demonstrated by default in the unsatisfactory composites seen in The Black Scorpion. In the latter part of that film, an outsized scorpion invades Mexico City, but many of the composites with live actors simply show a black silhouette of the scorpion superimposed over crowds of running people with no attempt to make the scorpion appear to be part of the action.

The use of Harryhausen's static matte-on-rear projection has already been mentioned in connection with suggesting depth in that it allows portions of the background plate to appear to be in the foreground. Traveling matte is a valuable tool in this area, too. Harryhausen used a double traveling matte for a shot in First Men in the Moon which shows an actor (Edward Judd) in the foreground, the skeleton of a vanquished animated moon worm in the middle ground, and more live actors (dressed as "Selenites," the insect moon people) in the background. The skeleton was placed over the Selenites with one traveling matte, and the resulting composite was used as the background plate for the second traveling matte which placed Judd in the foreground.[1]

It is also possible to use a finished rear projec-

---

[1]Harryhausen, Film Fantasy Scrapbook, p. 100.

tion composite as a background plate for a traveling matte. Whenever optical effects are added to optical effects, however, the final shot is degraded by an extra generation.

Puppet stand-ins sometimes serve to indicate depth. For example, most of the composite shots in the Mighty Joe Young roping scene are rear projection shots, with Joe animated in front of plates of live cowboys and horses. However, occasionally a horse and rider gallops by in the foreground, passing in front of Joe. This could have been done through traveling matte, but in this case the foreground horse and rider are extremely detailed puppets built by Marcel Delgado and animated with Joe.

Jim Danforth, who has been praised for his attempts to create unique composites,[1] made use of nearly all the interaction devices in one remarkable shot in When Dinosaurs Ruled the Earth. It is one of the first shots in the pleisiosaur sequence showing the pleisiosaur being restrained by ropes which are being staked down by men attempting to capture it. It is basically a rear projection set up, but this hardly conveys its complexity. Carefully placed actors appear to be both in the background and in the foreground. Two men in the foreground struggle with a rope which is matched to a rope around the dinosaur's

---

[1]Sam Calvin, "The Comparison Test," FXRH, I, No. 4 (Spring, 1974), p. 68.

neck. These men are actually on the rear projection plate, but their relative size makes them appear to be in the foreground, the matched rope reinforces the illusion. Another live actor may be seen in the "foreground" framed by a boulder which is in front of the beast, placed there via a static matte (if the actor were to move from his position, he would disappear at the edge of the boulder). A torch next to the boulder casts the shadow of the boulder onto the body of the pleisiosaur--this shadow had to be created in lighting the puppet, since the boulder is part of the rear projected image. Finally, human figures can be seen passing in front of the moving tail of the creature, and these figures are animated puppets. In addition to the elements of interaction, Danforth replaced portions of the background image (such as the sky) with more atmospheric images painted on glass, which were photographed with the puppets. Danforth's effects for When Dinosaurs Ruled the Earth were nominated for an Academy Award.

It should be noted that a composite sequence is almost never the result of a single photographic process. The most satisfying sequences are made up of many different shots, each of which has been executed in the most expedient way. A good example is the popular Talos sequence from Harryhausen's Jason and the Argonauts. In it, Jason (Todd Armstrong) and his band of sailors are attacked by

animated Talos, a huge bronze statue. Talos blocks the narrow entrance to a natural harbor and picks up a model of Jason's ship; this is in a rear projection/static matte composite with the harbor background plate. This action is intercut with traveling matte shots showing actors on a full scale ship set, with Talos behind them. As Talos tilts the ship, non-composite live action shots of actors falling into the water are intercut. Moments later, while Talos pursues survivors on land, Jason sneaks up behind him, having learned that Talos' weakness is a large valve in his heel. Rear projection long shots showing the actor working at the puppet's heel are intercut with closer shots of him struggling to turn the valve on a full scale mock-up heel.

Effect Animator's Role in Live Action Production

Ideally, the effect animator is closely associated with all phases of production of those scenes in which his animation is to play a part. Ray Harryhausen, through his long partnership with producer Charles Schneer, has maintained very strict control (he is even listed as associate producer on some of their later films). At times, he directs the live action for the background plates himself, or in conjunction with a stunt coordinator.[1] The actor's

---

[1]"Ray Harryhausen and Charles Schneer at the Na-

movements in relation to those of an imaginary co-star who will be added to the scene months later must be rehearsed again and again. A great deal of the success of a composite sequence depends on the actor's ability to deliver a believable performance under these highly artificial circumstances.

Sightlines are particularly important; actors must know where to look. To help them, Harryhausen has used long poles bearing marks which indicate the height of a given animated creature's head, hands, and other salient features, for a given shot and lens. The poles are thin, so as not to cast noticeable shadows, and are moved about out of camera range to give the actors consistent points to look at. Kerwin Mathews, discussing The 7th Voyage of Sinbad (in which he starred as Sinbad), describes them in an interview:

> "On this film we had what we called 'monster sticks'[1] . . . . . They were thirty feet long, and Ray would work with them himself, generally, being as conscientious as he is. It was always very tiring to manipulate [one], because they were very heavy. . . . But he had to move it himself so that he always controlled the feel of it."[2]

---

tional Film Theatre, London" (Part II) FXRH, I, No. 4 (Spring, 1974), p. 7.

[1]Mark Hamill and Anne Wyndham, "An Interview with Kerwin Mathews," FXRH, I, No. 4 (Spring, 1974), p. 41.

[2]Ibid. p. 43.

Obviously, it is folly to create more animation composite footage than will actually be needed, and, therefore, the effects animator's involvement may carry over from shooting into editing of the live action prior to commencing composite work. Harryhausen sometimes edits scenes himself,[1] and Danforth had considerable control over the editing of the animation scenes in When Dinosaurs Ruled the Earth.[2]

Cost Range for Composite Work

The costs of composite work are as variable as the amounts of time required to complete it. Again, only the most general current range may be suggested. The Beetle Man sequence in Flesh Gordon was done on an extremely restricted budget which Jim Danforth describes as "about rock bottom . . ."[3] for animation composite work. The sequence cost about 5,000 dollars, working out to approximately 230 dollars per shot.[4] On the high side, the effects work in When Dinosaurs Ruled the Earth averaged

---

[1]"Ray Harryhausen and Charles Schneer at the National Film Theatre, London" (Part II), FXRH, I, No. 4 (Spring, 1974), p. 7.

[2]Graham Shirley and Bill Taylor, "Danforth's Dinosaurs," Lumiere, No. 25 (July, 1973), p. 10.

[3]Danforth, lecture, May 26, 1976.

[4]Ibid.

1,800 dollars per shot.[1]

To the extent that an animator is not granted control of the elements which are to comprise his contribution, the effects, and usually the budget, of a film will suffer. Most special effects artists (not just those who deal in animation) complain that they are not consulted early enough in pre-production. Thorough pre-planning is extremely important and the general consensus is that calling the effects people in early results in better effects sequences which cost less.

---

[1] Ibid.

CHAPTER 5

PUPPET ANIMATION/LIVE ACTION COMPOSITES: ELECTRONIC

Electronically produced special effects have long been a staple of television production. Electronic image processing offers characteristics which make it particularly inviting as a means of solving some film effects problems. This chapter presents a summary of the writer's research into this area as it relates to puppet animation/live action composite work.

Electronic Traveling Matte

Of primary interest is electronic traveling matte. This process performs the same function as traveling matte in film, that is, it inserts the image of a given subject into the image of a background. The technique was referred to as "chroma key" for some years, and it was characterized by rather harsh edges around the matted subject and severe fringing around any object which did not present a distinct, focused outline against the matte background color. Now, however, several companies offer much improved electronic matte systems under new names, such as Technimatte, de-

veloped at Vidtronics; Imagematte, Image Transform's entry; and R-matte, from Sonex International Corporation.

A simple electronic matte set up might be arranged in the following manner. One television camera is focused on the background, an ordinary chessboard for example. A second camera is set on a long shot of an actor performing on an entirely blue stage; the correct shade of blue is sometimes called "chroma blue." The signals from the two cameras are combined electronically. The background image is visible in the composite only where the color blue is visible around the actor, showing him, in this example, standing on the chessboard. In practice, it is possible to use other colors for the matte color, but blue is the easiest to work with.[1] Even though it bears some similarity to film's blue screen traveling matte, electronic matte has advantages which could make it an excellent replacement for rear or front projection in puppet animation composite work.

First of all, unlike a blue screen composite, an electronic composite may be displayed immediately and continuously on a television monitor, even before it is recorded. Thus it would retain the puppet animator's need

---

[1]Jim Mendrala, lecture on video special effects in class at the University of Southern California, December 3, 1975.

to see his composite while he works.

The composite may be recorded on videotape and played back immediately. This means that color matching (such as the matching of floor inlays) could be checked in minutes, instead of the days required for film processing and printing. Furthermore, there is no danger of the colors shifting with respect to one another, as they may in printing and processing of film composite elements, since the electronic composite is complete as soon as it is recorded.

Another advantage is that an electronically generated matte is extremely precise. It almost never shows up as an outline around the matted subject.

Since it is a matte system, keyed to a matte color, electronic matting offers the possibility of hiding puppet support mechanisms (especially wires) simply by painting them chroma blue. This is a significant advantage over the problems of disguising supports in a rear or front projection set up.

In film, when an animator accidentally bumps his puppet out of position during a shot, he rarely has any recourse but to return to the beginning of the shot and start over. It isn't worth his time to risk getting a lurch in the action at that point by trying to reposition the puppet. If his animation were being recorded on video

disc, however, he would have the option of playing back a freeze frame on his reference monitor of the last good recorded frame. The image from the video animation camera could then be supered over this, and the puppet repositioned by aligning the two images of it visually. After a few more frames had been recorded, the accuracy of the alignment could be checked by simply playing the sequence back. This could be very helpful where an animator is involved with shots of extended length or which require a great deal of work per frame.

Still another advantage of electronic composites is their excellent registration. The composite elements do not jiggle or weave with respect to one another.

Finally, of considerable significance to the puppet animator is the potential for matting in a shadow with the matted subject. All of the latest electronic matte systems offer this feature. It is relatively simple to make the shadow appear to conform to or pass over objects in the background plate. Rough forms are built which approximate the shape of the objects. These forms are painted chroma blue and placed on the chroma stage in positions corresponding to the positions of the objects in the plate image. It is obvious that this would drastically reduce the need for puppet floor inlays and the inherent set up time they require.

These advantages are extremely tantalizing but, unfortunately, there are major stumbling blocks in the path of any comprehensive take-over by electronic matting in the area of feature film puppet animation/live action composites. In order to illustrate these problems, it will be useful to examine some examples of work which is being done in tape-film hybridization.

Animation/Live Action Composites for Television

Until fairly recently, animation itself was outside the reach of videotape, which could not be edited with frame-by-frame accuracy. Single frame editing is now a reality, however, and with it comes the possibility of recording animation one frame at a time directly on video-tape or disc. At Jean De Joux and Company Videoanimation, cel animation is routinely recorded on tape and combined with live action, for use on television. The live action is pre-recorded, and the animation drawings are developed to match it. The two are combined via electronic matte using the pre-recorded live action tape as a background plate. It is played back frame by frame while the cels are recorded, and the two signals are mixed onto a new tape.

Jean De Joux is very enthusiastic about the possi-bilities of videoanimation. He is quite sure that a varia-tion of his methods would be suitable for making puppet

animation/live action composites.[1] He is equally sure that special effects of high quality will soon be accomplished electronically for feature film use.[2] De Joux is not alone in this feeling. Richard Rubinstein, writing in a regular "Videotape" feature of Filmmakers Newsletter, judges the quality of Image Transform's 655 scan line system (which is capable of greater resolution than the American standard 525 scan line system) to be good enough to cause film producers to give serious thought to doing complex effects on tape and transferring them to film for inclusion in theatrical releases.[3] The feeling among advocates seems to be that the sheer momentum of rapidly advancing electronic technology will overcome all obstacles. Tape-to-film transfers have improved a great deal, for example. Some industrial films are being produced on tape and released on 16mm film.

One videotape television series has been produced in which puppet animation is combined with live action via electronic matte. This is the children's show, Land of the Lost, a Sid and Marty Krofft production.

For the composites in this show, the animation is done first. The puppets are filmed conventionally in

---

[1]Interview with Jean De Joux, November 4, 1975.

[2]Ibid.

[3]Richard Rubinstein, "Electronic Cinematography," Filmmakers Newsletter, VI, No. 6 (April, 1973), p. 46.

miniature settings. The resulting film is transferred to videotape. This tape becomes the background plate for live actors on a chroma blue stage. Imagematte is the system used to make the composites. Each composite take may be viewed immediately and thus, through trial and error, the action of the actors is matched to that of the puppets. Generally speaking, however, there is rarely any implied physical contact or closely timed interaction between puppet and actor in the composite shots. It is exceedingly difficult and time-consuming to achieve precise interaction when the animation has been done first. Associate producer of Land of the Lost, Tom Swale, points out that shooting the live action portion requires a crew of about forty people, and in addition to this there is the rental of the full sized chroma blue stage. Therefore, particularly in light of normal television production pressures, very little time may be alotted to the rehearsing and testing of complex interactions.[2]

Asked about the possibility of taping the live action first and then combining it on tape with animation, one video frame at a time (similar to Jean De Joux's procedure), Swale questions system reliability. Anyone can make up an impressive test reel, he says, but unless

---

[1]Interview with Jean De Joux, November 4, 1975.

[2]Interview with Tom Swale, November, 1975.

their system is as reliable as film, on which he can always depend for his animation, it is of little use in television production. He makes an example of the Imagematte system. It is relatively new and sensitive; it is not as reliable as the older, simpler chroma key. It can unexpectedly go out of adjustment, producing unsatisfactory composites. Production deadline pressures are such that no time may be spent on the set attempting to coax malfunctioning equipment to work properly. Thus a standby chroma key system is kept available to guarantee that production continues uninterrupted.[1]

It was a sort of half step in the theatrical direction, and therefore considerable attention was drawn by the television series The Invisible Man because it was in fact a 35mm film production with its effects sequences created on tape and transferred to film using the 655 line Image Transform system. Although the writer found the effects sequences to be quite clean looking when viewed on television, Ken Holland, Image Transform's Chief Engineer, insists that they are nowhere near good enough for viewing as projected 35mm film. He expresses some surprise that the sequences look as good as they do on television screens.[2]

---

[1] Ibid.

[2] Interview with Ken Holland, November, 1975.

Disadvantages

Puppet animators who have investigated electronic imagery are not impressed with it as an alternative to film. Ray Harryhausen states:

> We have considered using the Video technique for producing traveling mattes. It has many advantages but at the moment the technique has not been refined enough for theatrical use.[1]

David Allen agrees that the current video image is not acceptable as a source for 35mm film effects. Also, he insists that, regardless of whether or not the video image eventually matches 35mm film in resolution, it is unacceptable because of its flat contrast characteristics.[2]

Gene Warren has been involved in some testing with electronic imagery, and he concedes that there are many electronic effects tools which might be useful to the puppet animator. But he raises the argument that costs for tying up complex, expensive equipment for the lengths of time required for set up and animation would be astronomical. He, too, finds tape-to-film transfer quality below that necessary for 35mm theatrical productions.[3]

The basic problem is the broadcast industry's standardization at 525 horizontal scan lines. This is far below the resolving power of 35mm film. It is possible

---

[1]Letter from Ray Harryhausen, January 18, 1976.

[2]Interview with David Allen, November 3, 1975.

[3]Interview with Gene Warren, November 18, 1975.

to build video cameras and display tubes which are capable of much greater resolution than standard ones, but the missing link is the video recorder. A 1972 American Cinematographer article points out that many existing high resolution video systems use film to record the information gathered by their electronic cameras.[1] The article also states that the development of recorders capable of handling bandwidths wider than the standard bandwidth (that is, able to accept more image information per second then current machines) is a remote possibility.[2]

This situation still exists, and it is more than just a matter of finding funds for research. John Gale and Mel Rappaport, of Paramount's Magicam system,[3] are sure that designing a high resolution videotape recorder would involve one in nearly insurmountable problems.[4]

---

[1]Richard Patterson, "Electronic Special Effects," American Cinematographer, LIII, No. 10 (October, 1972), p. 1182.

[2]Ibid.

[3]Magicam is a dual-camera control system which allows one camera, aimed at a miniature set, to be "slaved" to a control camera which is aimed at live actors on a matte stage. The slave duplicates in miniature scale any move made by the control camera, thus creating composites which allow complete freedom of camera movement. With television cameras, electronic matte creates the composites. When film cameras are used, the resulting footage may be combined via blue screen traveling matte.

[4]Interview with John Gale and Mel Rappaport, January 7, 1976.

At Compact Video Systems, Newt Bellis goes so far as to suggest that the tape machine itself might be obsolete in as little as four to five years, with some sort of marriage between photographic and electronic systems taking its place.[1] Not willing to make such a sweeping prediction is Ken Holland, of Image Transform; but he does say that he sees no demand for a high resolution recorder and knows of no one who is working on one.[2]

The Electronic Printer

The probable reason for the lack of interest in a high resolution tape recorder (at least as far as its applicability to 35mm theatrical film effects is concerned) is something know as an electronic printer. There are at least two such devices under construction now, both expected to be complete by 1977. One has been designed by Petro Vlahos, Chief Scientist of the Research Center of the Association of Motion Picture and Television Producers (AMPTP). The other is being designed and built at Van der Veer Photo Effects.

The significant thing about these electronic printers is that they will be film-to-film systems, going from camera negatives to finished composite in one electronic

---

[1]Interview with Newt Bellis, January 22, 1976.

[2]Interview with Ken Holland, January 14, 1976.

step, thus eliminating the need for videotape either as an original source or as an intermediate step. The printers represent a serious effort to bring to film the flexibility of electronic special effects without sacrificing image quality. In the opinion of most of the people the writer spoke to, the effort will succeed.

The single dissenting voice was heard from Ken Holland. Image Transform was scheduled, at one time, to build the AMPTP printer. According to Holland, Image Transform withdrew from the project partly because they could not raise the necessary capital, but also because they feel the printer, which includes a sophisticated computerized control unit, will be extremely slow (operating at perhaps one frame a minute), and extremely expensive to run.[1]

Generally, however, both film and video representatives expect electronic printers to cause quite a sensation. Already mentioned is Newt Bellis, who sees them as one form of the revolution he visualizes for the future.[2] Also, John Gale, who is Chief Engineer at Magicam, predicts that the electronic printer will be a significant advance in theatrical film effects. Magicam's dual camera control system is suitable for film or electronic cameras, but

---

[1] Ibid.

[2] Interview with Newt Bellis, January 22, 1976.

tests which were made using it with conventional blue screen traveling matte yeilded unsatisfactory results, in Gale's opinion. Therefore, most of Magicam's work has been limited to video in order to take advantage of electronic matte. However, Gale expects a sudden increase in theatrical film work when an electronic printer becomes available.[1]

Linwood Dunn, leading expert on optical film effects and head of Film Effects of Hollywood, states that electronic image processing unquestionably permits greater control and speed than does an optical printer, and he is quite positive that some form of film-to-film electronic system will take precedence over any tape-to-film system for 35mm effects.[2]

Petro Vlahos offers a projected procedure which a puppet animator might follow in preparing footage for the AMPTP printer.[3] A background plate would be shot on 35mm film, just as it would be for blue screen or front/rear screen work. Then a standard 525 line video worktape copy would be made which the animator would use for reference while animating the puppet. The puppet would be photographed on film against a matte-color background

---

[1]Interview with John Gale, January 7, 1976.

[2]Interview with Linwood Dunn, January, 1976.

[3]Interview with Petro Vlahos, January 14, 1976.

(probably chroma blue). The reference monitor would show a composite of the worktape image with an image picked up by a video camera linked to the film camera's field through a beam splitter or rackover system. Color correction and alignment could be checked in real time using the reference monitor composite. It is probable that even the capability for correcting animation errors in mid shot could be included by adding a videodisc recorder to the reference monitor system, (to provide immediate freeze frame) and skipping the bad film frames when the final composite is made. The final composite would be created, of course, on the electronic printer itself, from the background plate and animation original negatives.

In addition to electronic matting, the printer could offer a number of other advantages. For example, since the original footage of the puppets will show them against the matte-color, it might often be possible to re-use sections of animation, matting the puppets over different background plates.

Vlahos claims that the AMPTP printer could offer improved registration. Its accompanying computer would be programmed to lock onto non-moving points in each image being composited, and to keep these points in precise registration with respect to one another while the com-

posite is made.[1] If this proves workable, it will bring to film composites the rock-steady registration of video composites.

The use of original negatives to make composites will bring a significant improvement in image quality to any effect which would otherwise be created through front or rear projection of a positive 35mm print. In addition, the AMPTP system will include gamma and color controls which will allow for the use of a variety of film stocks--Vlahos suggests fine grain Kodachrome reversal as an example--as original material.[2]

Barry Nolan, Research Consultant and Van der Veer Photo Effects, points out that electronic printers will offer considerable savings in time and film stock over conventional blue screen. The Van der Veer printer is expected to operate at about one frame per second, and should produce a composite of average length in a matter of minutes, where standard blue screen would require from five days to two weeks of laboratory work.[3] Furthermore, the electronic composite would require three feet of film to one foot of finished composite; standard blue screen

---

[1] Ibid.

[2] Ibid.

[3] Interview with Barry Nolan, January 14, 1976.

can require ratios up to twelve to one.[1]

Finally, of special interest to puppet animators is the claim that the AMPTP printer will be able to eliminate strobe by adding blur to jerky motion, again through a computer program.[2] This particular capability might almost have been conceived with puppet animation in mind.

With all the bright promises, however, comes one potential drawback. An electronic printer would function as an extra step over the usual front/rear screen process of combining puppet and live action. The cost of this step will not be definite until a printer is in operation

As might be expected, Barry Nolan and Petro Vlahos both predict that their respective systems will be cost competitive with studio in-house traveling matte production, when used as straight traveling matte tools.[3] In the case of the AMPTP system, more complex effects, such as the aforementioned addition of blur, will cost more because computer programs will have to be written to execute them. Mr. Vlahos says that costs for these effects are impossible to estimate at this time.[4]

---

[1] Ibid.

[2] Interview with Petro Vlahos, January 14, 1976.

[3] Interviews with Barry Nolan and Petro Vlahos, January 14, 1976.

[4] Interview with Petro Vlahos, January 14, 1976.

Whatever their cost, however, they still come as an extra step which is almost sure to be a cost increase over conventional puppet animation processes; and if an acceptable composite can be made more cheaply through conventional means, what justification is there for going through an electronic printer? Barry Nolan adds more weight to the negative side. Claiming some knowledge of puppet animation and its problems, he feels that the animator would be better off sticking to front projection than trying to use Van der Veer's or any other electronic printer.[1]

It is probably best to reserve judgement for the present. As indicated above, the electronic printer's most significant advantage for the puppet animator will probably be that of allowing him to animate in a matte situation with a dependable reference image of the composite. Potentially at least he could cut down on his most significant expense, set up time, both by using fewer floor inlays and in being able to match colors without waiting for film developing and processing. Should this saving in time prove to offset the cost of using the printer, puppet animation/live action composites may yet benefit from its arrival.

---

[1]Interview with Barry Nolan, January 14, 1976.

CHAPTER SIX

DRAMATIC ACHIEVEMENT OF PUPPET ANIMATION/LIVE ACTION FILMS

Critical Reaction

It is probably already evident that most of the examples given thus far are drawn from films which are little noted for anything other than their animation. The majority of the features under consideration do not fare well when judged as total films rather than as vehicles for special effects. In determining some of the reasons for this, it seems natural to turn first to the critics.

Critical reviews of puppet animation/live action features generally separate into three categories. Some are wholly negative, condemning the effects along with the rest of the film; some praise and defend the film along with the effects; most single out the effects as being the only worthwhile part of otherwise mediocre fare.

The first group often exposes more ignorance of filmmaking than insight into the dramaturgical problems of the films reviewed. One dismisses Mighty Joe Young as:

> a mock gorilla, consisting of several yards of terry cloth and powered by a mechanism as intricate

as a Consolidated Edison Booster station . . . .[1]

An extreme example of this sort of critical analysis appears in Joseph Morgenstern's review of One Million Years B.C.:

> The monsters are OK: better than the ones in Japanese movies, worse than the ones in Macy's Thanksgiving Day Parade. A few seem to be animated puppets, the others are nice little lizards and turtles, vastly enlarged by macrophotography.[2]

Indeed, a live lizard was used in the film, but the nice little turtle (a giant Archelon ischyros, according to Harryhausen)[3] is nothing but animated rubber and fiberglass (Fig. 13). For all his cynicism, Morgenstern appears to have mistaken the puppet for a living animal.

Reviewers belonging to the second group are guilty, it would seem, of oversight in other areas. A common defense for Harryhausen's films is that they are for children and therefore must not be judged by adult entertainment standards. Some reviewers go further than this. For example, while the screenplay for The Golden Voyage of Sinbad has been criticized for its "curious dislocations . . . ,"[4] and even denounced as the film's weakest

---

[1]John McCarten, Review of Mighty Joe Young, New Yorker, XXV, No. 24 (August 6, 1949), p. 39.

[2]Joseph Morgenstern, Review of One Million Years B.C., Newsweek, LXIX, No. 11 (March 13, 1967), p. 109.

[3]Harryhausen, Film Fantasy Scrapbook, p. 103.

[4]Phillip Strick, Review of The Golden Voyage of Sinbad, Monthly Film Bulletin, XLI, No. 480 (January, 1974), p. 8.

Figure 13. The Archelon ischyros from One Million Years B.C.
Photo from Ray Harryhausen's Film Fantasy Scrapbook, p. 109.

element,[1] a few reviewers have defended it. One claims that it is more complex than it appears.[2] Another notes that the climactic sequence involving an animated griffin is an illogical, unexpected, and unmotivated interruption of the story, but then goes on to say that this point is not worth talking about.[3] Still another concludes that Harryhausen films in general have a narrow appeal; claiming that:

> as the performers must act as props to the stunning visual effects, which are the real attractions . . . strong, in-depth characterizations are not called for.[4]

Obviously, most reviewers, and hopefully a proportion of viewers, are less willing to suffer through a substandard film in order to see a few minutes of excellent visual effects. Thus, most reviews of these features are similar to the following:

> "The Beast of Hollow Mountain" does not make his appearance in this Nassour production until a long, long time after the feature of the same name has started. When he does, things get pretty exciting for a very short time. Otherwise this . . . is a

---

[1]Page Cook, "The Sound Track," Films in Review, XXV, No. 6 (June-July, 1974), p. 362.

[2]Les Schwartz, Review of The Golden Voyage of Sinbad, Photon, No. 25 (1974), p. 12.

[3]Craig Reardon, "Comparison: The Two Voyages of Sinbad," Closeup, No. 1 (1975), p. 36.

[4]Dan R. Scapperotti, Review of The Golden Voyage of Sinbad, Cinefantastique, III, No. 2 (Spring, 1974), p. 44.

very dull affair.[1]

Except for Ray Harryhausen, who is quite dedicated to his image of the children's film, animators tend to agree with the last group of reviewers. Jim Danforth emphasizes that all departments of a film company must be directed to work in close harmony, to create a cohesive product; otherwise, "'the concepts of the effects man, the sound man, the director and the composer are all at odds with each other.'"[2]

David Allen adds:

> I'm afraid there has been an excess of adulation given to the technical side of these films, and it is exactly that attitude which, at the production levels, results in an effects- rather than story-oriented motion picture.[3]

Gene Warren, too, believes that animation cannot be the only reason for a film's existence. The effects must work within the structure of the film.[4]

There is a consensus, then, about what a good puppet animation/live action feature should contain, and there is also consensus that the majority of these films do not

---

[1]Review of The Beast of Hollow Mountain, The Hollywood Reporter, CXLI, No. 9 (August 23, 1956), p. 3.

[2]Graham Shirley and Bill Taylor, "Danforth's Dinosaurs," Lumiere, No. 25 (July, 1973), p. 12.

[3]David Allen, "Dramatic Principles in Stop-Motion," Photon, No. 22 (1972), p. 30.

[4]Interview with Gene Warren, November 18, 1975.

contain it. Why do so many films fall short?

The Scarcity of Puppet Animation Features

Part of the answer lies in the fact that there are very few films entered in the competition. Puppet-seen-as-puppet animation enjoyed a brief period of popularity in the United States during the 1940's when George Pal was producing the Puppetoons. Some even viewed puppet animation as the primary form for puppetry in the future.[1] This did not prove to be the case, however. America's interest in puppet-seen-as-puppet films seemed to die with the Puppetoons, and there are only six features on the writer's list which use puppets as puppets.[2]

For features which use puppets as non-puppet characters, there was a long hiatus after King Kong and Son of Kong (both 1933) which lasted until Mighty Joe Young was released in 1949. Since then, just over thirty features in this category have joined the ranks.

Some explanations for the scarcity of these films can be learned from those who have been involved in making them. Charles Schneer, who produced ten of the twelve

---

[1]Helen Long Luitjens, "The Contribution of Puppetry to the Art Life of Los Angeles," Unpublished Master's Thesis, University of Southern California, October, 1943, p. 79.

[2]In addition to these, of course, there are a few all-puppet features which include no live action, such as Hansel and Gretel (1954).

films on which Harryhausen has been head of special visual effects, has mentioned two reasons for producers to shy away from animation. One economic consideration is that production money is tied up for a long time (often a year or more) while the animation is being completed. Interest rates can accumulate substantial amounts over such periods.[1] The second reason is that there are few producers who care to spend the necessary time, as much as three years, to prepare and shoot just one picture.[2]

Gene Warren's experience is that most producers see puppet animation as inherently for children. Their logic then follows the course: Puppet films are for kids, and if a film is for kids, Disney should be doing it.[3]

Perhaps the most significant reason that so few puppet animation/live action features are made is that puppet animation, "one of the most specialized types of special effects . . .,"[4] simply is unfamiliar to many professionals in the film industry. The very word "anima-

---

[1]Dan R. Scapperotti and David Bartholomew, "The Golden Voyage of Sinbad" (interview with producer Charles Schneer), Cinefantastique, III, No. 2 (Spring, 1974), p. 45.

[2]Craig Reardon, "Charles Schneer Speaks His Mind," FXRH, I, No. 4 (Spring, 1974), p. 26.

[3]Interview with Gene Warren, November 18, 1975.

[4]John Brosnan, Movie Magic (New York: St. Martin's Press, 1974), p. 151.

tion" translates as "costly" in the minds of many producers. Puppet animation effects can be and have been completed on low budgets, but there remains an undeniable stigma about them. Ironically, this unfamiliarity sometimes breeds disaster which in turn reinforces the image of animation as an expensive, uncontrollable luxury. Jim Danforth comments:

> "Most producers of this kind of film only make one. They only make one because it is not a success, and the reason for this is that they make it without reference to what has gone before; it's not well grounded at all. The major mistakes are made over and over again."[1]

King Kong

The film which seems to have incorporated the fewest mistakes is King Kong. It is still the yardstick by which most puppet animation/live action features are judged. Often, King Kong's special effects are cited as the element which places it above the competition, but many would argue that Harryhausen and Danforth have rivaled King Kong in the area of sheer technical excellence. The film's long term success stems more from the fact that "it is a picture that succeeds as a whole, not just in any one department."[2]

Everyone involved with King Kong's production seems

---

[1]Graham Shirley and Bill Taylor, "Danforth's Dinosaurs," Lumiere, No. 25 (July, 1973), p. 11.

[2]Brosnan, Movie Magic, p. 154.

to have pulled out all the creative stops. For example, after the many unusual sound effects were fabricated, they were varied in pitch for the last two thirds of the film to harmonize with the music.[1]

Max Steiner's musical score is repeatedly singled out for praise. Its contribution to the film cannot be overstated.

The intensely atmospheric, misty, shadowy jungle created for Kong's island adds immeasurably to the impact of the film. It is astonishing how few films since have attempted to take advantage of such atmospheric settings. Countless animation sequences are played out against stark, spare backgrounds in flat, uncompromising daylight; all of which serves only to emphasize flaws in animation and composite work. Lack of budget is the reason most often cited by animators for dispensing with elaborate settings.

Producer Merian C. Cooper's tenacious control over King Kong cannot be ignored. He guided all phases of the production along strict, clearly defined lines, making it not just a tour-de-force of special effects, but "a tour-de-force of showmanship still to be eclipsed . . . ."[2] The majority of later films have lacked this sort of all-

---

[1]Goldner and Turner, The Making of King Kong, p. 189.

[2]Rudy Behlmer, "Merian C. Cooper," Films in Review, XVII, No. 1 (January, 1966), p. 17.

encompassing attention to detail. For example, 20 Million Miles to Earth is said to contain some of Harryhausen's finest work, yet it also exhibits basic, distracting inconsistencies, such as a sequence in which a character announces that the Ymir is invulnerable to gunfire because it has no heart or lungs, and then it is seen lying sedated in a laboratory, animated chest rising and falling with heavy breathing.

Finally, another very important aspect of King Kong is that:

> Kong is the hero of the story, not Denham nor Driscoll. He is not only the center of the actions, but the subject of the theme (beauty and the beast). This is the most basic and overlooked fact behind the attraction of the film.[1]

First one element then another of King Kong seems to have been lifted out to be highlighted in films that followed. Already noted is the conceptual fixation which dictates that puppet characters be huge. Interestingly, in assuming that bigger is better, filmmakers overlook the fact that Kong himself was not as tall as publicity claimed him to be. His apparent height was held to between eighteen and twenty-four feet, not fifty, lest he be so large as to make the human players ridiculously insignificant.[2]

---

[1]David Allen, "Dramatic Principles in Stop-Motion," Photon, No. 22 (1972), p. 26.

[2]Goldner and Turner, The Making of King Kong, p. 159.

The basic structure of a creature's capture and destructive escape has been duplicated several times. In The Valley of Gwangi, for example, cowboys enter a lost land, capture its prime monster, Gwangi the allosaurus, and display him in a public show, only to have him escape and devastate a town. Unlike Kong, however, Gwangi never aspires to be anything but an animal. While Harryhausen maintains that it is easier to develop sympathy with a humanoid character, he has said he feels that audiences may have some sympathy for Gwangi.[1] Whether humanoid or not, it is difficult to see how Gwangi's actions could lead anyone to feel sorry for him. He makes his entrance by gobbling up a tiny, squealing dinosaur. He pursues his would-be capturers with such persistent ferocity that he brings down on himself an avalanche which facilitates his capture. His first action upon being freed from a cage by a Gypsy dwarf (who misguidedly believes that Gwangi must be released in order to avert a curse) is to bite the little man in half. Finally, he attacks and slaughters a luckless elephant in a savage fight scene which decidedly leaves one feeling sorry for the elephant.

---

[1]"Ray Harryhausen and Charles Schneer at the National Film Theatre, London" (Part II), FXRH, I, No. 4 (Spring, 1974), p. 14.

Potentials

It is a significant indication, perhaps, of puppet animation's potential that when even the slightest spark of originality is present, these films tend to do well at the box office and establish trends in fantasy film making. For example, in 1953 the modest production of Harryhausen's The Beast of 20,000 Fathoms received typically qualified reviews:

> The picture has a few scary moments when the special effects men, unhampered by antidiluvean human dramatics, let the rhedosaurus run loose in Manhatten . . . .[1]

However, the subject matter, a big monster rampaging though city streets, hadn't been touched in twenty years, and the film did remarkably good business. It is now widely held to be responsible for the whole menagerie of outsized, atomic age creatures which paraded across screens for the remainder of the decade. The following evaluation of Mighty Joe Young, made in 1964 by a youthful reviewer writing in an animation fan club publication, indicates how solidly entrenched these cliches had become by the end of the 1950's:

> All in all, Mighty Joe Young was good. Despite its lack of dinosaurs and armies defending their cities from Joe, the original ideas in the film

---

[1]Review of The Beast from 20,000 Fathoms, Time, LXI, No. 25 (June 22, 1953), p. 88.

made it good.[1]

Harryhausen himself broke away from this trend in 1958 with The 7th Voyage of Sinbad. For the first time, puppet animation gave life to mythical, magical beasts of bewildering variety. Again, the film was tremendously popular, and again, it was imitated. In fact, producer Edward Small, who had turned down the project when Harryhausen presented it to him, now produced a carbon copy, Jack the Giant Killer, using the same actors, Kerwin Mathews and Torin Thatcher; the same director, Nathan Juran; and a group of animators including Jim Danforth. Danforth has even said that he and the others studied animation footage from the The 7th Voyage of Sinbad as a guide in doing the animation for the Small production.[2]

Chronic Emphasis on Special Effects

The problem, of course, with this and most other puppet animation/live action features is that the scripts are inadequate. This results from the fact that, very often, the script is developed after the decision has been made to make an animation picture. Charles Schneer and Ray Harryhausen have often worked in this manner and, in

---

[1]Steve Towsley, Review of Mighty Joe Young, Animation Journal, No. 2 (November, 1964).

[2]Don Grant, "Jack the Giant Killer," Modern Monsters (October-November, 1966), p. 13.

terms of financial return, they have been quite successful at it. Reviewer Nick Seldon notes:

> Rarely are motion pictures ever made as vehicles for talents other than actors or actresses, but in the case of The Golden Voyage of Sinbad, we can attribute the entire production to the unlikely talents of the special effects man. Ray Harryhausen now exists as one of the most unusual commercial commodities in the film industry, and no one else in the past or present has ever achieved his unique stature as both an artist and a proven box office risk.[1]

Undoubtedly, part of Harryhausen's success is due to his reputation for speed and dependability. Jim Danforth comments: "'Nobody, but nobody in the business works faster than Ray Harryhausen.'"[2] Charles Schneer reports that Harryhausen has never gone over schedule.[3] But Schneer himself is equally important. He is virtually unique. David Allen rates him as being more a patron of puppet animation than an ordinary producer.[4] It is clear, too, that the effects in their films are nearly as important to Schneer as they are to Harryhausen, for Schneer has said of the negative reviewers:

---

[1]Nick Seldon, "The Golden Voyage of Sinbad: A Harryhausen Showcase," Jump Cut, No. 4 (November-December, 1974), p. 6.

[2]Sam Calvin, "The Comparison Test," FXRH, I, No. 4 (Spring, 1974), p. 70.

[3]Craig Reardon, "Charles Schneer Speaks His Mind," FXRH, I, No. 4 (Spring, 1974), p. 26.

[4]Interview with David Allen, November 3, 1975.

> "When the critics go to most of these movies, they are evaluating human problems rather than problems that give rise to pictures of fantasy and take you to another world. Our chief accomplishment, as far as we're concerned is making the unreal, real. And the critic's picture is making the real, more real."[1]

With this emphasis in mind, then, Schneer/Harryhausen films are built up in one of two ways. Either they are based on a series of puppet animation scenes, or animation scenes are added to existing story material.

In following the first path, drawings are made, usually by Harryhausen himself, depicting the basic components of each puppet animation sequence in the proposed film. These drawings are similar to the many drawings used to maintain continuity during production, except that, at this stage, they may represent nothing more than exciting events which have yet to be related to one another. Harryhausen has stated that one purpose of the initial set of drawings can be to spark script development.[2]

The next step, then, is to hire a writer, whose job it is to account for the animation events. It is interesting to note just how rigidly fixed these events are. Many reviewers have complained about the confusing circumstances

---

[1]Dan R. Scapperotti and David Bartholomew, "The Golden Voyage of Sinbad" (interview with producer Charles Schneer), Cinefantastique, III, No. 2 (Spring, 1974), p. 43.

[2]Harryhausen, Film Fantasy Scrapbook, p. 20.

surrounding the sudden arrival, and demise, of the griffin in The Golden Voyage of Sinbad. Harryhausen comments:

> In one version of the script, a much more grandiose entrance was designed for the griffin. In another, the slave girl Margiana called the griffin into being through a prayer.[1]

The significant implication is that there was never any question as to whether or not the griffin should appear in the first place.[2]

The second approach, that of adding animation sequences to existing story material, seems to result in somewhat better films with curiously unsatisfying effects. Animated monsters were added to modified versions of Jules Verne's Mysterious Island and to H. G. Wells' First Men in the Moon, for example. Neither film incorporated effects scenes or puppet characters as popular as those in The 7th Voyage of Sinbad of Jason and the Argonauts, but reviewers were more pleased with the dialogue, direction, and acting in the former films, particularly First Men in the Moon.

In defense of the Schneer/Harryhausen team, it

---

[1] Ibid., seventh page of color plates following page 128.

[2] It must be said that even King Kong was begun without a finalized shooting script. As Marcel Delgado flatly put it, "King Kong wasn't a final script. It was written just--fooling around" (Marcel Delgado in tape recorded conversation with Don Shay, April 6, 1973). However, the theme was present, as so was the ever-watchful Cooper to make sure that theme was adhered to at every turn.

should be noted that in many ways their films are the best of this tiny genre. The 7th Voyage of Sinbad, even though it sprang from a few of Harryhausen's sketches, was a monumental departure from over thirty years of puppet dinosaur and ape tradition. In this alone, it must be regarded as an extremely important film.

The professional animators the writer spoke with were careful to emphasize that Harryhausen's animation is never less than excellent. Also, because his control is so absolute, his animation sequences are usually well planned and very well executed. This makes them far more exciting than those, for example, in Goliath and the Dragon, an Italian film to which shots of an animated dragon were added by the company which purchased the film for American release.[1] Even in a more sophisticated film, George Pal's 7 Faces of Dr. Lao, the animated Loch Ness Monster appears only in a rather long denoument after the film's messages have been delivered and the villain has been defeated. The entire sequence seems to have been something of an afterthought.

In concluding this chapter, a few puppet animation films should be mentioned which have avoided the effects-emphasis bias, at least to some degree. The Legend of

---

[1]Graham Shirley and Bill Taylor, "Danforth's Dinosaurs," Lumiere, No. 25 (July, 1973), p. 8.

Hillbilly John, originally titled Who Fears the Devil?, is unlike any other film on the list. Its two, short animation sequences are set against the tranquil background of rural mountain life. The film contains few other visual effects, and it does not attempt to build up a horrific or intensely fantastic atmosphere; thus the animation sequences are startling and effective.

Lou Bunin's Alice in Wonderland deserves mention because in it Bunin attempts to use puppets to approximate the feel of the story's original illustrations.[1] Critical response to the film is summed up by Ralph Stephenson:

> Critics found it unequal but with moments of real beauty, in spirit faithful to the original, intelligently adapted, and far better than "Disney's hideous film."[2]

Finally, tom thumb has probably received the most consistently favorable reviews for any puppet animation/live action feature save King Kong. It is one of the few films which use puppets as puppets (Tom's toy friends); and it has been lauded for its simple, charming, well acted story as well as for its special effects.

---

[1]Interview with David Allen, November 3, 1975.

[2]Ralph Stephenson, The Animated Film (New York: A. S. Barnes and Co., 1973), p. 99.

CHAPTER SEVEN

SOME AESTHETIC CONCLUSIONS

Puppet Animation's Individuality

In feature film work, the actual animation of puppets is usually done by just one or two animators. Therefore, in spite of the fact that it is widely regarded as simply technological special effects work, the animation itself is a highly individualistic form of expression, and it deserves study in this light. It is often possible, for example, to recognize Ray Harryhausen's work by characteristic moves that some of his creatures make. They are as distinctive as an artist's brush stroke or John Wayne's walk. Similarly, Mrs. Willis O'Brien said of her first viewing of King Kong, "I could see O'Bie's personality in everything Kong did, practically."[1]

Nevertheless, except for occasional articles in "fan" magazines, feature puppet animation is not discussed at all. In fact, writers in the field of animation tend to dismiss

---

[1]Letter from Darlyne O'Brien to Don Shay, January 19, 1964.

the whole spectrum of puppet animation as a sort of poor relation. In The Animated Film, Ralph Stephenson grants that there may be some possibilities for interesting camera movement in a dimensional film, but claims that one can't achieve sweep and spectacle on a miniature set.[1] He even goes so far as to suggest that only camera angles which look down on puppets will be effective.[2] John Halas and Roger Manvell, in The Technique of Film Animation, also view the puppet film as a restrictive medium which cannot offer the "complete freedom of the drawn film."[3] In their brief consideration of the puppet film, however, they do present a familiar axiom which may serve as a useful starting point for this discussion:

> There should never be any doubt that what is being achieved on the screen could only be achieved by this means. Better a live actor than a puppet emulating a live actor.[4]

Alternatives to Puppet Animation for Special Effects

It might be said then that an animation sequence which could just as well have been executed by some other means is not as satisfying as one which is clearly suited

---

[1]Ralph Stephenson, The Animated Film (New York: A. S. Barnes and Co., 1973), p. 12.

[2]Ibid., p. 12.

[3]John Halas and Roger Manvell, The Technique of Film Animation (New York: Hastings House, 1968), p. 264.

[4]Ibid., p. 264.

to animation. However, it must be noted that there are those who contend that puppet animation is never an acceptable tool for bringing film characters to life. To the practiced eye, puppet animation is usually recognizable as such, largely because of the effect of strobe, and some filmmakers simply dislike the look of it. David Allen retorts with the animators' point of view:

> Anybody that has that impression of animation, who can view it and only be turned off by the fact that it has a stroboscopic phenomenon, and not be turned on by any of the obvious craft and . . . dramatic advantages that it has, is to me a person that shouldn't be making artistic decisions at all.[1]

The dramatic advantages of animation may be illustrated by considering the alternatives. Animation's detractors feel that mechanical contrivances, actors in suits, or the various lizards which have been pressed into service as dinosaurs do just as well. In Gorgo (1960), for example, the huge monster which invades London is played by a man in a rubber suit equipped with controls for blinking the eyes, curling the lips, swinging the tail, and so on. One writer claimed:

> With this full-scale monster figure, the King Brothers were able to achieve greater realism than would have been possible with a small-scale animated figure - the bane of all previous monster pictures.[2]

---

[1]Interview with David Allen, November 3, 1975.

[2]Ray Mercer, "Monsters and Miniatures," American Cinematographer, XL, No. 12 (December, 1959), p. 765.

The realism referred to is that of the huge miniature sets which were built to accomodate the actor in scale. The monster itself has a single, unchanging expression, and is hopelessly arthritic when compared to the agile creatures which populate the films under consideration here. Furthermore, any creature played by a person in a costume is restricted to roughly human proportions. It is difficult to imagine how a man, or men, in suit could have portrayed the Centaur in The Golden Voyage of Sinbad.

Strictly mechanical monsters can escape the limits of human anatomy, but, as Harryhausen points out, they "always seem to have limitations and repetitions."[1] An animated creature is limited only by the imagination of the screenwriter and the skill of the animator. The problems encountered in using the full scale bust of King Kong to peer into New York hotel windows illustrates this fact.

> Kong's face which looks into the window in this and other scenes is that of one of the eighteen-inch models. The large head proved unsatisfactory for these scenes because it was too inflexible to convey the idea that the ape was hanging onto the side of the building and moving about.[2]

The mechanical dinosaurs in The Land That Time Forgot (1975) are dubious competitors at best. Most of them are rooted to one spot, lest they amble away from their

---

[1]Harryhausen, Film Fantasy Scrapbook, p. 47.

[2]Goldner and Turner, The Making of King Kong, p. 165.

control wires and power cables, while a few slide along on tracks. None do more than make repeated rather vague gestures. No precise interaction is attempted in composite shots, and only so much interaction can be implied with intercutting.

The use of live animals as fantasy creatures is of highly questionable value, too. Harryhausen was severely criticized by his followers for using an iguana as one of the dinosaurs in One Million Years B.C.[1] An obvious objection is that a lizard looks nothing like a dinosaur, but, as with mechanical creatures, the biggest sacrifice is the control over interaction. Boundary crossing objects, for example, are out of the question because both elements of the composite shots are filmed live (making matching next to impossible). Dummy humans, inevitably limp and obvious, must be used where lively animated puppet stand-ins would be used with an animated creature. Finally, there is the question of the treatment of the animals themselves. Harryhausen comments on his use of puppets over lizards to stage the triceratops/ceratosaurus fight in One Million Years B.C.:

> Real lizards are basically lethargic, making it imperative to provoke them almost cruelly in order to present an effective fight.[2]

---

[1]Harryhausen, Film Fantasy Scrapbook, p. 106.

[2]Ibid., p. 103.

Jim Danforth describes the fate of some live eels which were used to star as monster eels in Around the World Under the Sea (1966):

> "The eels weren't cooperating, and in desperation [the effects technicians] finally killed them and worked them like marionettes on wires. In some cases they were charged electrically to get them to writhe; the whole thing was highly disgusting.[1]

Naturally, there are situations which are not suited to animation. A scene which called for a giant dog would probably best be completed with a live dog. Similarly, it would be foolish to suggest that an animated shark would have been more effective than the mechanical ones built for Jaws (1975). The shark is rarely seen, and it spends all of its time in the water (a troublesome element in puppet animation); it is a good example of a "character" which is suited to mechanical origins.

Puppet animation, then, is probably best used to create sequences which demand fantastic, generally non-humanoid, highly mobile characters, particularly where those characters must physically interact with live actors. Animation may also be used to solve certain special problems such as, for example, those scenes in The Great Rupert which called for complex action beyond the capabilities of

---

[1]Graham Shirley and Bill Taylor, "Danforth's Dinosaurs," Lumiere, No. 25 (July, 1973), p. 10.

the live squirrel.

Judging Animation Quality

Given an effects sequence with these requirements, what are some criteria for judging the puppets and the animation? To begin, the question of the desirability of "realism" often arises. Lou Bunin feels that, since the film goer knows that puppets aren't real, creating puppets with realistic accuracy is a pointless exercise.[1] Furthermore, Bunin says of the animation itself that "'naturalistic movement lessens the believability.'"[2] In taking this position, however, Bunin is addressing himself to the puppet-seen-as-puppet film. In those features which use puppets to represent non-puppet entities, the rules are essentially reversed. It is necessary to construct puppets which look like living creatures and to animate them with a degree of realism which is consistent with their roles. Unless a scene is being played with puppets meant to be seen as puppets, such as the scenes with Tom Thumb (Russ Tamblyn) and his puppet/toys in tom thumb, the average film goer does not think of the puppet as a puppet (many people still believe Kong to be a man in a suit, in spite

---

[1]Howard Beckerman, "Puppets in Wonderland," Filmmakers Newsletter, IX, No. 1 (November, 1975), p. 36.

[2]Ibid., p. 36.

of all that has been said and written about King Kong).

Thus, it would seem unfair to accuse Pete Peterson, for example, of being overly realistic in his animation of the scorpions seen in The Black Scorpion (on which Willis O'Brien supervised the special effects).[1] Although the film has many weak points, Peterson's animation is nothing short of astonishing. In one chilling scene, a giant scorpion plucks a squirming lineman off a telephone pole, pins him to the ground with its pincers, and skewers him with its stinger (the lineman is substituted by a puppet human for the bulk of the scene, which makes Peterson's work all the more admirable). When the stinger plunges home, the scorpion even rocks forward and down on its legs, throwing its "weight" behind the thrust. The animation is painstakingly realistic, but the event depicted is wildly fantastic, and it depends on this realistic animation for its dramatic believability. Furthermore, it is difficult to imagine how the scene could have been accomplished as effectively through any means other than animation.

The term which is used most often in discussing feature film puppet animation is "smoothness." Reviewers

---

[1]Peterson, who was handicapped by multiple sclerosis (Don Shay, Focus on Film, No. 16, p. 43), also executed the animation for The Giant Behemoth and did some of the work in Mighty Joe Young.

and fans seem to judge animation as "smooth" or "not smooth" and let it go at that. Really, of course, smoothness is related to realism and believability. If a creature which appears huge and proportionately ponderous is seen jerking swiftly about, that creature's dramatic impact is damaged. However, one cannot simply apply a flat criterion of smoothness to the problem and judge all animation accordingly. There are other elements which affect the overall success of the animation in a given scene.

Equally important, for example, is the animator's attention to detail. It is not enough just to make precise incremental moves. Mark Wolf notes that Harryhausen made an extra effort to lessen the effect of strobe on the wings of the flying creature, Homunculus, in The Golden Voyage of Sinbad: "The fluidity of motion resulted from the wingtips bending with the flow of action on ascension or descension . . . ."[1] Not only must the animator be aware that such subtle refinements of motion are necessary, he must design his armatures with the capability of performing them.

Another example of attention to detail may be found in 20 Million Miles to Earth. In the course of that film,

---

[1]Mark D. Wolf, "The Effects: An Examination of the Visual Effects in The Golden Voyage of Sinbad," Closeup, No. 1 (1975), p. 9.

the Ymir grows from about twelve inches tall to about twenty feet tall. Harryhausen changed its walk cycle correspondingly. The creature completes a step in ten to twelve frames when it is small; but by the end of the film the same action is stretched to twenty frames, giving the creature a slower, heavier stride.

A puppet character's role in a film may indicate a specific approach to the animation. Mark Wolf comments on the motion Harryhausen imparted to the puppet of a ship's wooden figurehead (The Golden Voyage of Sinbad) brought to life by Koura (Tom Baker), an evil magician and controlled by him from a distance:

> The animation is very carefully designed, as she moves with stiff halting movements as though she actually is being controlled mentally from miles away by the straining Koura.[1]

Here the animation is deliberately jerky since that type of motion is appropriate for the character.

The anatomy of a puppet character may also suggest to the animator movement which can make the character's performance that much more effective. For example, the tyrannosaurus in The Beast of Hollow Mountain walks upright on its two huge, powerful hind legs. Normally, it moves relatively slowly, but this pace is changed in one composite which shows the beast pursuing two cowboys on horse-

---

[1] Ibid., p. 10.

back. It bounds into frame taking giant, springy steps. This movement is consistent with the tyrannosaurus' physique, and it is animated carefully, maintaining a sense of the mass of a large creature. Just as important, this sudden revelation adds a frightening dimension to the threat posed by the beast to its human co-stars.

Puppet Personality and Physicality

As may already be apparent, the best puppet animation is not solely a technological exercise. A puppet character often is, or should be, a performer. Consider what has been said time and again about Kong:

> I believe it to be true that few actors can claim the dynamic personality that was projected from the screen KONG.[1]

> That O'Brien was able to invest a creature made of metal, rubber, glass and fur with a personality and "acting" sufficient to rival the most memorable performances of the finest character actors of the screen must be considered one of the real miracles of cinematic achievement.[2]

> "[Kong] is more than a monster. He is a genuine character, a creature of intelligible rage, nobility of a kind and, above all, pathos. A prehistoric Lear, in a sense. . . ."[3]

---

[1]Letter from Ray Harryhausen to Don Shay, March 25, 1969.

[2]Goldner and Turner, The Making of King Kong, p. 149.

[3]Fay Wray (quoting Paul Johnson), "How Fay Met King Kong, or The Scream That Shook the World," The New York Times (Sunday, September 21, 1969), Section 2, p. 17.

Another puppet which is said to project personality is Mighty Joe Young. Jim Danforth cites Ray Harryhausen's animation of Joe's nightclub rampage as the best feature animation to date; his reasons are that it is very well executed and is also a solid part of the film's structure.[1] In the sequence, Joe is given a great deal to drink by some frivolous nightclub patrons. This is important because up to this time, Joe has been shown to be basically passive and non-violent. Then one of the nightclubbers deliberately burns Joe's finger and Joe flies into a rage. His drunkenness is sustained by Harryhausen throughout the sequence; much of the damage Joe causes is the result of his blundering into things, losing his balance, and misjudging distances in his leaps and vine-swinging. All the animation is staged, of course, in Willis O'Brien's complex composites, which add immeasurably to the sequence's power. After Joe has been subdued, the authorities order that he be destroyed, and his human friends must rally to save his life.

Except for the occasional praise of Mighty Joe Young, no single feature animation character has been singled out as having as much acting ability as King Kong. In the case of Harryhausen's work, fans have developed a defensive

---

[1]Danforth, lecture, May 26, 1976.

explanation for this, which has been set down by Sam Calvin in FXRH:

> It is surely [Kong's] humanoid appearance which enables him to manifest such a striking personality. When the screen actions of Harryhausen's animals are compared to Kong, it is clear that Ray's creatures have not possessed the distinctive character of Kong. But how does one give an octopus a distinctive personality? Most of Harryhausen's monsters cannot possibly display any more personality beyond the characteristics displayed already in his pictures. . . . Only when a humanoid creation like the Ymir or the Cyclops is considered may Harryhausen be criticized for limiting the "personality" of his monsters.[1]

Is this really true? In this writer's opinion, the development of personality stems not so much from the choice of specific kinds of puppet character/being, but from the choice of actions the puppet is given to play. Already mentioned, in Chapter One, is the lively chair of "A Chairy Tale," which achieves its character without resorting to any changes in shape. It remains a rigid chair throughout. Furthermore, Harryhausen's own creations indicate possibilities for non-humanoid characters with distinctive personalities. The tiny prehistoric horse, eohippus, which makes a brief appearance in The Valley of Gwangi is a good example.

In the story, the eohippus is perhaps ten inches high and lives in a tiny corral constructed by its owners,

---

[1]Sam Calvin, "The Comparison Test," FXRH, I, No. 4 (Spring, 1974), pp. 53-54.

members of a turn-of-the-century wild west show. It peeks out of its miniature stable, then edges uneasily into the center of the corral, tail swishing, ears twitching nervously, often holding one tiny hoof poised in mid air, ready to lauch a quick scamper back to the stable should danger threaten.

The eohippus is hardly a multifaceted character, yet it is rare that even this much characterization is afforded a puppet in feature films. Most serve simply as "monsters." At worst they do little more than move about, almost aimlessly (Journey to the 7th Planet, Monster from Green Hell). Even more sophisticated monsters respond to two stimuli only: 1) an inexplicable instinct to destroy man or his architecture, and 2) mortal wounds. So rarely does a puppet character exceed these limits that it is cause for some comment when it happens.

For example, in When Dinosaurs Ruled the Earth there is a sequence in which Sanna (Victoria Vetri) makes friends with a baby dinosaur after she is discovered by its mother. Jim Danforth gave the baby an inquisitive, wobbly-legged, puppy-like quality. Writers in fantasy film oriented publications were quick to point this out.

> I find that people tend to remember the baby more than anything else [in this film], because the use of animation to create a sympathetic character is

almost unheard of.[1]

> Much to Danforth's credit he has animated these scenes with a wry sense of humor, and instills in the mother dinosaur and her tiny offspring a personality and sense of character that makes them almost endearing. Indeed, to find examples of animation that are this personable one must go back to masterworks like O'Brien's King Kong and and Mighty Joe Young.[2]

It is interesting to note that the puppet characters in nearly all of the films which Willis O'Brien presided over are marked by appropriately consistent yet highy imaginative action (whether he actually performed the animation or not). Of almost legendary fame is the moment in King Kong when the tyrannosaurus pauses to scratch its ear, just before it spies Fay Wray and is engaged in its fateful combat with Kong. This simple, brief action contributes much to the feeling that the puppet dinosaur is a living creature, going about its daily routine, plagued by an occasional itch. In a different way the scorpions of The Black Scorpion, which are anything but personable, exhibit many nuances of creative action which reflect O'Brien's remarkable insight into animal behavior. One scorpion reacts to the sudden brilliance of a photographer's flash-

---

[1]Mark Wolf, "Stop Frame: The History and Technique of Fantasy Film Animation" (part two), Cinefantastique, II, No. 1 (Spring, 1972), p. 15.

[2]Frederick S. Clarke, Review of When Dinosaurs Ruled the Earth, Cinefantastique, I, No. 3 (Summer, 1971), p. 27.

bulb by darting backward into its lair. Another investigates a large metal bucket which has been lowered into a cave on a long cable. When the crane above attempts to raise the bucket, the scorpion yanks it back down and begins trying to sting it to death. It is extremely uncommon for a movie monster (animated or otherwise) to make such a mistake, yet the action is thoroughly believable of a scorpion. Finally, in a prime example of what has been termed O'Brien's "cheerful sadism,"[1] there is a scene in which a horde of scorpions wreck a passenger train, and then start killing each other in fighting over the human victims.

So, it is just as important to consider what animated characters do as well as how they do it. In regard to this, David Allen points out that there is a subjective relationship between the animation and the story in which it appears. Allen notes that some of the animation in King Kong is rough and jerky, but these technical failings are less noticeable in that film than they would be in a film which attempts to stand on its special effects alone. When one is dealing with characters, instead of situations, Allen says, it is not necessary for the effects to be

---

[1]William K. Everson, Review of One Million Years B.C., Films in Review, XVIII, No. 3 (March, 1967), p. 179.

"clinically pristine."[1]

In a limited way, the tyrannosaurus sequence in The Beast of Hollow Mountain may be said to benefit from this sort of relationship. It isn't the entire story which helps in this case, for it is a rather ordinary, cliche-ridden Western. On top of that, most of the animation, in terms of smoothness, is marginal. However, the structure of the final effects sequence has merit.

In particular, this tyrannosaurus has some traits which make it more interesting than many other puppet stars who sport technically better animation. It is far less purposeful than the average monster. In fact, it is rather refreshingly stupid. It pursues first one person, then another, being easily distracted by shouts and gunfire and it even responds to minor wounds. At one point, it has apparently decided not to follow some intended victims down a dangerously steep slope; but then a ledge collapses under its feet and it tumbles unwillingly to the bottom. Only then does it elect to take up the chase again. Ultimately, it is lured to its death in a truly inventive scene. Jimmy (Guy Madison) uses himself as bait, swinging on a long rope back and forth over a quicksand pit until the tyrannosaurus makes a grab for him, loses its balance, and falls into the pit.

---

[1]Interview with David Allen, January 15-16, 1976.

That puppet animation has been used in a very restricted manner in feature films must already be apparent from the examples given throughout this work. Of the forty-one features the writer has catalogued which may be said to combine puppet animation and live action, more than half limit their animated stars to dinosaurs or various other Kong-sized beasts. It is significant, too, that the characters are beasts, with beasts' limited potential for motivation and characterization. The exceptions, ironically, are the very few features which include cartoon-style puppet-as-puppet characters.

Feature puppet animation, then, might also be judged by the extent to which it expands or explores the virtually limitless possibilities for puppet characters. For example, King Kong and 1925's The Lost World presented something which had never been seen by audiences before, animated dinosaurs. The nine animated (and many more non-animated) dinosaur pictures to follow may be judged less innovative, at least on the basis of what they chose as subject matter.

An example of an exceptionally bizarre animated character may be seen in an offbeat film called Fiend Without a Face (1958). The villains of this piece are human brains (Fig. 14) which push themselves along by coiling and uncoiling their spinal cords, inchworm fashion.

Figure 14. Brain monster from Fiend Without a Face. This is not a composite shot; the actress (Kim Parker) is being "attacked" by a full scale puppet figure used for some live action shots requiring bodily contact. Photo from Denis Gifford's A Pictorial History of Horror Movies, p. 171.

Spawned in a freelance scientist's experiments, and drawing their life force from a local nuclear reactor, the brains begin attacking humans. A given brain selects a target, leaps at his neck, takes a firm grip with the tentacle-like spinal cord, and sucks out the victim's brain and spinal cord. Here again, the film has little to offer but these strange monsters. One reviewer notes, "'Direction and acting are primitive, but the macabre effects may satisfy the bloodthirsty.'"[1]

Indeed, during the pitched battle between humans and brains which climaxes the film, the brains prove spectacularly vulnerable to shots from pistols and a deftly wielded axe. When dying or wounded they spout great volumes of viscous, mottled fluid. However, two final points are noteworthy about these animated characters. First, their size gives them dramatic potential not shared by a giant monster; the brains can, and do, hide behind furniture and pop down the chimney. Second, the brains demonstrate intelligence and even some patriotism. One brain steals a hammer which the humans have been using to board up windows; and later, when Jeff Cummings (Marshall Thompson) attempts to dynamite the nuclear reactor from which the brains derive their energy, a wounded brain, sput-

---

[1]Review of Fiend Without a Face condensed from Variety in Film Facts, I, No. 32 (September 10, 1958), p. 133.

tering a trail of fluid, struggles toward the burning fuse, only to collapse before it can reach up to put the fuse out.

Another character which might be said to explore a new area in feature puppet animation is the one which appears last in the sex comedy, Flesh Gordon. Hailed by one reviewer as "a real scene stealer...,"[1] this large, green biped deliberately mimics Kong at times, but is quite different in one respect: It occasionally speaks in a low, mellow voice. When it is first called upon to destroy hero Flesh Gordon (Jason Williams), for example, it mumbles, "Oh, me. A monster's work is never done," with bulbous lips writhing in exaggerated lip sync.

Conclusion

Such examples are rare and, again, they are usually taken from films of otherwise questionable dramatic value. For the most part, animation is used only for certain kinds of monster situations. Often, as has been noted, the desire to do something with animation comes first, and then a story is written to fit the animation; or, animation scenes are tacked onto an existing story. In very few instances has animation been selected simply as the most expedient means of creating desired characters called

---

[1]Alexander Stuart, Review of Flesh Gordon, Films and Filming, XXI, No. 7 (April, 1975), p. 43.

for in the original script. Again, it would seem that members of the motion picture industry at large do not think of puppet animation as a viable option.

To those who view puppet animation as having tremendous potential, this is an unfortunate situation, for some excellent fantasy and science fiction films have been made which might have been much better had they employed puppet animation for their effects. Them (1954) for example, has been praised for its taut, detective-style script, but its full-scale mechanical giant ants are sluggish, lifeless and quite obviously mechanical. They appear to slide in and out of frame, legs flailing in a vague approximation of a walking motion.

The Thing from Another World is another example. This film, too, is highly regarded as a suspenseful, well acted, fast-paced science fiction thriller. Furthermore, its antagonist is a malevolent, intelligent, plant-being. Unfortunately, the being, when it appears, looks almost exactly like the Frankenstein monster. Proponents of puppet animation speculate that the film would have been even more effective if the being had been something more outlandish than a human in make up. Jim Danforth sketched a possible conception for the plant-creature, giving it thorny, multi-tentacled arms and branching, root-like feet.[1]

---

[1]Danforth's sketch is reproduced on the back cover of Photon, No. 22 (1972).

The situation has not changed, nor does it appear to be changing. At this writing, the Schneer/Harryhausen team has embarked on a third Sinbad fantasy, following the financial success of The Golden Voyage of Sinbad; and King Kong is being remade without animation, starring a forty foot tall hydraulically operated ape alternating with a man in an ape suit.

Until a producer with high standards for the dramatic necessities of a film sees fit to develop material which is appropriate to the characteristics of puppet animation, it would appear that film goers will be faced with a choice between more of the same or nothing at all.

BIBLIOGRAPHY

LIST OF FILMS

In making up the following list, a concerted effort has been made to verify that all of the films included definitely contain puppet animation characters combined with live action. Films for which, in the opinion of the writer, there is inadequate verification have not been included. The writer has seen most of the films on the list, but has had to rely on other sources in a few cases. Where possible persons who worked on the films were contacted; or, at least one reliable written source was found. One must be wary of popular articles and books on special effects and fantasy films. They often use the word "animation" quite loosely, and sometimes make statements which are wholly incorrect.

For example, a 1966 American Cinematographer article on the use of miniatures describes the mechanical dragon seen in The Magic Sword (1962) as being "photographed by means of mechanical animation."[1] In The Filmgoer's

---

[1]Charles Loring, "How to use Miniatures for 'Big'

Companion, author Leslie Halliwell states in his entry for King Kong:

> Other monsters animated by the stop-motion . . . process include Rodan (a pterodactyl); The Beast from Twenty Thousand Fathoms, Gorgo and Godzilla (dinosaurs); Tarantula; Them (ants) and The Black Scorpion.[1]

Only The Black Scorpion and The Beast from 20,000 Fathoms contain puppet animation. In the case of Rodan and Godzilla, however, Halliwell adopts the widespread assumption that the hordes of monsters in Japanese films are animated. Carlos Clarens, too, for example, after discussing Willis O'Brien's work at length, states that, because animation has become so expensive, "the best animation nowadays comes from the Japanese studios where costs are still held down . . . ."[2]

It is reasonably certain that little, if any, puppet animation has been used in Japan's monster pictures. Ray Harryhausen has said that there is no animation evident in the ones he has seen.[3] Also, in Movie Magic, John

---

Production Value in Low Budget Filming," American Cinematographer, XLVII, No. 4 (April, 1966), p. 261.

[1]Leslie Halliwell, The Filmgoer's Companion (3rd ed.; New York: Avon Books, 1971), p. 549.

[2]Carlos Clarens, An Illustrated History of the Horror Film, (New York: Capricorn Books, 1968), p. 96.

[3]"Ray Harryhausen and Charles Schneer at the National Film Theatre, London" (Part II), FXRH, I, No. 4 (Spring, 1974), p. 13.

Brosnan states that the monsters of Eiji Tsuburaya, special effects expert who has supervised a great many of the Japanese films, are all either mechanical or actors in suits.[1] In addition, none of the animation "fan" publications mentions Japanese films as containing puppet animation.[2]

Some films have used puppet animation in their title sequences, but they cannot be said to combine puppet animation with live action. Therefore, such films are not included here. Even the long puppet animation prologue by Lou Bunin for The Ziegfeld Follies (1946) is distinctly separate from the rest of the film, thus eliminating it from this category. The same is true for the Willis O'Brien/Ray Harryhausen dinosaur sequence in The Animal World (1956). One other exception should be noted, Harryhausen's Earth vs. The Flying Saucers. Even though puppet animation is combined with live action in this film, the animation is used only for the flight of the saucers and the destruction of a number of Washington D.C. buildings; there are no animated characters in the film.

The list is alphabetical. It includes the distribu-

---

[1]John Brosnan, Movie Magic (New York: St. Martin's Press, 1974), p. 203.

[2]The sole exception is Gigantis, The Fire Monster (U. S. release 1959) which sometimes is said to contain a brief puppet animation sequence as part of its opening.

tor, date of U.S. release and major credits. The following abbreviations are used; P - producer, D - director, S - screenplay, PH - photography, AFX - animation and/or visual effects.

ALICE IN WONDERLAND, Souvaine Selective, 1951

P - Lou Bunin
D - Dallas Bower
S - Henry Meyers, Albert Lewin, Edward Eliscu; based on the story by Lewis Carroll
PH - Gerald Gibbs, Claude Renoir
AFX - Lou Bunin, Irving Block, Lloyd Knechtel

BABES IN TOYLAND, Buena Vista, 1961

P - Walt Disney
D - Jack Donohue
S - Joe Rinaldi, Ward Kimball, Lowell S. Hawley; based on the operetta by Victor Herbert and Glen McDonough
PH - Edward Colman
AFX - Eustace Lycett, Joshua Meador, Bill Justice, Xavier Atencio

THE BEAST FROM 20,000 FATHOMS, Warner Bros., 1953

P - Hal Chester, Jack Dietz
D - Eugene Lourie
S - Fred Frieberger, Lou Morheim; based on the story "The Foghorn" by Ray Bradbury
PH - Jack Russell
AFX - Ray Harryhausen

THE BEAST OF HOLLOW MOUNTAIN, United Artists, 1956

P - Edward and William Nassour
D - Edward Nassour, Ismael Rodriquez
S - Robert Hill; additional dialogue by Jack DeWitt; story by Willis O'Brien

PH - Jorge Stahl Jr.
AFX - Henry Sharpe, Jack Rabin, Louis DeWitt

THE BLACK SCORPION, Warner Bros., 1957

P - Frank Melford, Jack Dietz
D - Edward Ludwig
S - Robert Blees, David Duncan; from a story by Paul Yawetz
PH - Lionel Lindon
AFX - Willis O'Brien, Peter Peterson

DINOSAURUS!, Universal, 1960

P - Jack H. Harris, Irvin S. Yeaworth, Jr.
D - Irvin S. Yeaworth, Jr.
S - Jean Yeaworth and Dan E. Weisburd
PH - Stanley Cortez
AFX - Tim Baar, Wah Chang, Gene Warren, Don Sahlin, Tom Holland

EQUINOX, Tonylyn, theatrical release 1971

This was an amateur film which was purchased for theatrical release, at which time additional writing and photography were done.

Credits for original version:

P - Dennis S. Muren
D - Mark McGee
S - Mark McGee
PH - Mike Hoover
AFX - David Allen, Jim Danforth, Dennis Muren

Credits for theatrical version:

P - Jack H. Harris
D - Jack Woods
S - Jack Woods

FIEND WITHOUT A FACE, Amalgamated, 1958

P - John Croydon

D - Arthur Crabtree
S - Herbert J. Leder; from story "The Thought Monster by Amelia Reynolds Long
PH - Lionel Banes
AFX - "Ruppel and Nordhoff" and Peter Nielson

FIRST MEN IN THE MOON, Columbia, 1964

P - Charles H. Schneer
D - Nathan Juran
S - Nigel Kneale, Ian Read; based on the novel by H. G. Wells
PH - Wilkie Cooper
AFX - Ray Harryhausen

FLESH GORDON, Variety, 1974

P - Howard Ziehm, William Osco
D - Michael Benveniste, Howard Ziehm
S - Michael Benveniste
PH - Howard Ziehm
AFX - Tom Scherman, David Allen, Mij Htrofnad (Jim Danforth), Robert Maine, Bill Hedge

THE GIANT BEHEMOTH, Allied Artists, 1959

P - David Diamond
D - Eugene Lourie, Douglas Hickox
S - Eugene Lourie; from story by Robert Able and Allen Adler
PH - Ken Hodges
AFX - Willis O'Brien, Peter Peterson, Jack Rabin, Irving Block, Louis DeWitt

THE GOLDEN VOYAGE OF SINBAD, Columbia-Warner, 1973

P - Charles H. Schneer
D - Gordon Hessler
S - Brian Clemens; from story by Brian Clemens and Ray Harryhausen
PH - Ted Moore
AFX - Ray Harryhausen

GOLIATH AND THE DRAGON, American International, 1960

P - Achille Piazzi, Gianni Fuchs
D - Vittorio Cottafavi
S - Mario Piccolo, Archibald Zounds, Jr.
PH - Mario Montuori
AFX - Gene Warren (Projects Unlimited)

THE GREAT RUPERT, Eagle Lion Film, 1950

P - George Pal
D - Irving Pichel
S - Laszlo Vadney
PH - Lionel Lindon
AFX - Miles Pike, Roy Reynertson, Dale Tholen, John Abbot

IT CAME FROM BENEATH THE SEA, Columbia, 1955

P - Charles H. Schneer
D - Robert Gordon
S - George Worthington Yates
PH - Henry Freulich
AFX - Ray Harryhausen

JACK THE GIANT KILLER, United Artists, 1962

P - Edward Small
D - Nathan Juran
S - Orville Hampton, Nathan Juran
PH - David S. Horsley
AFX - Howard Anderson Co., Jim Danforth, David Pal

JASON AND THE ARGONAUTS, Columbia, 1963

P - Charles H. Schneer
D - Don Chaffey
S - Jan Read, Beverley Cross
PH - Wilkie Cooper
AFX - Ray Harryhausen

JOURNEY TO THE BEGINNING OF TIME, New Trends Associates, 1966

Credits for this film are sketchy. It was made in Czechoslavakia under the supervision of Karel Zeman. Later, an English language version was made and released in the United States.

Czechoslovakian version:

S - Karel Zeman, J. A. Novotny
PH - Vaclav Pazdernik, Antonin Horak

English language version:

P - William Cayton
D - William Cayton
S - William Cayton with additional dialogue by Fred Ladd

JOURNEY TO THE 7TH PLANET, American International, 1961

P - Sidney Pink
D - Sidney Pink
S - Sidney Pink, Ib Melchior
PH - Age Wiltrup
AFX - Gene Warren, Bent Barfod Films

KING KONG, RKO, 1933

P - Merian C. Cooper, Ernest B. Schoedsack
D - Merian C. Cooper, Ernest B. Schoedsack
S - James A. Creelman, Ruth Rose; from story by Merian C. Cooper
PH - Eddie Linden, Vernon Walker, J. O. Taylor
AFX - Willis O'Brien, E. B. Gibson, Marcel Delgado, Fred Reefe, Orville Goldner, Linwood G. Dunn, William Ulm, Sidney Saunders, Carroll Shepphird, Carroll H. Dunning, Frank Williams

THE LEGEND OF HILLBILLY JOHN, Two's Company, 1973

P - Barney Rosenzweig
D - John Newland
S - Melvin Levy

PH - Flemming Olsen
AFX - Gene Warren

THE LOST CONTINENT, Lippert Pictures, 1951

P - Sigmund Neufeld
D - Samuel Newfield
S - Richard H. Landau; story by Carroll Young
PH - Jack Greenhalgh
AFX - Augie Lohman

THE LOST WORLD, First National Pictures, 1925

P - Earl Hudson
D - Harry O. Hoyt
S - Marion Fairfax; from the novel by Arthur Conan Doyle
PH - Arthur Edeson, Homer Scott, J. Devereaux Jennings
AFX - Willis O'Brien, Ralph Hammeras, Fred Jackman, Marcel Delgado

MIGHTY JOE YOUNG, RKO, 1949

P - Merian C. Cooper, John Ford
D - Ernest B. Schoedsack
S - Ruth Rose; from story by Merian C. Cooper
PH - J. Roy Hunt
AFX - Willis O'Brien, Ray Harryhausen, Marcel Delgado, George Lofgren, Fitch Fulton, Harold Stine, Bert Willis, Linwood Dunn

THE MONSTER FROM GREEN HELL, Distributor's Corp. or America, 1958

P - Al Zimbalist
D - Kenneth Crane
S - Louis Vittes, Endre Bohem
PH - Ray Flin
AFX - Gene Warren, Jess Davison, Jack Rabin, Louis DeWitt

MYSTERIOUS ISLAND, Columbia, 1961

P - Charles Schneer
D - Cy Enfield
S - John Prebble, Daniel Ullman, Crane Wilbur; from the novel by Jules Verne
PH - Wilkie Cooper
AFX - Ray Harryhausen

THE NEW GULLIVER, Mosfilm, 1935

D - Alexandr Ptushko
S - Alexandr Ptushko, G. Roshal and Bolotin; based on Jonathan Swift's Gulliver's Travels
PH - Alex Renkov
AFX - Sarah Mokil, S. Olga Taezhnaya, Nicholas Renkov, Igor Shkarenkov

ONE MILLION YEARS B.C., Warner-Pathe, 1966

P - Michael Carreras
D - Don Chaffey
S - Michael Carreras; from original screenplay for One Million B.C. by Mickell Novak, George Baker, Joseph Frickert
PH - Wilkie Cooper
AFX - Ray Harryhausen

7 FACES OF DR. LAO, MGM, 1964

P - George Pal
D - George Pal
S - Charles Beaumont; from story "The Circus of Dr. Lau" by Charles G. Finney
PH - Robert Bronner
AFX - Paul B. Byrd, Wah Chang, Jim Danforth, Ralph Bodine, Robert R. Hoag

THE 7TH VOYAGE OF SINBAD, Columbia, 1958

P - Charles H. Schneer
D - Nathan Juran
S - Kenneth Kolb

PH - Wilkie Cooper
AFX - Ray Harryhausen

SON OF KONG, RKO, 1933

P - Merian C. Cooper
D - Ernest B. Schoedsack
S - Ruth Rose
PH - Eddie Linden, Vernon L. Walker, J. O. Taylor
AFX - Willis O'Brien, E. B. Gibson, Marcel Delgado, Carroll Shepphird, Fred Reefe, W. G. White, Frank Williams, Carroll Dunning, C. Dodge Dunning

THE THREE WORLDS OF GULLIVER, Columbia, 1960

P - Charles H. Schneer
D - Jack Sher
S - Arthur Ross, Jack Sher; based on Jonathan Swift's Gulliver's Travels
AFX - Ray Harryhausen

tom thumb, MGM, 1958

P - George Pal
D - George Pal
S - Ladislas Fodor, based on Grimm fairy story
PH - Georges Perinal
AFX - Tom Howard, Gene Warren, Wah Chang, Don Sahlin

20 MILLION MILES TO EARTH, Columbia, 1957

P - Charles H. Schneer
D - Nathan Juran
S - Bob Williams and Christopher Knoph; from story by Charlott Knight
PH - Irving Lippman, Carlos Ventigmilia
AFX - Ray Harryhausen

THE VALLEY OF GWANGI, Warner-Pathe, 1969

P - Charles H. Schneer

D - James O'Connolly
S - William E. Bast, Julian More
PH - Edwin Hillier
AFX - Ray Harryhausen

WHEN DINOSAURS RULED THE EARTH, Hammer, 1970

P - Aida Young
D - Val Guest
S - Val Guest; based on story by J. G. Ballard
PH - Dick Bush
AFX - Jim Danforth, David Allen, Allan Bryce, Roger Dicken, Brian Johnstock

THE WONDERFUL WORLD OF THE BROTHERS GRIMM, MGM, 1962

P - George Pal
D - Henry Levin
S - David P. Harmon, Charles Beaumont, William Roberts; from story by David P. Harmon based on Grimm fairy tales
PH - Paul Vogel
AFX - Gene Warren, Wah Chang, Tim Baar, Robert R. Hoag, Jim Danforth, Don Sahlin, David Pal

BOOKS

Brosnan, John. Movie Magic. New York: St. Martin's Press, 1974 (Chapter 7, "The Model Animators").

Broz, Jaroslav. The Path of Fame of the Czechoslovak Film. Prague: Ceskolslovensky Filmexport, 1967 (pp. 71, 86, 89).

Butler, Ivan. The Making of Feature Films: A Guide. Harmondsworth, Middlesex, England: Penguin Books, 1971 (interview with Ray Harryhausen, pp. 144-146).

Clarens, Carlos. An Illustrated History of the Horror Film New York: Capricorn Books, 1968.

Fielding, Raymond. The Technique of Special-Effects Cinematography. 2d ed. revised. New York: Hastings House, 1968 (pp. 324-375).

Gifford, Denis. A Pictorial History of Horror Movies. London: Hamlyn Publishing Group, 1974.

_____. The British Film Catalogue: 1895-1970. David and Charles/Newton Abbot, 1973.

_____. Science Fiction Film. New York: E. P. Dutton, 1971.

Goldner, Orville, and Turner, George E. The Making of King Kong. New York: A. S. Barnes, 1975.

Halas, John, and Manvell, Roger. The Technique of Film Animation. New York: Hastings House, 1968.

Halliwell, Leslie. The Filmgoer's Companion. 3d ed. New York: Avon Books, 1971 (entry for King Kong, p. 549).

Harryhausen, Ray. Film Fantasy Scrapbook. 2d ed. revised. New York: A. S. Barnes, 1974.

Heraldson, Donald. Creators of Life. New York: Drake Publishers, 1975.

Holman, L. Bruce. Puppet Animation in the Cinema. Cranbury, New Jersey: A. S. Barnes, 1975.

Jones, Jack R. Fantasy Films and Their Fiends. 1964 (privately published).

Lee, Walt, and Warren, Bill. Reference Guide to Fantastic Films. Los Angeles: Chelsea-Lee Books; Vol. I, 1972; Vol. II, 1973; Vol. III, 1974.

Lutz, E. G. The Motion-Picture Cameraman. New York: Charles Scribner's Sons, 1927.

Maltin, Leonard. The Disney Films. New York: Crown Publishers, 1973 (entry for Babes in Toyland, pp. 194-196).

Shipley, Thorne, ed. Classics in Psychology. New York: Philosophical Library, 1961 (Max Wertheimer, "Experimental Studies on the Seeing of Motion," pp. 1032-1089).

Stephenson, Ralph. The Animated Film. New York: A. S. Barnes, 1973.

PERIODICALS
(Film Composites and Animation)

Abbot, L. B. "The Cameraman and Special Photographic Effects," American Cinematographer, LVI, No. 10 (October, 1975), pp. 1150-1153, 1176-1177, 1184+.

Alice in Wonderland (article). The Hollywood Reporter, CXIV, No. 29 (June 12, 1951), p. 6.

Allen, David. "Dramatic Principles in Stop-Motion," Photon, No. 22 (1972), pp. 25-31.

Beckerman, Howard. "Puppets in Wonderland," Filmmakers Newsletter, IX, No. 1 (November, 1975), pp. 36, 38.

Behlmer, Rudy. "Merian C. Cooper," Films in Review, XVII, No. 1 (January, 1966), pp. 17-35.

Beyer, Walter. "Traveling-Matte Photography and the Blue Screen System," Journal of the SMPTE, LXXIV, No. 3 (March, 1965), pp. 217-239.

Calvin, Sam. "Editorial," FXRH, I, No. 4 (Spring, 1974), p. 2.

_____. "The Comparison Test," FXRH, I, No. 4 (Spring, 1974), pp. 52-71.

Carducci, Mark. "Ray Harryhausen: An Interview with the Master of Stop-Motion Animation," Millimeter, III, No. 4 (April, 1975), pp. 20-24.

Cobb, Norman E. and Glickman, Richard B. "A Rear Projection System for Television Composites Using Low Powered Projection Apparatus," Journal of the SMPTE, LXXXI, No. 9 (September, 1972), pp. 672-675.

Dunn, Linwood G. "The 'Mad, Mad' World of Special Effects," American Cinematographer, XLVI, No. 3 (March, 1965), pp. 160-163+.

Dunning, Carroll H. "Dunning Process and Process Backgrounds," Journal of the SMPE, XVII, No. 5 (November, 1931), pp. 743-748.

Fear, Ralph G. "Projected Background Anematography," American Cinematographer, XII, No. 9 (January, 1932), pp. 11-12, 26.

Fielding, Raymond. "The Scotchlike Process," American Cinematographer, LIII, No. 4 (April, 1962), pp. 228-229, 242-245.

Foster, Frederick. "Matts, Miniatures, and Meticulous Cinematography," American Cinematographer, XXXI, No. 3 (March, 1950), pp. 82-83, 98.

Glickman, Richard B., Siegart, Karen, and Wexler, Sy. "A New Tool for Composite Cinematography," American Cinematographer, LIII, No. 1 (January, 1972), pp. 42-43, 78-79.

Grant, Don. "Jack the Giant Killer," Modern Monsters (October-November, 1966), pp. 6-13.

Hamill, Mark, and Wyndham, Anne. "An Interview with Kerwin Mathews," FXRH, I, No. 4 (Spring, 1974), pp. 38-45.

Hanson, John Stag. "The Man Who Killed Kong" (part one), Movies International, I, No. 3 (July-August-September, 1966), pp. 20-26, 65.

Harrington, Clifford V. "Japan's Master of Monsters," American Cinematographer, XLI, No. 8 (August, 1960), pp. 448-449, 502.

Hayes, Michael, ed. Newsletter published by the Marcel Delgado Appreciation Society, No. 3 (November, 1969).

Henry, Joe. "The Science of Process Photography," American Cinematographer, XXXIX, No. 1 (January, 1958), pp. 36-37, 56.

Hilchey, Eugene. "Special Visual Effects Outside the Camera," American Cinematographer, XLVI, No. 11 (November, 1965), pp. 726-730.

Hoult, Robert L. "A Black and White Traveling Matte Process," American Cinematographer, XL, No. 10 (October, 1959), pp. 612-613, 634-636.

_____. "Making Miniatures Look Realistic," American Cinematographer, XLI, No. 10 (October, 1960), 598-600, 616, 618.

_____. "Traveling Mattes in Color," American Cinematographer, XL, No. 11 (November, 1959), pp. 676-678, 693-694.

Lightman, Herb A. "Filming the First Cinerama Feature," American Cinematographer, XLIII, No. 9 (September, 1962), pp. 536-537, 560-565.

Loring, Charles. "How to use Miniatures for 'Big' Production Value in Low Budget Filming," American Cinematographer, XLVII, No. 4 (April, 1966), pp. 260-263.

Mandell, Paul, and Prestone, David. "Animator: Don Sahlin," Closeup, No. 2 (1976), pp. 14-23.

Margutti, Victor L. A. "Some Practical Traveling Matte Processes," American Cinematographer, XLI, No. 11 (November, 1960), pp. 670-671, 684, 686-689.

McGee, Susan. "Danforth--Career Notes," The Movie People (September, 1975), pp. 31-36.

Mercer, Ray. "Monsters and Miniatures," American Cinematographer XL, No. 12 (December, 1959), pp. 747, 764-765.

O'Brien, Willis. "Miniature Effects Shots," International Photographer, V, No. 4 (May, 1933), pp. 38-39.

Osborne, Alan. "Father of Kong," Cinema Papers (April, 1974), pp. 210-215.

Person, Charles W. "Making Actors of Prehistoric Monsters," Illustrated World (November, 1919), pp. 379-381.

Pittaro, Ernest M. "Pitarro on Stop-Motion," Photo Methods for Industry, XII, No. 9 (September, 1969), pp. 46-50, 52.

"Poll Tally" (most popular Ray Harryhausen films, effects, and puppets as ranked by FXRH readers polled), FXRH, I, No. 4 (Spring, 1974), p. 77.

Prestone, David, and Mandell, Paul. "Animator: Lou Bunin," Closeup, No. 2 (1976), pp. 5-11.

Ptushko, A. "The Coming of a New Gulliver," Sight and Sound, IV, No. 14 (Summer, 1935), pp. 60-62.

"Ray Harryhausen and Charles Schneer at the National Film Theatre: London," (Part II), FXRH, I, No. 4 (Spring, 1974), pp. 3-14.

Reardon, Craig. "Charles Schneer Speaks his Mind," FXRH, I, No. 4 (Spring, 1974), pp. 26-28.

_____. "Comparison: The Two Voyages of Sinbad," Closeup, No. 1 (1975), pp. 25, 35-37.

Rider, L. F. "The Alekan-Gerard Process of Composite Photography," American Cinematographer, XLIII, No. 7 (July, 1962), pp. 428, 430, 432-434.

Ryu, Keiichiro. "Lumiscope Lens-Screen System for Color Television," Journal of the SMPTE, LXXXI, No. 9 (September, 1972), pp. 688-671.

Scapperotti, Dan R., and Bartholomew, David. "The Golden Voyage of Sinbad" (interview with producer Charles Schneer), Cinefantastique, III, No. 2 (Spring, 1974), pp. 4-5, 42-43, 45.

Scot, Darrin. "Wizardry in Special Effects," American Cinematographer, XLIV, No. 4 (April, 1963), pp. 218-219, 243-245.

Shay, Don. "Willis O'Brien: Creator of the Impossible," Focus on Film, No. 16 (Autumn, 1973), pp. 18-48.

Shirley, Graham, and Taylor, Bill. "Danforth's Dinosaurs," Lumiere, No. 25 (July, 1973), pp. 8-12.

"This is Ray Harryhausen," Kaleidoscope, III, No. 1 (1967), pp. 18-23.

Thomas, Jeremy. "Ray Harryhausen: Creator of Special Visual Effects," Cinema Papers (January, 1974), pp. 12-15, 70.

Towsley, Steve. Review of Mighty Joe Young, Animation Journal, No. 2 (November, 1964).

"Traveling Matte Systems," American Cinematographer, XLIII, No. 9 (September, 1962), pp. 538-539, 567-568, 571.

Turner, Glen H. "Animation with Puppets," American Cinematographer, XXXII, No. 11 (November, 1951), pp. 460-472+.

"20 Million Miles to Earth," Famous Monsters of Filmland, No. 37 (February, 1966), pp. 4-14.

Uman, Joel. "The Monstruous World of Ray Harryhausen," Take One, IV, No. 8 (November-December, 1973), pp. 22-23.

Vlahos, Petro. "Selection and Specification of Rear-Projection Screens," Journal of the SMPTE, LXX, No. 2 (February, 1961), pp. 89-95.

Walker, Vernon. "Saunders Cellulose Screen Reduces Hot Spot," American Cinematographer, XIII, No. 6 (October, 1932), p. 11.

Wolf, Mark. "Ray Harryhausen's Aerial Brace Creations," FXRH, I, No. 4 (Spring, 1974), pp. 15-24.

_____. "Stop Frame: The History and Technique of Fantasy Film Animation" (part one), Cinefantastique, I, No. 2 (Winter, 1971), pp. 6-21.

_____. "Stop Frame: The History and Technique of Fantasy Film Animation" (part one), Cinefantastique II, No. 1 (Spring, 1972), pp. 8-17.

Wolf, Mark D. "The Effects: An Animation of the Visual Effects in The Golden Voyage of Sinbad," Closeup, No. 1 (1975), pp. 8-11, 31-34.

Wray, Fay. "How Fay Met King Kong, or the Scream that Shook the World," The New York Times (September 21, 1969), Section 2, p. 17.

PERIODICALS
(Electronic Composites)

Glickman, Richard B. "Videotape-to-Film Transfers in Color," American Cinematographer, LIII, No. 10 (October, 1972), pp. 1116-1119, 1197-1199.

Holm, Wilton R. "The New Electronic Composite Photography and Image Modification System," American Cinematographer, LVI, No. 4 (April, 1975), pp. 424-425, 438, 474.

Howell, David A. "A Primer on Digital Television," Journal of the SMPTE, LXXXIV, No. 7 (July, 1975), pp. 538-541.

Kiger, Bob. "'Videography:' What Does it all Mean?" American Cinematographer, LIII, No. 10 (October, 1972), pp. 1112-1115, 1172-1174, 1188-1193.

Madson, Axel. "In the Picture: Video," Sight and Sound, XLII, No. 3 (Summer, 1973), p. 146.

Matza, Joe. "Magicam," American Cinematographer, LVI, No. 1 (January, 1975), pp. 34-37, 72-73, 112-113.

Patterson, Richard. "Electronic Special Effects," American Cinematographer, LIII, No. 10 (October, 1972), pp. 1160-1164, 1180-1183.

Rubinsteing, Richard. "Electronic Cinematography," Filmmakers Newsletter, VI, No. 6 (April, 1973), pp. 42, 44, 46.

PERIODICALS
(Reviews Surveyed)

Babes in Toyland

Hartung, Philip T. Commonweal, LXXV, No. 13 (December 22, 1961), p. 341.
Knight, Arthur. Dance Magazine, XXXVI, No. 1 (January, 1962), pp. 22-23.
Life, LI, No. 23 (December 8, 1961), pp. 55-56, 58.
Newsweek, LVIII, No. 25 (December 18, 1961), p. 98.
Walsh, Miora. America, CVI, No. 12 (December 23-30, 1961), pp. 424-425.

The Beast from 20,000 Fathoms

Alpert, Hollis. Saturday Review (June 20, 1953), pp. 32-33.
McCarten, John. The New Yorker (July 4, 1953), p. 43.
Time, LXI, No. 25 (June 22, 1953), p. 88.
Walsh, M ra. America, LXXXIX, No. 15 (July 11, 1953), p. 384.

The Beast of Hollow Mountain

The Hollywood Reporter, CXLI, No. 9 (August 23, 1956), p. 3.

Dinosaurus!

"Tube." Variety (Daily), CVII, No. 4 (June 9, 1960), p. 3.

Equinox

Film Facts, XIV, No. 18 (1971), pp. 447-448.
Pirie, David. Monthly Film Bulletin, No. 456, Vol. 39 (January, 1972), p. 5.

Flesh Gordon

Brown, Geoff. Monthly Film Bulletin, No. 494, Vol. 42 (March, 1975), p. 55.
Stuart, Alexander. Films and Filming, XXI, No. 7 (April, 1975), pp. 42-43.

Fiend Without a Face

Film Facts, I, No. 32 (September 10, 1958), pp. 132-133.

First Men in the Moon

Film Facts, VII, No. 42 (November 20, 1964), p. 268.
Monthly Film Bulletin, No. 368, Vol. 31 (September, 1964), p. 134.

The Golden Voyage of Sinbad

Cook, Page. "The Sound Track" (review of Miklos Rozsa's score for The Golden Voyage of Sinbad), Films in Review, XXV, No. 6 (June-July, 1974), pp. 362-366.
FXRH, I, No. 4 (Spring, 1974), pp. 29-36.

Jackson, Fred. Take One, IV, No. 8 (November-December, 1973), p. 23.
Scapperotti, Dan R. Cinefantastique, III, No. 2 (Spring, 1974), p. 44.
Schwartz, Les. Photon, No. 25 (1974), pp. 11-14.
Seldon, Nick. Jump Cut, No. 4 (November-December, 1974), p. 6.
Strick, Phillip. Monthly Film Bulletin, No. 480, Vol. 41, (January, 1974), p. 8.
Stuart, Alexander. Films and Filming, XX, No. 6 (March, 1974), pp. 45-46.

Goliath and the Dragon

Monthly Film Bulletin, No. 331, Vol. 28 (August, 1961), p. 117.

The Great Rupert

The Hollywood Reporter, CVII, No. 10 (December 30, 1949), p. 3.

It Came from Beneath the Sea

Newsweek, XLV, No. 19 (May 9, 1955), p. 103.

Jack the Giant Killer

Film Facts, V, No. 30 (August 24, 1962), pp. 180-181.
Monthly Film Bulletin, No. 403, Vol. 34 (August, 1967), p. 125.
Newsweek, LX, No. 6 (August 6, 1962), p. 77.

Jason and the Argonauts

Eyles, Allen. Films and Filming, X, No. 1 (October, 1963), pp. 25-26.
Miller, Jonathan. The New Yorker (August 24, 1963), p. 65.
Time, LXXXII, No. 3 (July 19, 1963), p. 78.
Walsh, Moira. America, CIX, No. 6 (August 10, 1963), p. 143.

Journey to the Beginning of Time

Film Facts, X, No. 4 (March 15, 1967), p. 38.

Journey to the 7th Planet

Gerrard, David. Films and Filming, VIII, No. 11 (August, 1962), p. 34.

King Kong

Gow, Gordon. Films and Filming, XXI, No. 4 (January, 1975), pp. 45-50.
Nation (March 22, 1933), p. 326.

Mighty Joe Young

Commonweal (July 22, 1949), p. 368.
Life, XXVII, No. 4 (July 25, 1949), pp. 94-95.
McCarten, John. The New Yorker, XXV, No. 24 (August 6, 1949), p. 39.
Pryor, Thomas M. The New York Times, XIX, (July 28, 1949), p. 3.
Newsweek (August 8, 1949), p. 68.
Time (August 8, 1949), p. 70.

The Monster from Green Hell

Film Facts, I, No. 52 (January 28, 1959), p. 285.

Mysterious Island

"E. L." The Film Daily, CXIX, No. 113 (December 14, 1961), p. 7.
Film Facts, IV, No. 48 (December 29, 1961), pp. 311-312.
Hartung, Philip T. Commonweal, LXXV, No. 13 (December 22, 1961), p. 341.
Lincoln Rae. Films and Filming, VIII, No. 11 (August, 1962), p. 34.

Monthly Film Bulletin, No. 341, Vol. 29 (June, 1962), p. 82.
Time, LXXIX, No. 2 (January 12, 1962), p. 62.
"Tube." Variety (Daily), CXIV, No. 1 (December 6, 1961), p. 3.

One Million Years B.C.

"D.W." Monthly Film Bulletin, No. 395, Vol. 33 (December, 1966), p. 180.
Everson, William K. Films in Review, XVII, No. 3 (March, 1967), pp. 178-179.
Johnson, Ian. Films and Filming, XIII, No. 4 (January, 1967), p. 30.
Morgenstern, Joseph. Newsweek, LXIX, No. 11 (March 13, 1967), p. 109.

7 Faces of Dr. Lao

Hartung, Philip T. Commonweal, LXXX, No. 3 (April 10, 1964), pp. 91-92.
_____. Senior Scholastic (Teacher edition), LXXXIV, No. 11 (April 17, 1964), p. 22.
Monthly Film Bulletin, No. 382, Vol. 32 (November, 1965), p. 169.
Time, LXXXIV, No. 6 (August 7, 1964), p. 89.

7th Voyage of Sinbad

Ashton, Prudence. Films in Review, X, No. 1 (January, 1959), pp. 40-41.
Cahoon, Herbert. Library Journal, LXXXIII, No. 22 (December 15, 1958), p. 3508.
Hartung, Philip T. Commonweal, LXIX, No. 11 (December 12, 1958), p. 293.
Newsweek, LII, No. 24 (December 15, 1958), p. 114.
Time, LXXIII, No. 4 (January 26, 1959), p. 91.
Walsh, Moira. America, C, No. 12 (December 20-27, 1958), p. 381.

The Three Worlds of Gulliver

"R.S.T." Films in Review, XI, No. 10 (December, 1960),

p. 616.
Time, LXXVII, No. 6 (February 3, 1961), p. 69.

tom thumb

Ashton, Prudence. Films in Review, X, No. 1 (January, 1959), p. 40.
Baker, Peter G. Films and Filming, V, No. 4 (January, 1959), p. 23.
Cahoon, Herbert. Library Journal, LXXXIII, No. 22 (December 15, 1958), p. 3508.
Hartung, Philip T. Commonweal, LXIX, No. 11 (December 12, 1958), p. 293.
Time, LXXIII, No. 1 (January 5, 1959), p. 84.
Walsh, Moira. America, C, No. 12 (December 20-27, 1958), p. 381.

20 Million Miles to Earth

The Film Daily, CXI, No. 116 (June 17, 1957), p. 6.
Monthly Film Bulletin (November, 1957), p. 141.

The Valley of Gwangi

Hutchison, David. Films and Filming, XVI, No. 3 (December, 1969), p. 56.

When Dinosaurs Ruled the Earth

Clarke, Frederick S. Cinefantastique, I, No. 3 (Summer, 1971), pp. 26-27.
"Rich." Variety (Daily), CXLIX, No. 21 (October 6, 1970), p. 3 (reviewed under title When Dinosaurs Ruled the World).
Weis, Buddy. Castle of Frankenstein, IV, No. 4 whole No. 16 (July, 1971), pp. 13-14.

The Wonderful World of the Brothers Grimm

Durgnat, Raymond. Films and Filming (August, 1963), p. 25.

UNPUBLISHED MATERIAL

Baker, Everett Burgess. "An Investigation of a Method for Controlling the Posing of Three Dimensional Figures used in Making Animated Model Films," Unpublished Research Project, University of Southern California, 1944 (part one), 1945 (part two).

Burtt, Benjamin P., Jr. "The Development of A Dual-Screen, Dual-Mirror Front Projection Technique for Application to 16 mm Special Effects Cinematography." Unpublished Master's thesis, Department of Cinema, University of Southern California, 1976.

Delgado, Marcel. Letters to Don Shay, November, 1963; and December 12, 1963.

Farino, Ernest D. Letter to the writer, December 19, 1975.

Hammeras, Ralph. Letter to Don Shay, circa early 1964.

Harryhausen, Ray. Letters to Don Shay, July 17, 1963; September 15, 1963; and March 25, 1969.

Harryhausen, Ray. Letter to the writer, January 18, 1976.

Larrinaga, Mario. Letter to Don Shay, June 30, 1967.

O'Brien, Darlyne (Mrs. Willis O'Brien). Letter to Don Shay, January 19, 1964.

Smith, David R. Letter to the writer, November 19, 1975.

OTHER SOURCES

Bernard Productions. Personal interview with Bernard Rosenzweig, producer of The Legend of Hillbilly John; Hollywood, California, November 18, 1975.

Cascade California, Inc. Personal interviews with David Allen, animator; Hollywood, California, November 3, 1975; January 15, 1976; January 16, 1976.

_____. Personal interview with Jim Danforth, animator; Hollywood, California, November 3, 1975.

_____. Personal interview with Bill Hedge, animator; Hollywood, California, November 3, 1975.

Compact Video. Personal interview with Newt Bellis, Vice President of Marketing and Sales; Burbank, California, January 22, 1976.

Danforth, Jim. Lecture on Special Visual Effects, University of Southern California; part of a course presented by the Society of Motion Picture and Television Engineers Committee on Education in cooperation with the University, Spring, 1973.

_____. Lecture on Special Visual Effects, University of Southern California; part of a course presented by the Society of Motion Picture and Television Engineers Committee on Education in cooperation with the University, May 26, 1976.

Delgado, Marcel. Tape recorded conversation with Don Shay, recorded April 6, 1973.

Edison Studios press release on Willis O'Brien, circa 1916.

Excelsior Animated Moving Pictures. Personal interviews with Gene Warren, President; Hollywood, California, November 18, 1975; January, 1976.

Film Effects of Hollywood. Personal interview with Linwood Dunn, President; Hollywood, California, January, 1976.

Image Transform. Personal interviews with Ken Holland, Chief Engineer; North Hollywood, California, November, 1975; January 14, 1976.

Jean De Joux and Company Videoanimation. Personal interview with Jean De.Joux, Co-director and Co-producer; Beverly Hills, California, November 4, 1975.

Magicam. Personal interview with John Gale, Chief Engineer, and Mel Rappaport; January 7, 1976.

Mendrala, Jim. Lecture on video special effects, University of Southern California; part of a course presented by the Society of Motion Picture and Television Engineers Committee on Education in cooperation with the University, December 3, 1975.

Pike, Miles. Personal interview with Miles Pike; Van Nuys, California, February 24, 1976.

Research Center of the Association of Motion Picture and Television Producers. Personal interview with Petro Vlahos, Chief Scientist; Hollywood, California, January 14, 1976.

Shepphird, Carroll. Tape recorded conversation with Don Shay, recorded April 6, 1973.

Sid and Marty Krofft Television Productions. Personal interview with Tom Swale, Associate Producer of Land of the Lost; Hollywood, California, November, 1975.

Tholen, Dale. Personal interview with Dale Tholen; Culver City, California, March 29, 1976.

Van der Veer Photo Effects. Personal interview with Barry Nolan, Research Consultant; Hollywood, California, January 14, 1976.