

THE ESSENTIALS OF PRODUCING 16mm CEL ANIMATED FILMS

by

JOHN ROGER STOCKARD

B. A., University of North Carolina, 1955

A MASTER'S THESIS

submitted in partial fulfillment of the
requirements for the degree

MASTER OF ARTS

Department of Technical Journalism

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1969

Approved by:

F. Virginia Howe
Major Professor

LD
2668
T4
1969
575

TABLE OF CONTENTS

CHAPTER	PAGE
I. THE PROBLEM AND DEFINITIONS OF TERMS USED	1
The Problem	2
Definitions of Terms Used	3
Scope of the Study	4
Procedure	5
II. THE REVIEW OF THE LITERATURE	11
Books	11
Periodicals	20
Evaluation of the Literature	28
III. FINDINGS OF THE STUDY	29
Studio Operations and Training	29
Animation Equipment	40
Animation Materials	49
The Animation Process	57
IV. LIMITATIONS OF THE STUDY	63
V. SUMMARY AND CONCLUSIONS	64
ACKNOWLEDGMENT	71
BIBLIOGRAPHY	72
APPENDIX A. The Questionnaire	76
APPENDIX B. Studios Surveyed	79
APPENDIX C. Sources of Equipment and Materials	85
APPENDIX D. Bar and Exposure Sheet Samples	88

CHAPTER

PAGE

APPENDIX E. A Comparison in Percentages of the Amount of

Production by the Respondents in 16mm and

35mm Film 91

LIST OF TABLES

TABLE	PAGE
I. Percentage of Animation Produced by Each Studio in Six Categories of Intended Use	31
II. Percentage of Employees Trained by Popular Methods Compared to the Method of Training Preferred by the Respondents	36
III. Animation Stands, Cameras, and Lenses Used by Respondents	41
IV. A Comparison in Percentages of the Amount of Production by the Respondents in 16mm and 35mm Film	50
V. Percentages of Production in Various Animation Forms Reported by the Respondents	52

LIST OF FIGURES

FIGURE	PAGE
1. The Basic Oxberry Animation Stand	44
2. The Dimensions of the Three Most Popular Animation Cel Registration Systems	47

CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

Animation, one of the few remaining hand arts predating spoken language, has continued to find increasing importance in a world of supersonic flight, cybernetics, mass production, and bulging cities. The impression of motion has manifested itself in our graphic arts from the earliest cave drawings to such modern artistic masterpieces as "Nude Descending a Staircase, Number Two."¹ Animated film production became a possibility as early as 1908.²

Until recently most animated films were theatrical cartoons created by only the largest film studios. Today this situation has changed. Animation ". . . is now the favored medium for TV commercials and spot announcements,"³ and ". . . animation has an enormous appeal for educational purposes, for a great range of subjects."⁴ New and improved equipment has been developed making it possible for animation studios to turn out more effective films faster and more profitably.⁵

¹Painting by Marcel DuChamp, 1912, now hanging in The Philadelphia Museum of Art.

²John Halas and Roger Manvell, The Technique of Film Animation (New York: Hastings House Publishers, 1959), p. 14.

³Vern W. Palen, "Animation Major Factor in Production of TV Ad Films," American Cinematographer, Vol. 36 (October, 1955), 588.

⁴George H. Bouwman, "Animation at the Horace Mann School," Educational Screen and Audiovisual Guide, Vol. 6 (February, 1965), 28.

⁵Vern W. Palen, "Aerial Image Techniques," American Cinematographer, Vol. 44 (September, 1963), 524.

Film studios throughout the United States, which are not now using animation, are looking to animation as a potential means of enhancing their productions. Studios are aware of the audience appeal of animation and have heard of the new equipment. A problem arises when these studios attempt to locate concise information on the essentials of producing film animation.

Before this study was undertaken, Mr. Orlan Hill, manager of the animation department, Calvin Productions, Incorporated, Kansas City, was shown a prospectus for the study. He was asked to evaluate the proposed study on the basis of its content and value to the animation industry. He expressed full support of the study and indicated that such a study was long over-due.

This endorsement, by the manager of Calvin's animation department, is of considerable importance to this study. Calvin is one of the largest producers of animated films between the east and west coasts. There are sixteen full time employees in the Calvin animation department and the company has been involved in animated film production for twenty-seven years.

I. THE PROBLEM

Statement of the problem. The purpose of this study was (1) to examine current studio operations and training procedures, (2) to analyze the most popular technical animation equipment in terms of its suitability for animation filming, (3) to determine the most common material used for producing film animation, and (4) to outline the basic

steps to be followed in the production process.

Importance of the study. Current, comprehensive, and concise published material on technical production procedures has not kept pace with the increase in interest and technical developments for film animation. Eli L. Levitan has said, ". . . the animation technique, although considerably older than any other motion picture technique, is the least understood and perhaps the most misunderstood."⁶ Any attempt to render understandable all the aspects of the animation process in one volume would be an overwhelming undertaking. However, for the beginning animator, there is still a great need for ". . . more information on the practical nuts and bolts of animation. This would at least give a reference for personal experimentation."⁷

II. DEFINITIONS OF TERMS USED

Animation. Everything that moves is animated. In the sense that all films show movement, they are animated films. However, when the term "animation" is used in relation to motion pictures it has a very specialized meaning. In this context animation has been described as

. . . the art of giving apparent movement to inanimate objects. The word is also used for the sequence of drawings made to create the movement and for the movement itself when seen on the screen.⁸

⁶ Eli L. Levitan, Animation Art in the Commercial Film (New York: Reinhold Publishing Corporation, 1960), p. 7.

⁷ Statement by Mr. Howard W. Cotton, Film Production Department, Southern Illinois University, in answer to questionnaire.

⁸ John Halas and Roger Manvell, The Technique of Film Animation (New York: Hastings House Publishers, 1959), p. 336.

The research for this study has not revealed a more concise and fully explanatory definition for film animation. The research did reveal that the term "animation" has many different meanings even to personnel working in the field. Generally authors take several pages in their manuscripts to convey its meaning.

For the purpose of this study, animation is defined as the photographic recording on motion picture film, one frame at a time, a series of drawings each of which represents an isolated phase of an analyzed and predetermined movement. This film, when projected, will integrate these recorded drawings in the eye of the viewer into an illusion of the predetermined movement, a movement which has never existed in reality.

Cel animation. Cel animation is that animation form which utilizes sheets of cellulose acetate or other transparent material for the surface on which the drawings are traced.

III. SCOPE OF THE STUDY

Animation form. All research has pointed to the fact that cel animation, while being the most popular form of animation, can also serve as a common denominator for all other forms of film animation. Most of the basic principles which apply to cel animation have direct application to other forms of animation such as puppet and object animation, cut-out paper animation and animation with still pictures. For this reason cel animation has been taken as the exclusive example throughout the study.

16mm Film. 16mm film production is an expanding industry in the United States. This trend is largely due to the influence of television, lower production costs, and portability and accessibility of equipment. As an aid to this form of film production, all production procedures covered in this study have been converted into terms compatible with 16mm film production.

IV. PROCEDURE

The author of this study has been fortunate to accumulate over four years of experience in the field of 16mm film animation in both commercial television and university film production. During this time there was opportunity to examine empirically some of the popular production procedures and to develop procedures specifically suited to 16mm production and modest budgets.

While gaining this experience two significant facts became apparent; the extreme difficulty of locating specific and useful information on animation, and the appalling lack of source material available to the beginning animator.

This preliminary investigation for the study made it apparent that direct contact with persons now engaged in film animation would best serve the needs of the study. This contact took three forms (1) a questionnaire mailed to studios now producing animated films; (2) letters to manufacturers concerning equipment and materials; and (3) personal interviews with the sixteen man staff of the animation department of Calvin Productions, Incorporated, Kansas City.

The questionnaire was designed with the cooperation of Dr. F. Virginia Howe and based on the author's previous film knowledge, experience, and research. Because of the complexity and flexibility of animation techniques, it was determined that largely open-end questions would be most appropriate for the study. "They give opportunity for spontaneous, unanticipated responses rather than confining the respondent to a choice among alternatives imposed by the question."⁹ Therefore, the questionnaire was intended to gather from the industry answers which were more vital and more current than anything now available in print.

Four animation studios were selected to test the questionnaire. Three of them were selected because of their demonstrated interest in animation through publications, Anifilm Studios, New York, Cambria Studios, Los Angeles, and Playhouse Pictures, Hollywood. The fourth, Calvin Productions, was chosen because of the writer's business association with the Calvin personnel. A letter of explanation was enclosed with the questionnaires sent to each of the four studios. It indicated the purpose of the study and of the test. Also enclosed was a sample of the cover letter designed to accompany the questionnaire for the actual survey of the study. The four test studios were urged to give a critical evaluation of both the questionnaire and of the final cover letter for their comprehensiveness and clarity.

Two of the studios in this test answered indicating that they

⁹ Arthur Komhauser and others, Research Methods in Social Relations Part Two: Selected Techniques (New York: Dryden Press, 1951), p. 427.

thought the questionnaire and cover letter essentially sound. The remaining two studios did not reply even after follow-up letters were sent. With this endorsement 120 animation production studios throughout the United States were mailed questionnaires. The number of studios selected was believed sufficient to obtain enough replies to determine significant facts for the study.

The final form of the questionnaire consisted of twenty-two questions on three pages. The specific aims of the questionnaire were (1) to determine the variations and consistencies in animation techniques now used; (2) to determine the variations and consistencies in studio personnel structure; (3) to obtain information on what equipment is used and why; and (4) to examine current opinions on the necessary training for personnel in film animation.

The use of stationery of the Office of Extension Radio-Television, Kansas State University, was permitted for the cover letter accompanying the questionnaire. This was felt helpful to support the study in the opinion of the respondents. Beyond explaining the purpose of the questionnaire, the cover letter asked for samples of "bar" or "lead" sheets and other printed information to explain more explicitly each studio's operation.¹⁰ An offer was made to return a tabulation of all completed questionnaires to those respondents interested in this phase of the study.

¹⁰"Bar" or "Lead" sheets are used for the original layout of an animated production. An example is shown in Appendix D.

Distribution of the questionnaires was based on the premise that animation business firms, due to commercial competition, are more likely to have the most workable equipment, follow the most practical production procedures, and utilize the most efficient organization of personnel. Of the 120 studios consulted, all but four were commercial establishments. Of these four, two were universities, and two were public supported organizations. These were included because of their recognized work in the animation field.

An effort was made to distribute the questionnaires among all sizes of companies, from those employing one or two persons to those employing well over one hundred. As a result of this procedure, it was hoped to determine those practices which are indispensable to the animation process regardless of production volume. Reputation and geographical location were also factors in the selection of the studios. Of all the questionnaires, eighty-eight, or 73 per cent of them, were mailed to either New York or California where clearly the major portion of animation work is performed. The remaining thirty-two, or 27 per cent, were distributed among seventeen additional states.

Letters were sent to manufacturers of animation equipment and materials as the next step in procedure of the study. An investigation determined twenty-two companies were the leading contributors to this phase of animation. Individual letters were drafted for each company. Questions were tailored to obtain specific information relative to the operation and function of the equipment and materials. Where appropriate, manufacturers were asked to send photographs of their equipment,

instructional manuals, catalogues, and price lists. In the case of photographs, permission was asked to include these photographs in the study.

Interviews with eight of the sixteen members of the animation department of Calvin Productions, Kansas City, Missouri, constituted the third phase of the procedure. Calvin Productions was particularly suited for this study for two reasons: it is considered to have one of the largest and most capable animation staffs between the two U.S. coasts; and it produces almost all of its work on 16mm film. Calvin Productions also operates two of the most expensive, complex, and popular animation stands available in the world.

The writer has become well acquainted with the staff of the animation department at Calvin through a business relationship spanning two and one-half years. During this time fourteen trips were made to Calvin. These personal contacts provided an excellent opportunity to obtain first hand information on animation techniques. In many cases, the information was brought back and tested on the animation facilities at Kansas State University. Much of the information gathered in this manner is not available in print.

During the course of the study, many questions arose which were either unanswered or unsatisfactorily answered in the review of the literature, questionnaire responses, previous interviews, or through personal experimentation by the author. A list of these questions was taken to Mr. Orlan Hill, manager of the animation department at Calvin. A tape recorder was used during the interview to assure accuracy in

recording the answers to these questions. A still camera also was used to visually document, for the study, certain phases of the animation process.

CHAPTER II

REVIEW OF THE LITERATURE

Most of the previously published material on animation has been focused on the uses and the effects on audiences of the animated film. Such information is valuable from a sociological viewpoint, but not useful for the purpose of the study. It has been pointed out that information leading to an understanding of the essentials of the animation production process is limited. Nine books and fifteen articles have been found which do contribute to this understanding. Those publications have been briefly summarized here in the order that it was felt most helpful for the beginning animator to study them.

I. BOOKS

Any study of animation which does not include something of the art, history, and technique of Walt Disney is difficult to imagine. An excellent source for this information has been provided in a book by Robert D. Feild.¹ This book is definitely not a text on production principles, therefore is not ideally suited for this study. Walt Disney, however, is such a great figure in the world of animation that one cannot seriously become involved in animation without knowing something about this pioneer and innovator.

Mr. Feild begins his book by tracing Disney's early interest in

¹Robert D. Feild, The Art of Walt Disney (New York: The Mac-Millan Company, 1942).

animation and also shows the link between the parent comic strip and the embryonic animated film. It has been pointed out that one of the major factors governing the success of Walt Disney was his early understanding of the importance of the animation sound track.²

The book is rather romantic in style and almost gives the reader the impression of what a very complete tour through the Disney studios must have been like in 1942, near the height of Disney's technical development. The reader becomes well acquainted with the sense of perfection insisted upon by Mr. Disney. Many production conferences were recorded verbatim in this book. It is extremely interesting to read of the high degree of psychological analysis that was applied to the creation of each character in a Disney production. The storyboard, so necessary to the animated film, is quite clearly described by Mr. Feild.³ Other technical aspects of animation are not so clearly outlined.

Mr. Feild points out that Roy Disney was as much responsible for the success of the Disney productions as was Walt.⁴ Actually, Walt Disney had made no money on his films prior to the publication of Mr. Feild's book. Roy Disney capitalized on the reputation of his brother's characters and provided funds for Walt through syndicated comic strips, advertising, and toy manufacturing.

Although the book cannot act as a guide to the beginning animator,

²Feild, op. cit., p. 37.

³Ibid., pp. 101-27.

⁴Ibid., pp. 49, 66-70.

it should be read. Here the young animator can get some understanding of the patience, determination and child-like enthusiasm that one should have when entering this demanding profession.

Messrs. John Halas and Roger Manvell have been connected with several books on animation. It would be appropriate to mention one of their collaborative efforts now. Design in Motion⁵ is frankly a picture book. Like Mr. Feild's book, it does not contain a great deal of detail of animation techniques, but it does introduce the reader to the vast range of visual styles which can often spur the reader's enthusiasm and imagination. Design in Motion is the type of book the animator should have by his work table for constant reference along with many other books on art styles. The special feature of this book is that it represents animation art from all the major production centers throughout the world.

The Animated Film⁶ was the result of the single effort of Roger Manvell. This book is an attempt to explain the problems of producing a full length animated feature. The Halas and Batchelor film "The Animal Farm" was used as the exclusive example throughout the work. This film is unique in that it is the only full length animated feature produced for the adult audience. The book is divided into three sections. Section one describes the evolution of the drawn film. The second section

⁵ John Halas and Roger Manvell, Design in Motion (New York: Hastings House Publishers, 1962).

⁶ Roger Manvell, The Animated Film (London: The Sylvan Press, 1954).

indicates some of the differences between the full length production and the short feature and section three suggests the potential future of the full length animated feature.

There is some parallel between this book and the book by Mr. Feild.⁷ The need for exceptional planning during the early stages of production is made quite clear.⁸ The work of the layout and background artists also has been partially outlined.⁹ The liberal use of illustrations help in making the book understandable.

John Halas worked with Bob Privett to produce the book How to Cartoon for Amateur Films.¹⁰ This book, as the title implies, is a very basic book. Some of the suggestions, particularly concerning animation equipment, would appall the experienced animator. However, the book does have a great deal of merit. For all its simplicity, there are some production details in this book found in no other literature. The essentials of timing action have been rather well outlined.¹¹ In addition an analysis of the physical laws can be found which must carry over from real life into animation. Timing action along curved paths has also been somewhat clarified.¹² The authors have also included

⁷Feild, loc. cit.

⁸Manvell, op. cit., pp. 19-35.

⁹Ibid., pp. 24-46.

¹⁰John Halas and Bob Privett, How to Cartoon for Amateur Films (London and New York: Focal Press, 1951).

¹¹Ibid., pp. 23-29.

¹²Halas and Privett, op. cit., p. 40.

suggestions for making maximum use of as few cels as possible.¹³

Advanced Animation¹⁴ was well recommended by several sources.

This book proved to be an unexpected shock for it is mainly a cartoon handbook of the type sold in paint and art supply stores. This book is basically another picture book. The pictures, however, are of great value to the beginning animator. The sequence of drawings necessary for creating animation of the walking figure is reproduced in this book. The drawings are analyzed from the front, side, and rear in the walk, strut, and run cycle.¹⁵ Also represented in these drawings can be found the movements of the four legged creature and the flight of the bird.¹⁶ These drawings can save the beginning animator many hours of experimentation.

Although Basic Titling and Animation¹⁷ is only a simple handbook, it has great value to the study. This booklet summarizes in very few pages various forms of animation, simple animation equipment, and basic techniques. The most important aspect of the booklet is its diagrams for the construction of an inexpensive, but workable animation stand.¹⁸ This can be very helpful, indeed, when the stand shown can be built for

¹³ Ibid., pp. 85-89.

¹⁴ Preston Blair, Advanced Animation (New York: Walter J. Foster, 1949).

¹⁵ Ibid., pp. 24-25.

¹⁶ Ibid., pp. 4, 23.

¹⁷ Basic Titling and Animation (Eastman Kodak Company, First Edition, third printing, 1965).

¹⁸ Ibid., pp. 28-30.

perhaps, under \$200. Also included in this publication are some techniques using still photographs to create unique effects for minimal labor and material costs.¹⁹

There are three books which are valuable and essential to this study. They are the most difficult to comprehend and therefore would be better understood after the other literature had been reviewed. They are The Technique of Film Animation,²⁰ Animation Art in the Commercial Film,²¹ Animation Techniques and Commercial Film Production.²² These last two books by Levitan compliment each other well, each covering different aspects of the animation process. There is, however, some overlap of information between these last two books and the first mentioned. All three books contain excellent glossaries.

The authors Halas and Manvell, who wrote The Technique of Film Animation,²³ have divided their book into four parts. The first part is a basic introduction to some of the factors governing the work of the animator. Much of this information has been covered in other literature. The second part is of least value to the study. It is more oriented to an understanding of animation from the viewpoint of the advertising

¹⁹Eastman Kodak Company, op. cit., pp. 28-30.

²⁰John Halas and Roger Manvell, The Technique of Film Animation (New York: Hastings House Publishers, 1959).

²¹Eli L. Levitan, Animation Art in the Commercial Film (New York: Reinhold Publishing Corporation, 1958).

²²Eli L. Levitan, Animation Techniques and Commercial Film Production (New York: Reinhold Publishing Corporation, 1962).

²³Hales and Manvell, loc. cit.

agency or public relations office.

Part three is of most importance to the study. The development of the storyboard is again, clearly analyzed.²⁴ Character development, both visually and in relation to the script is well explained.²⁵ Part three also acquaints the reader with the job positions usually found in the average animation studio.²⁶ These positions are divided into the following categories: (1) producer, (2) director, (3) designer, (4) layout and background artist, (5) key animator, (6) assistant animator, (7) inker and colorist, (8) checker, (9) cameraman, (10) editor, and (11) the studio manager. From one to three pages have been devoted to the duties performed in each of these positions. The authors state that in the small studio, these job functions will still be performed, but that a few people will serve in many capacities.²⁷

Part four is a broad section surveying some of the other forms of animation such as puppet animation, animation with still pictures, and object animation. The similarity between the production of these forms and that of cel animation is indicated.²⁸ However, there is very little specific information on techniques.

²⁴ Halas and Manvell, op. cit., pp. 159-63.

²⁵ Ibid., pp. 163-68.

²⁶ Ibid., pp. 209-33.

²⁷ Ibid., p. 210.

²⁸ Ibid., p. 263.

Animation Art in the Commercial Film²⁹ is an effort to give an over-all concept of the procedures involved in making an animated film. This book is short, the copy is brief and to the point, and the numerous illustrations are well explained in the text. A television commercial has been used in this book to illustrate the step by step process of producing film animation. This book has also been divided into sections. They are (1) a quick introduction to animation in general, (2) the planning aspects of animation, (3) the production process, (4) the filming operation, and (5) an example showing the relationship between the exposure sheet and the finished film.

Sections one, two and three are a partial restatement of things said in section one, two and three of the Halas and Manvell book.³⁰ Like that book, too, section three of Levitan's book is most important to the study. However, Mr. Levitan, the author, presents a finer break down of the elements of the production process, than is evidenced in previous studies.

The highlights of this section are the uses of the exposure sheet, hold cel, using cels in layers, exposures in ones, twos, and threes. Pictures of the movement cycle of the walking, strutting, and running person are also available. Another valuable series of pictures included in this section are those representing lip synchronized

²⁹Eli L. Levitan, Animation Art in the Commercial Film (New York: Reinhold Publishing Corporation, 1958).

³⁰Halas and Manvell, loc. cit.

animation.³¹ They are the most complete directions for this process found in any of the reviewed material.

The section on the filming operation for animation is exceptionally short, consisting mainly of effectively captioned pictures. The last section of this book is a discussion of a one minute commercial on a scene by scene basis. The exposure sheet and the important drawings are explained in detail in order to show how all elements of an animated film are brought together to form a unified whole.

Animation Techniques and Commercial Film Production,³² Mr. Levitan's second book, is a very comprehensive book, but in many ways goes beyond the need of the study. A large portion of the book is devoted to special effects which superimposes or matts one picture over another. The book contributes to the study in two major areas; equipment and labor saving art and camera techniques.

This book is virtually the only one which has attempted to explain, in any detail, the mechanical equipment used for producing animation. The field guide, the animator's stage, a pattern made to conform to the proportions of the camera gate, is mentioned here for the first and only time in all animation literature.³³ Levitan explains the movements of the animation camera, the animation stand and the art work

³¹ Levitan, op. cit., pp. 70-71.

³² Eli L. Levitan, Animation Techniques and Commercial Film Production (New York: Reinhold Publishing Corporation, 1962).

³³ ibid., p. 18.

itself.³⁴ He demonstrates the use of the pantograph.³⁵ This is a device, attached to the animation stand, which can be used to simplify the plotting of diagonal or complex curved movements of the art work.

The labor saving art and camera techniques mentioned in this book are similar to those found in other literature, but Mr. Levitan has presented them in a more complete manner. Several pages are devoted to the use of special guides and "gimmic" cels.³⁶ Sliding cels are also explained.³⁷

Beyond the specific needs for animation, the book goes into great detail on the operation and effects produced by the optical printer. This is an interesting machine, but it is not a basic part of the animation process. It has its uses mainly in trick effects for live film as well as additional effects for animation produced by the normal process.

II. PERIODICALS

The ten most normal steps in producing animated films are traced very briefly in an article by Dr. Roy Madsen.³⁸ Essentially, they are: (1) script and storyboard, (2) sound recording, (3) designing the

³⁴ Ibid., pp. 15-18.

³⁵ Ibid., p. 38.

³⁶ Levitan, op. cit., pp. 108-20.

³⁷ Ibid., p. 53.

³⁸ Dr. Roy Madsen, "Animation: Its History, Techniques, and Applications," Industrial Photography, Vol. 16 (March, 1967), 22, 23, 52-56.

characters, (4) layout of over all design including scale, (5) preparing backgrounds, (6) drawing the animation, (7) preparing the exposure sheets, (8) inking and painting cels, (9) animation photography, (10) final editing of film. This article is a reproduction of one complete chapter of fifteen chapters of an unpublished book by Dr. Madsen. According to the foreword to the article, the other chapters are concerned with historical background and some specific techniques. The author of the article does not clarify them further.

"In the making of motion pictures, a creative business, which deals in ideas, data communication is the life blood of the industry."³⁹ Mr. Stephen Bosustow uses these words in writing about one of the most valuable pieces of information now available to the animation industry. He is referring to a device, which he invented, to communicate accurately and simply all the information necessary to make a storyboard understandable to the people connected with a filmed production. Although the device was designed primarily for live film production, it has particular application to the animation industry. The device is a type of storyboard. Through this article it is easy to see how one can write out an entire production, indicating the exact relationship between the action, voice, music, sound effects and optical effects on a frame by frame basis. A refinement of this technique has been further explained in the findings of this study.

Adrian Woolery has written an account of how an animated public

³⁹ Stephen Bosustow, "Creative Production Control," American Cinematographer, Vol. 46 (April, 1965), 241-43.

service announcement was produced for the Navy.⁴⁰ Much of the information is repetitive of what has been said elsewhere, but Woolery does point out the difficulties in keeping color constant when a single scene is composed of many painted cels in layers. He also suggests some of the types of films used during the testing and filming of animation.

In writing about planning animation, Carl Fallberg said, "Since the animated cartoon is a pictorial medium, certainly the best way to develop an idea for it is by means of pictures."⁴¹ He is referring to the animation storyboard. In The American Cinematographer, he sketches the problems of the story man and the vicissitudes of the story itself. These are shown in relationship to the other persons connected with an animated production.

Mr. Fallberg follows his first article by a second three months later in the same magazine.⁴² In this he explains some of the job titles and responsibilities of other key people usually associated with the animation process. He also indicates some of the problems and advantages of preparing music for animation.

There are two articles worth reading concerning the work of the animation cameraman. The first of these is by Stephen Bosustow,

⁴⁰ Adrian Woolery, "Production Procedures for Animated Commercials," American Cinematographer, Vol. 43 (July, 1962), 415, 436-38.

⁴¹ Carl Fallberg, "Production Techniques of the Animated Film," American Cinematographer, Vol. 46 (February, 1965), 110, 111, 118-20.

⁴² Carl Fallberg, "How Cartoon Director Uses Camera Thinking," American Cinematographer, Vol. 46 (March, 1965), 168-69, 184-85.

mentioned earlier for his storyboard technique.⁴³ The second is an article by Leon Rhodes.⁴⁴

Mr. Bosustow's article goes into great detail. He shows how an exposure sheet is designed and demonstrates what it means to the cameraman. Mr. Bosustow, however, is referring to an exposure sheet designed for a 35mm production. Some translation is necessary in order to understand it in terms of a 16mm production.

Leon Rhodes said, "The skilled and imaginative animation cameraman has a unique opportunity to create motion picture footage which is far more sophisticated than simple 'cartoon' animation."⁴⁵ Mr. Rhodes feels that the animation cameraman should be involved with the early planning of the animated film. By doing so, he may make suggestions which may save many hours of labor both on his own part and that of the artists preparing the materials for the camera. Allowing the cameraman occasionally to alter the timing of the film can also result in a savings of time and money.

Ingenious devices which can speed up the production of animation are discussed in an article entitled, "Automation in Animation."⁴⁶ The effects of these devices as seen on the screen, however, are the subject

⁴³ Stephen Bosustow, "The Animation Cameraman," American Cinematographer, Vol. 46 (November, 1965), 731-33.

⁴⁴ Leon S. Rhodes, "The Creative Potential of the Animation Cameraman," American Cinematographer, Vol. 47 (January, 1966), 40-43.

⁴⁵ Rhodes, op. cit., p. 40.

⁴⁶ Tom Pickens, "Automation in Animation," American Cinematographer, Vol. 43 (March, 1962), 172-73, 176, 178, 199.

of the article. The mechanics behind the effects are not explained.

Ernest Pittaro presents a very complete look at animation camera equipment in Photo Methods for Industry.⁴⁷ His remarks are quite different from those found in the second book by Eli L. Levitan.⁴⁸ Mr. Pittaro devotes several paragraphs to the types of cameras that can be used in animation. His remarks on the operation of the spring driven camera will be helpful to producers with limited budgets. The operation and use of the camera dissolve mechanism, the bipack camera, and some simple before-the-lens effects are some of the other helpful mechanical aspects of animation explained by Mr. Pittaro.

The current growth of interest in animation in television commercials has led to the development of a simplified animation technique which enables studios to produce larger quantities of animation at higher speed and lower cost. Lowell A. Bodger calls this technique, "limited animation."⁴⁹ Basically he explains the process as using as few cels as possible to carry the visual message of the film. The resultant jerky, stylized actions of the animated characters can be incorporated into the total film design as an intentional and unique visual device.

⁴⁷ Ernest Pittaro, "Camera Animation," Photo Methods for Industry, Vol. 9 (September, 1966), 58-60, 75-77.

⁴⁸ Eli L. Levitan, Animation Techniques and Commercial Film Production (New York: Reinhold Publishing Corporation, 1962).

⁴⁹ Lowell A. Bodger, "Production Advantages of Limited Animation," American Cinematographer, Vol. 42 (June, 1961), 358-59, 371-72.

Rex Flemming is another advocate of "limited animation." He has prepared an excellent article explaining the process.⁵⁰ It is a visually well documented account of how 178 cels were used to produce eighty-three seconds of animation. The use of the standard hot press for trick title work is another interesting facet of animation included in the article.

Just as limited animation techniques are useful for production speed and economy, another device to aid the animators is the aerial image projector. The initial cost of this device may be considerable, but its use may save a great deal on future productions.

The aerial image projector is explained in an article by Francis Lee and Vern W. Palen:⁵¹

In animated film production aerial images are introduced by means of "underneath projection"; the animation camera photographs the top lighted cel (or product placed thereon) and an underneath-projected image simultaneously, resulting in a composite scene or setup in a single photographic operation.⁵²

The projector shutter is synchronized and interlocked with that of the animation camera, so that both shutters open and close simultaneously for an effective exposure. The live action (on film) is projected and diverted upwards towards the animation cel board. . . . Here the image becomes "aerial"--suspended in space--just below the animation cel and is recorded simultaneously by the animation camera along with the animation art work or

⁵⁰ Rex Flemming, "Limited Animation Can Meet or Beat Live Shooting Costs," American Cinematographer, Vol. 46 (September, 1965), 574-78, 578-79.

⁵¹ Francis Lee and Vern Palen, "Special Effects Without Mattes," American Cinematographer, Vol. 41 (November, 1960), 668-69, 694-95.

⁵² Ibid., p. 668.

other object or material, much the same as in background projection.⁵³

Mr. Palen continues his interest in this aerial image technique three years later in another article.⁵⁴ In this article, he presents a question and answer session between himself and Mr. Albert Smeles of Anifilm Studios in New York. The article emphasizes the combining of animated characters with live film. This process involves a technique called rotoscoping. Mr. Smeles answers the question of just what rotoscoping is in this manner:

Rotoscoping or more correctly, a rotoscope, is a frame-by-frame tracing of the live scene that enables registration of the characters or "stats" to the live action. The original rotoscope is made by projecting the scene in the aerial image unit to the condensing lenses on the table. When a sheet of tracing paper is laid over the lenses it reveals the live action frame as if it were projected on a screen.⁵⁵

The film producer interested in animation may have some questions on the influence of computers on future animation equipment and techniques. These last two articles discussed in this review may help answer some of these questions.

Dr. Douglas A. East has written one of these articles in which he describes the two major forms of computer animation today.⁵⁶ They are

⁵³ Ibid., p. 669.

⁵⁴ Vern W. Palen, "Aerial Image Techniques," American Cinematographer, Vol. 44 (September, 1963), 524-25, 550-52.

⁵⁵ Palen, op. cit., p. 525.

⁵⁶ Douglas A. East, "Computer Animation," Industrial Photography, Vol. 16 (March, 1967), 26, 32, 108-10.

the cathode-ray tube display system and the "area" technique.

He explains that the cathode-ray tube display system is similar in operation to that of the television picture tube. In this system, each drawing is traced on the tube by the computer, recorded by the animation camera, erased and the process repeated again. In this instance, the drawings are not actually lost as the computer can remember them and retrace them on a moment's notice.

The "area" technique, according to Dr. East, takes the approach of dividing a screen into a large number of square areas of fixed size, and then varying the light intensity within each area to create the light and dark areas of the picture prescribed by the computer. Pictures created by this "area" technique are copied by the animation camera, just as they are in the cathode-ray tube display system.

In both of these systems of computer animation, directions are programmed implicitly rather than explicitly.

That is, it is possible to give the computer a few instructions which enable it to draw a certain figure and then to give the computer some general rules by which it can determine the location, orientation, and the dimensions of this figure in each frame.⁵⁷

Dr. East estimates that costs for this type of animation varies from \$400 per minute to a high of \$2,000. The photographic examples of computer animation accompanying the article aesthetically compare very poorly with cel animation. Computer animation seems best suited for technical work, where often picture quality is not of supreme importance.

⁵⁷ East, *op. cit.*, p. 32.

A second article on computer animation has been found in Photo Methods for Industry.⁵⁸ This article is essentially a more detailed description of the cathode-ray tube display system. The article is well illustrated and outlines the four basic steps in computer animation. They are (1) instructions are punched on cards and fed into the computer, (2) the computer constructs the desired pictures and writes their descriptions on magnetic tape, (3) the tape is used to control a display tube or light screen, and (4) a motion picture camera records the pictures and the film is processed by normal photographic methods.

The article evaluates the quality of computer animation:

A perfectionist might object to the "screen" effect, but it seems to us that this was no worse than looking at a coarse-screened halftone. Except, perhaps, in the commercial theatre, this should form no impediment to the audience acceptance of a computer made film.⁵⁹

III. EVALUATION OF THE LITERATURE

With only nine books and fifteen articles containing pertinent material for the study, it would seem appropriate for all of this material to be read. Reviewing the material, however, presents three basic problems: (1) it is, for the most part, too broad and too general, (2) virtually all of the material is written for 35mm animation production, and (3) the material is difficult to locate.

⁵⁸"Flicks from Figures," Photo Methods for Industry, Vol. 7 (July, 1964), 60-61, 79.

⁵⁹Ibid., p. 79.

CHAPTER III

FINDINGS OF THE STUDY

Of the 120 studios mailed questionnaires, twenty-five, or 20.8 percent of them responded by completing the questionnaire. An additional three studios indicated that they are no longer producing animation. Six questionnaires were returned marked "moved: no forwarding address." One company replied saying that they were in business to make money and had no time for questionnaires.

In general the twenty-five studios responding to the questionnaire did so with enthusiasm and expressed great interest in the study. Nineteen of the respondents indicated that they would like to receive a copy of the final tabulation of the questionnaire. Nine studios included bar sheets and exposure sheets, and five more included brochures advertising their services.

I. STUDIO OPERATIONS AND TRAINING

The average number of years in business of the responding studios was found to be fourteen and one-half years. The youngest studio responding had been in animation only three years and the oldest, thirty-seven years. Twelve, or almost half of the studios, had been engaged in animation less than ten and one-half years and six, or almost one-fourth of the studios, had been in animation over twenty years.

The study revealed that animation is generally a part of a larger studio operation. Only three, or 12 percent of the studios, reported

that 100 percent of their total production was animation, while an additional eight, or 32 percent of the respondents indicated that between 75 and 99 percent of their total production was animation. Four studios, or 16 percent, produced 50 to 75 percent of their work as animation and five companies, or 20 percent of all respondents, reported that animation accounted for only 25 to 50 percent of their production. An additional five studios said that less than 25 percent of their film work was animation. This relationship is more clearly shown:

<u>Percentage of Total Production That Is Animation</u>	<u>Number of Studios Percentile</u>
100	3
75- 99	8
50- 75	4
25- 50	5
0- 25	<u>5</u>
Total Studio Respondents	25

The use to which animation has been put has been divided into six major categories for the study. These are television commercials, entertainment, education, titles, technical instruction, and business. Studios were asked to indicate, in percentages, the amount of animation that they produced in these six categories. Aside from these categories, no other use for animation was mentioned, although opportunity to indicate this was provided in the questionnaire. Table I on Page 31 shows

TABLE I
 PERCENTAGE OF ANIMATION PRODUCED BY EACH STUDIO IN
 SIX CATEGORIES OF INTENDED USE

Television Commercial	Entertainment	Education	Titles	Technical Instruction	Business
10	0	0	0	70	20
0	25	75	0	0	0
90	5	0	0	0	5
40	0	0	40	20	0
2	95	0	0	0	3
0	5	10	75	10	0
0	0	95	5	0	0
100	0	0	0	0	0
20	15	5	50	5	5
60	5	10	20	5	0
60	0	20	10	10	0
30	1	19	10	10	30
10	10	20	30	20	10
40	0	10	0	30	20
25	50	25	0	0	0
0	100	0	0	0	0
50	0	10	20	10	10
20	50	10	10	0	10
40	40	10	10	0	0
10	90	0	0	0	0
85	0	10	5	0	0
60	40	0	0	0	0
0	30	40	0	30	0
15	0	30	0	30	25
25	0	0	75	0	0
Average Percent					
31.8	22.4	15.9	14.4	10.0	5.5

each percentage listed by each studio for the six categories.¹ At the bottom of the table can be seen the average percentage of all animation produced in each category. Television commercials are the most popular use to which animation is put, accounting for almost 32 percent of all animation produced by the respondents. Also, from this table it can be seen that there is a general trend towards specialization in a few categories for any given studio. Over half of these studios produce animation in only three categories or less.

An effort was made in the study to discover if there was a practical minimum of personnel necessary for producing film animation. Studios were requested in the questionnaire to indicate the number of persons employed in each job title position as established in the review of the literature on Page 17. In analyzing the answers to this request, a great variety was found in studio personnel structures. One studio was found to be a one-man operation and two others were two-men operations. All three of these studios, however, did indicate that they hired free lance artists as needed. The two universities included in the study reported that they borrowed talent from other departments of the university and had no studio structure of any consequence. The largest and most atypical of all studios reported in the study was the Hanna-Barbera Studio. This studio is such an exception to the rule that

¹With the exception of Table IV, all studio respondents are listed in the same order in each table. Each table consists of a list of twenty-five responses. By doing so, the recorded answers for a single studio may be located on all tables. For instance, the first line across the top of the list of studio responses on all tables represents the answers given by a single studio. The second line on all tables represents another studio.

it will be discussed separately.

Eighteen of the studios were found to employ five or more employees. Below the five employee level there seemed little studio structure other than each employee participating in each production as needed. Above the five employee level, specific duties are more definitely assigned to each member of the studio team. By averaging the number of employees in the various job title positions in the studios with five or more employees, the quantity of employees in each position is shown:

<u>Job Title Position</u>	<u>Average Number of Employees</u>
Producers	.9
Directors	1.0
Design/layout and back- ground artists	2.1
Key animators	2.0
Assistant animators	1.3
Inkers and colorists	3.1
Cameramen	1.0
Editors	<u>.6</u>
Total average size of studio staff	12.0

These personnel averages do not include the personnel of the Hanna-Barbera Studio. Opportunity was given in the questionnaire for studios to indicate other job functions performed which were not listed in the questionnaire. One hot-press operator was the only other position reported.

Opportunity was also given in the questionnaire for respondents to designate which of their personnel worked in both live and animated production. Six studios reported that only their producers worked in both areas and only two studios replied that all of their employees

worked in both live and animated production. These last two studios mentioned were both small studios employing under seven people.

The Hanna-Barbera studio employed personnel in the same job title positions as other studios, but in larger quantities. More people were found employed at the Hanna-Barbera studio than all the other studios responding to the questionnaire. This studio is now the world's largest producer of animated films. Its total staff numbers over 500, but this figure includes administrative personnel and other support personnel for the animation department proper. The actual size of the animation department is 343 persons. Within the animation department the number of people in each position is shown:

<u>Job Title Position</u>	<u>Number of Persons</u>
Producers	5
Directors	4
Design/layout and background artists	60
Key animators	50
Assistant animators	50
Inkers and colorists	140
Cameramen	18
Editors	<u>16</u>
Total animation staff	343

Over the past four years, the author has found that many television studios, advertising agencies, government and university film studios are desiring to add animation to their film capabilities. They have expressed a great interest in the training necessary for film animation. In an effort to understand this training, one of the requests in the questionnaire was for studios to report the number of their

employees that had received training (1) by apprenticeship, (2) in professional art school, (3) in a university, and (4) other methods. They were also asked to indicate the type of training which they thought best in preparing for a career in animation. Table II on Page 36 is a listing by studio of the responses to this request. The column on the left indicates the exact staff size of the responding studios. The number of employees trained by each method is placed in the next column and the preferred method of training as indicated by each studio is marked with an "X" in the section on the right of the table. The training methods both received and preferred are listed across the top of the table.

Of the 595 employees included in the study, 77 percent, or 458 of them, received their training by apprenticeship. An additional 20 percent, or 119 of them, were trained in a professional art school. The remaining 2.6 percent, or 15 employees, received either university training or a combination of all methods listed.

It can be seen from Table II that the preferred method of training is somewhat different from the type of training actually received by the employees. It can also be seen that the studios generally tend to prefer the type of training that they had had for the most part, but this is not always the case. Only eleven studios, or slightly less than half, preferred apprenticeship training over all other methods. This is quite a contrast to the more than three-fourths who had received training by that method. An additional eleven, or again slightly less than half of the respondents, felt that art school preparation followed by an apprenticeship period would constitute the ideal training. Only two studios

TABLE II

PERCENTAGE OF EMPLOYEES TRAINED BY POPULAR METHODS COMPARED TO
THE METHOD OF TRAINING PREFERRED BY THE RESPONDENTS

Number of Studio Staff Members	Percentage of Employees Trained by Each Method				Preferred Method of Training			
	Apprenticeship	Art School	University	Apprenticeship, Art School, and University	Apprenticeship	Art School	Art School first, Then Apprenticeship	Art School, Apprenticeship, and University
26	100	-	-	-	-	-	X	-
2	-	-	-	100	-	-	-	X
21	10	80	10	-	-	-	X	-
2	100	-	-	-	X	-	-	-
343	90	10	-	-	-	-	X	-
1	100	-	-	-	-	-	X	-
3	100	-	-	-	X	-	-	-
8	75	20	5	-	-	-	X	-
3	100	-	-	-	X	-	-	-
6	100	-	-	-	-	-	X	-
5	50	50	-	-	X	-	-	-
7	50	40	10	-	-	-	X	-
8	40	60	-	-	X	-	-	-
4	50	50	-	-	-	-	X	-
8	50	50	-	-	-	-	X	-
25	20	45	35	-	X	-	-	-
5	50	50	-	-	X	-	-	-
5	50	50	-	-	-	-	X	-
24	50	50	-	-	-	X	-	-
8	50	50	-	-	X	-	-	-
20	60	40	-	-	X	-	-	-
20	50	40	10	-	-	X	-	-
10	50	50	-	-	-	-	X	-
16	100	-	-	-	X	-	-	-
15	100	-	-	-	X	-	-	-
Totals 595	77.0	20.4	2.3	.3	11	2	11	1

indicated that art school alone would suffice. University training was mentioned by only one studio as a necessary part of animation training, and in this case, it meant to be combined with art school and apprenticeship training.

To learn more about animation training sources, the respondents were asked to name the best published material which could help train people for animation. Only about half of the studios responded to this part of the question. Most of the comments were very general, indicating such things as "books," "magazines," and "articles on animation." Two periodicals were mentioned, "Graphis"² and "Art News."³ These periodicals, however, are concerned with the graphic art styles rather than art techniques designed specifically for animation. One respondent felt that The Art of Walt Disney⁴ was a particularly good source book. Another believed that equipment manuals were most valuable and The Technique of Film Animation⁵ was suggested by still another studio. Preston Blair's Advanced Animation⁶ was named by two respondents as the best source now available. The overall impression given by these

² A monthly pictorial digest of advertising art published in Switzerland and distributed in the U.S. by Hastings House Publishers.

³ A monthly digest of fine arts published in the U.S. by Newsweek Inc.

⁴ Robert D. Feild, The Art of Walt Disney (New York: The Macmillan Company, 1942).

⁵ John Halas and Roger Manvell, The Technique of Film Animation (New York: Hastings House Publishers, 1959).

⁶ Preston Blair, Advanced Animation (New York: Walter J. Foster, 1949).

responses and lack of responses is that there is presently no single publication available today which is an outstanding source of animation knowledge.

Studios were asked also in the questionnaire to indicate whether or not their clients were sufficiently informed on animation techniques, and if not, to indicate how they can best be helped. This question stimulated some of the most lively answers of the entire questionnaire. Seven of the twenty-five respondents simply indicated that their clients were sufficiently informed. The remaining eighteen studios, however, emphatically said that they were not and indicated that they definitely should be. On this question there was no middle ground apparently.

The opinions varied among the studios as to how clients may be helped in understanding the animation process. Three responding studios reported that in their opinion, clients do not know the process and will never know, regardless of the training methods available to them. Two studios said that clients are not interested in the process, only results.

Thirteen of the respondents offered constructive advice on the proper method of training clients. Of these, three studios indicated that more exposure to animated films would help clients. Another felt that clients should be individually instructed in studio procedure, and four more studios stated that clients simply should spend more time in the animation studio and learn by watching the process. A comprehensive text book in simple language was the suggestion of five other studios.

The suggestion of a text book partially anticipated the next

questions on the questionnaire. This question asked the respondents to give their opinions on whether or not there is a need for a more comprehensive reference book for animation. If they felt that such a book was needed, they were to indicate in which subject area they felt the greatest need. Only five studios or twenty percent of the responding studios reported that they saw no need for such a book. The remaining twenty studios or eighty percent indicated that they were very much in favor of such a book. The answers to the question, "In which area of animation do you feel the greatest need?" were difficult to tabulate. Some of the answers were very lengthy, some indicated several types of books in the same answer, and most used different words to express similar thoughts. By far, the most frequently expressed desire was for a book on all aspects of animation. This would include instruction on drawing action, timing action, painting, using exposure sheets, camera and animation stand operation, and shooting techniques.

Two other books were mentioned as needed by three other studios. These were books on animation aesthetics and books on the operation of animation stands.

Some complaints were registered against previously published material. Four studios added to the questionnaire a note to the effect that they thought previous material was too general in scope and far too romantic. They wished a more practical approach to animation. Three other studios complained that previously published material was now out of date and that current information on techniques was needed.

II. ANIMATION EQUIPMENT

The equipment generally used by an animation studio can be divided into five categories, (1) sound recording equipment, (2) artists' drawing and painting materials, (3) filming equipment, (4) film processing equipment, and (5) editing equipment. There has been no indication throughout the study that sound recording, film processing, and editing is appreciably different from live film production. Therefore, these aspects of the process have not been included in the study. There is, however, one facet of the sound reading process which is different from live film production and will be discussed later.

The animation stand and the animation camera are the two most expensive pieces of equipment owned by an animation studio. Table III on Page 41 is a listing of all the stands and cameras used by the studios responding to the questionnaire. The quantity of stands and cameras used by each studio is included in this list as well as the types of lenses used. Dashed lines in any column indicate no reply on that point by the responding studio. A total of thirty-four animation stands were found being used by the twenty-five studios. Of these, eighteen were found to be Oxberry animation stands and all of the Oxberry stands were mounted with Oxberry cameras except two. One of these stands was mounted with a Maurer 05 and the other one with a Mitchel camera.

The Acme brand name seems more popular on a camera than on an animation stand. Only four Acme animation stands were reported being used by the respondents, while thirteen Acme cameras were found in service. Four of these Acme cameras, of course, were on Acme animation

TABLE III
ANIMATION STANDS, CAMERAS, AND LENSES USED BY RESPONDENTS

Animation Stands	Cameras	Lenes
2 Oxberry	2 Oxberry	Zeiss 57mm, Ektar 28mm
1 Own Design	1 Bell & Howell 2709 1 Arriflex S	Baltars 25, 35, 50, 75, 101, and 152mm
3 Oxberry	3 Oxberry	Bausch and Lomb 30, 50, and 58mm
1 Oxberry	1 Oxberry	Ektar 25mm, Nikkor 55mm
6 Richardson-Bowlds	6 Acme	Tessar 65mm
1 Oxberry	1 Oxberry	Ektar 25, 47mm
1 Own Design	1 Maurer 05 1 Arriflex S 1 Cine Special	Schneider 25mm, Macro Killar 40mm, Ektar 25mm
1 Oxberry	1 Maurer 05	Ektar 25mm
1 Oxberry	1 Oxberry	Ektar 28mm
Use Camera Service	not applicable	not applicable
1 Aerial Image Oxberry	1 Oxberry	Cook 25, 40, 100mm
2 Oxberry	2 Oxberry	no reply
1 Oxberry	1 Oxberry	Ektar 25, 50mm
1 Oxberry	1 Oxberry	Ektar 25mm, Cook 50mm
Use Camera Service	not applicable	not applicable
1 Oxberry	1 Oxberry	no reply
1 Oxberry	1 Mitchel	Ektar 25, 47mm
1 Acme	1 Acme	no reply
1 Acme	1 Acme	Wallensak 65mm
1 Patented Stand (Own Design)	1 Patented Camera (Own Design)	no reply
1 Richardson-Bowlds	1 Acme	65mm
1 Acme	1 Acme	Nikkor 65mm
1 Oxberry	1 Oxberry	Raptar 55mm
1 Richardson-Bowlds	1 Acme	Nikkor 65mm
Use Camera Service	not applicable	not applicable
1 Aerial Image Oxberry	1 Oxberry	Cook 50, 100mm
1 Acme	1 Acme	Baltar 30mm
1 Richardson-Bowlds	1 Acme	Wollensak 65mm

Note: The quantity of lenses used by a given studio was not indicated by the respondents. It is assumed that studios reporting using more than one camera, but only one type of lens, used more than one lens of the type reported.

animation stands, but nine Acme cameras were mounted on Richardson-Bowlds animation stands. This makes the Richardson-Bowlds animation stand the second most popular animation stand in use by the respondents. The Hanna-Barbera studio uses exclusively Richardson-Bowlds animation stands with Acme cameras. This studio has a total of six animation stands. The remaining three Richardson-Bowlds animation stands were located in other studios.

Three animation stands were built by the studios themselves. All of these stands were located in studios employing less than eight people. One of these animation stands was fitted alternately with a Bell and Howell 2709 or an Arriflex S. In this case, the respondent indicated that the camera was changed according to the type of work being shot. The Bell and Howell 2709 was used for 35mm work and the Arriflex S for 16mm filming. Another of the studio-built animation stands had the option of three cameras, a Maurer 05, an Arriflex S and an Eastman Cine Special. Economy was the reason given for the construction of only one of these three studio-built stands. Another reason for a studio-built stand was habit, according to the respondent. It seems that this particular respondent had been in the habit of constructing his own equipment long before such stands as the Acme and Oxberry became available. The remaining studio-built animation stand apparently included a studio-built camera as well. This stand was reported as a secret patented rig, and no further information was given concerning it. This rig was designed and built to perform certain tasks desired by the particular studio. Economy was indicated as definitely not the reason for its

construction.

In examining the manufacturer's specifications of the commercial animation stands, all were found to include north/south and east/west compound movements, as well as zoom camera movement, and rotational movement of either the camera or compound. All stands had at least four peg bars also. Two of the Oxberry cameras were fitted with aerial image projectors. Figure 1 on Page 44 is a picture of the Oxberry animation stand, the most popular stand found in service by the study.

All of the Oxberry and Acme cameras, according to the manufacturers, were fitted with camera gates which could be changed to handle either 16mm or 35mm film. The Mitchel, the Bell and Howell 2709, the Arriflex, and the Eastman Cine Special were not designed with this capability.

The most important similarity among all of these cameras is that they all have one or more registration pins in the camera gate to assure proper alignment of each frame of film during the photographic process.

The lenses reported used by the various studios were generally found to be standard equipment supplied by the manufacturer. The manufacturer's specification shows that all 25mm to 40mm focal length lenses are used for 16mm photography. All 40mm and above focal length lenses are used for 35mm photography.

Only seventeen of the twenty-five studios responded to the question concerning lighting. Many of these seemed to have confused the brand names of their lighting instruments with the type of lamps they used. Many studios said that their lights were "Sylvania" or "GE." Perhaps

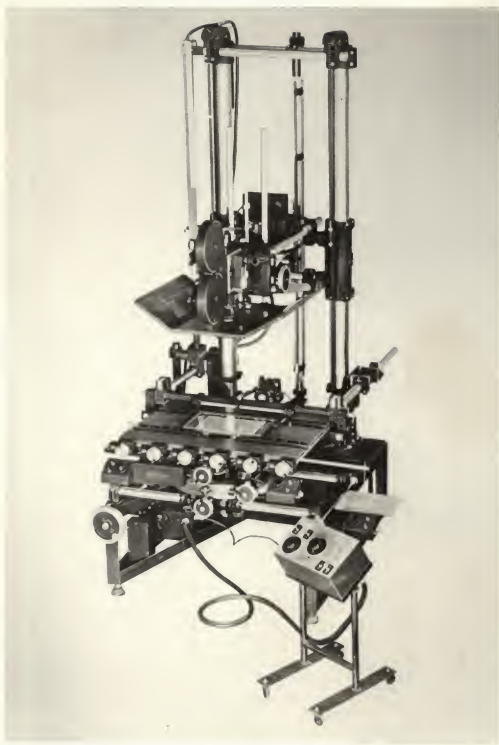


FIGURE 1

THE BASIC OXBERRY ANIMATION STAND

the questionnaire was not phrased properly on this point.

Nine of the respondents did indicate that they used quartz iodine lights. Five more indicated the use of "baby" fresnel lights, and three said that they used photofloods. A cameraman at Calvin Productions, Inc. said that the use of photoflood lights is a rare practice and should be avoided.⁷ The photoflood lights cause too many unwanted reflections, and also that a great deal of heat and glare is directed toward the cameraman. Despite this, however, three companies are apparently using photoflood lights successfully. Of these three, one is a university, one is a two-man company in business for five years, and the third is a studio which employs twenty people and which has been producing animation for seven years.

The respondents reported thirteen brand names relative to the types of lights that they used. Of these thirteen, eight were Colortran, and the remaining five were Mole-Richardson, Kleglight, Crause and Hinds, Bardwell-McAllister, and Smith-Victor. With the exception of the Smith-Victor and Colortran instruments, all of these were of the fresnel type of lighting instrument.

The studios were not so indefinite when indicating the quantity and wattage of the lights that they used. All studios indicated that they used one light on each side of the animation stand. Most of the studios were found using 650 to 750 watt lamps, however, two studios reported using 300 watt lamps and two others used 1000 watt lamps.

⁷Personal interview with Charles Radaman, Animation Cameraman, Calvin Productions, by the author, April 23, 1968.

As has been pointed out in many sources in the review of literature, the art work for a single frame of animation may consist of a background with three to five layers of cels over it. Each cel may have painted on it a portion of the composite scene. A registration system is necessary to plan and keep in order the multiple drawings required in animation.

All of the studios responded to the question relating to the type of registration system they used. The specifications of the three most popular systems found in use are shown in Figure 2 on Page 47. They are the Acme, Oxberry, and Signal Corps. The Acme system was found to be by far the most popular system, being used by thirteen of the responding studios. The reasons generally given for the choice of this system were that the Acme system is the most popular, and supplies are readily available. The California studios said that the Acme system is the standard system in that area. The Oxberry registration system was found in use by six of the respondents. One respondent said that he used the Oxberry system because it came with his animation stand. The other users of Oxberry equipment made essentially similar comments. Two studios were found using the Signal Corps system. They were less ambiguous in their reasons for preferring that system; they felt that the Signal Corps system did not tear cels as readily.

Film processing equipment was not found to be a necessary part of an animation studio operation. Only five studios indicated that they had laboratory facilities. Three of these reported that they produced less than 10 percent of their total film production as animation, and all

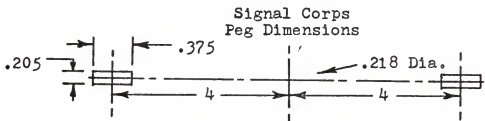
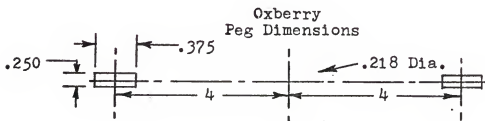
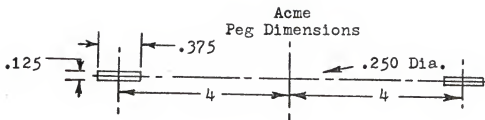


FIGURE 2

THE DIMENSIONS OF THE THREE MOST POPULAR
ANIMATION CEL REGISTRATION SYSTEMS

three had been in animation for eighteen years or longer. Another studio had been in animation for seven years and produced 50 percent of its work as animation, and one of the universities reported that it had a laboratory. All of these studios, except for the university, had nine or more people in the respective animation departments.

Studios were specifically asked in the questionnaire to indicate what pieces of their equipment they had designed themselves. Ten of the twenty-five respondents reported that they had designed at least some part of their animation equipment. As previously mentioned, three studios had designed and constructed their own animation stands. Three other studios indicated that they had added special devices to their commercial animation stands. One such device was an automatic rackover system added to an Oxberry animation camera. The studio did not indicate why they built the device rather than buying it directly from the Oxberry Corporation. Such a device is commercially available from the manufacturer. Another studio reported building its own projector-viewer for rotoscoping. Again, no reason was given for constructing the device as it is also available from the manufacturer. Perhaps the rackover and the projector-viewer were both studio built for economic reasons. The third studio that added a special device did so in order to perform a special task. This studio added an instrument to its animation stand which allows the camera to focus on very small areas on a standard 2 x 2 slide. This device enables the cameraman to carefully move the slide in various ways for a tilting or panning effect. Special animation desks reported by four studios were the only other forms of

equipment found constructed by the studios themselves. With the flexibility in artistic styles exhibited so obviously in animated films, particularly on television, the author had expected to find many more devices designed to create special effects within the individual studios.

III. ANIMATION MATERIALS

There were both consistencies and variations found among the materials used in animation. The amount of production on either 16mm or 35mm film ranged from 0 to 100 percent in each category for any single studio. Table IV on Page 50 is a listing of all the answers given by the studios concerning the percentage of their work produced on either 16mm or 35mm film.⁸

It can be seen from Table IV that more 16mm film is being used for animation than 35mm film. Of all the animation shot by the respondents, 56 percent is on 16mm film. All questionnaires were closely examined to determine if any relationship existed between the size of film used, the studio size, the years in animation, and the type of use for which the animation was intended. No relationship was found. One surprising fact was noticed, however. Many studios were found shooting original work for television on 35mm film contrary to the fact that local stations only project 16mm film.

An analysis of the questionnaires showed that an equal amount of

⁸The studio responses in Table IV are arranged for a quick comparison of the volume of work produced on 16mm and 35mm film. For this reason, the twenty-five responses given here are not in the same order as all of the other tables.

TABLE IV

A COMPARISON IN PERCENTAGES OF THE AMOUNT OF PRODUCTION
BY THE RESPONDENTS IN 16mm AND 35mm FILM

16mm Film	35mm Film
100	0
100	0
99	1
99	1
95	5
90	10
90	10
90	10
90	10
85	15
80	20
75	25
50	50
50	50
40	60
30	70
25	75
20	80
10	90
10	90
10	90
5	95
1	99
1	99
0	100
Average Percent 56	44

NOTE: This table appears in Appendix E with the studio responses arranged in the same order as the other tables in the study.

television commercials are filmed on both sizes of films. Three of the respondents, however, did add notes to the questionnaire to the effect that training films and educational films are generally shot on 16mm film, while television commercials are generally shot on 35mm film. However, the questionnaire did not reveal this as a clear cut trend.

Since 16mm film is one of the major interests of the study, the studios were asked in the questionnaire if they felt that 16mm film animation was becoming more popular. If they indicated that they thought it was, they were to check one or more of three possible reasons for this as listed in the questionnaire or name other reasons. The three reasons given on the questionnaire were these: television; increase in educational and training films; and better film equipment. All twenty-five studios replied to this question. Only two studios felt that 16mm animation was not becoming more popular; two others said "yes and no"; and one reported that it simply did not know. The remaining twenty studios did feel that 16mm animation was becoming more popular and checked all of the three reasons given in the questionnaire for this opinion.

Table V on Page 52 shows cel animation to be definitely the favored medium on animation. A total of over 75 percent of all the animation produced by the respondents was cel animation. Filmographs were the next most popular form of animation. Filmographs, as explained by Orlan Hill,⁹ are films produced with animation equipment; still photographs

⁹Personal interview with Mr. Orlan Hill, May 17, 1968.

TABLE V

PERCENTAGES OF PRODUCTION IN VARIOUS ANIMATION
FORMS REPORTED BY THE RESPONDENTS

Cels	Puppets	Models	Paper Sculpture	Filmographs	Other	(Form)
100	-	-	-	-	-	-
40	30	-	-	-	30	Cut Outs
90	-	-	-	10	-	-
50	-	-	20	-	30	Camera Animation
100	-	-	-	-	-	-
70	-	-	10	20	-	-
70	-	-	-	30	-	-
100	-	-	-	-	-	-
10	-	5	-	85	-	-
90	-	-	-	10	-	-
90	-	10	-	-	-	-
40	-	-	-	60	-	-
50	-	-	50	-	-	-
90	-	5	-	-	5	Drawing on Film
100	-	-	-	-	-	-
100	-	-	-	-	-	-
80	10	10	-	-	-	-
100	-	-	-	-	-	-
100	-	-	-	-	-	-
30	-	-	-	-	70	Optical Printing
100	-	-	-	-	-	-
100	-	-	-	-	-	-
20	-	10	-	70	-	-
95	-	5	-	-	-	-
75	10	10	5	-	-	-
Average Percent	75.6	2.0	2.2	3.4	11.4	5.4

are used in the place of art work for the films' visual subject matter. The photographs are manipulated in much the same manner as are the cels in cel animation. Mr. Hill further explained that the word "filmograph" is a new word having been coined by the industry. Table V shows that over 11 percent of all animation production is in the form of filmographs. Together, puppets, models, and paper sculpture total 7.6 percent of all animation production. Other forms of animation found in the study accounted for another 5.4 percent of the total production. These were animation with cut-outs, hand drawing on the film, and camera animation. Only one studio each was found producing animation in these three forms. The author had expected to find more animation with cut-outs and did not expect any commercial studio to be producing animation by hand drawing directly on film stock.

Orlan Hill was asked to explain camera animation.¹⁰ He said that it is essentially a very complex form of a filmograph. It differs only in that a great many traveling mattes are prepared and used in this technique, as well as a lot of double exposure photography. The visual subject matter in this form of animation may be art work or partial art work, but is more likely to be animation with still photographs or double exposure with live film and titles. The visual effectiveness, then, of this type of film is accomplished more by complex manipulation of the images recorded on film within the animation camera, rather than by drawing a sequence of pictures which are recorded by the camera for the

¹⁰Op. cit., Hill Interview.

desired effect.

The preferences expressed by the studios for a particular animation form overlapped considerably from one response to another. Six studios did not respond when asked on the questionnaire why they preferred a particular animation form. Among the nineteen studios who did respond, the overwhelming majority produced animation on cels and indicated that they did so because it was the most standard method. Most of these same studios also listed the flexibility of cel animation and the availability of supplies as other good reasons for their choice. Three studios reported that subject or desired screen effect generally dictated the form of animation that they used. Other reasons given for choice of animation form by the respondents were clients' choice, speed and economy, less costs, and the easiest method of filming television commercials.

The studios were amazingly consistent in naming the material that they used for pencil tests and original films. Many, however, were reluctant to answer the question concerning the type of material on which they recorded original sound.

All but the three studios using a camera service indicated a response to the question concerning films. Pencil tests were found shot on Eastman Plus-X 7276 in approximately 80 percent of the cases. One studio reported that it used any type of black and white film available at the time of the shooting. Two studios were found using Eastman Kodak Release Positive 5305 and another said that it used Eastman High Contrast Positive 5363 in addition to a normal use of Eastman Plus-X 7276.

All of these films are 16mm in size and black and white. This would indicate that 16mm film is invariably used for pencil tests even though the final film may be shot on 35mm film.

The studios were even more consistent in their answers to the question concerning the type of film used for the final original filming. All of the studios responding to this question indicated that they shot their 16mm production on Ektachrome Commercial 7255, and their 35mm productions on Eastman Color Negative 5251. No other sizes or types of films were given for this purpose. These films, then, are apparently invariable industrial standards.

Eleven studios did not respond to the question asking them to name the type of material on which they recorded original sound. This may be because sound recording is not an area of responsibility generally given to the artists, animators, and animation cameramen. It would seem possible that in a small studio, the sound recording may be an aspect of production which can easily be sublet to another organization. The fact remains, however, that before animation can begin, the sound track must be analyzed by an animator or an editor.

Of the fourteen studios replying to the question of original sound recording, eleven of them reported that they recorded original sound on 16mm magnetic film. Only one studio reported that it recorded original sound on 35mm magnetic film, and two studios said that they recorded sound on one-fourth inch magnetic tape.

Another invariable consistency found in the study concerns the types of paints used by the responding studios. Twenty-three of the

twenty-five respondents answered the question concerning the paints used for cel animation. Brand names as well as retail outlets were given in answer to this question. In the case of retail outlets, the author wrote each retail source and asked each what brand and type of paints they were selling. All of the answers were the same. Cartoon Color from the Cartoon Colour Company of Culver City, California, was the only type and brand found in use. The author found that the Shiva Company at one time produced cel paint, but they indicated that the demand was so low that they discontinued it.

The special quality of Cartoon Colors is that they are "cel compensated colors."¹¹ Each color is available in from one to twenty shades, each shade being only slightly darker than the previous shade. The degree of darkness between the shades is equal to the darkening qualities of a .005 inch thick sheet of acetate or one standard cel. When using cels in layers, an object may be painted on the top layer with a given shade and another portion of the same object may be painted on the next lower cel with a lighter shade of the same color. The color of the lower cel will be darkened by the cel above it to make it appear the same when viewed from above or from the camera position.

The paints and inks used for airbrush and backgrounds varied so much that a listing is difficult. Virtually all of the large manufacturers of artists' colors were included in the answers given by the respondents. Some of them were Grumbacher, Shiva, Liquetex,

¹¹"Cel compensated" is a term used by the manufacturer in its advertising.

Winsor-Newton Design Colors, Weber, and others. Pelican ink, however, was the only ink named as suitable for use on animation cels. The author, also, has experimented with many types of inks and found Pelican ink to be far superior to other brands. It flows more smoothly and holds better than other inks.

IV. THE ANIMATION PROCESS

The artistic process in animation is so flexible and complex that the author did not feel that the questionnaire could be used effectively to reveal much detail of the process. The data cited in the review of literature is at present the best source available on the actual artistic process of animation. However, five questions were included in the questionnaire which were relative to the production process.

It seemed appropriate to ask if the artists themselves timed the sound track or whether other personnel performed this task. Also, the author wished to determine if optical or magnetic sound tracks were preferred by the animation industry. Twenty-three of the twenty-five respondents replied to these two questions. Sound tracks were found to be timed by the artists in fourteen of the studios, and nine studios indicated that they had editors do this work. Magnetic tracks were found to be preferred by eighteen of the studios; two used optical tracks; and three studios reported that they used both. The reasons for the choice of magnetic tracks are their expediency and time-saving qualities, and the fact that they are less expensive than other sound tracks. The only reason given for using optical tracks was that music

can be more accurately read.

Another question on the animation process gave the respondents an opportunity to explain any special methods or techniques which they considered unusual or different from conventional animation. Nine respondents did not complete this part of the questionnaire. Six of the studios said that they used no special techniques, and four studios reported that they do but that their process is a secret. Two respondents replied that they had been in animation for a number of years and could not begin to explain the intricacies of their process in the space allowed.

Only four studios actually reported any special techniques which they considered different from the most normal method of producing animation. Photographing while the camera, compound, or artwork is in motion was one such technique reported. According to the experts at Calvin Productions, however, this is not a particularly special process.¹² A "joy stick" compound control was mentioned by another studio as an innovation. Again, according to the manufacturer's accessory list, this is not so much of an innovation as it is a luxury accessory. The "joy stick" control mechanism simply facilitates the movements of the compound somewhat better than the more popular and less expensive method. One studio simply reported that its work was more artistic than other studios. The studio which had earlier listed hand drawing on films, listed it again at this point in the questionnaire as a special or

¹²Personal interview with Orlan Hill, Calvin Productions, Inc., May 21, 1968.

unusual technique. Hand drawing on film represents the only truly innovative technique found in this phase of the study. The cameramen at Calvin Productions seem to feel that the other processes mentioned here might likely be found in many of the other studios reporting.¹³ Calvin personnel said that they thought the other studios simply felt that their processes were a part of what can be considered normal animation functions.

Another query in the questionnaire concerning the process of film animation was relative to the secrecy involved in an individual studio's process. This was included to find out if there is a significant part of the animation process which will never be known. Nine studios reported that they did have trade secrets. These nine studios were not the same nine studios who did not complete the previous question concerning special techniques. The responses to the question on trade secrets were checked against the answers given in other parts of the questionnaire, such as number of years in business, percentage of work on either 16mm or 35mm film, the intended use of the animation, and the size of staff; absolutely no relationship was found.

Seventeen of the studios responded to the final question on the questionnaire which was relative to the technical developments of the last decade or so which have changed or expanded studio operation. Three studios indicated that better equipment is responsible for their increased production. Four more studios said that color films have been

¹³Personal interview with Charles Radaman, Calvin Productions, Inc., May 21, 1968.

improved, thus increasing their production. The new Xerox devices were reported as having increased production in three studios. The Xerox devices mentioned here are machines which transfer or copy the lines from the animator's bond layout paper onto the acetate cels used in cel animation. This process eliminates the tedious job of inking the lines on the cels by hand.

Seven different studios each named a different element which has changed or helped their production: the addition of special studio-built equipment; the spread of color television; the addition of automatic table movements in synchronization with camera movements; new magnetic tape devices; the addition of an aerial image unit and bipack camera; market increases due to the development of 8mm cartridge load projectors; better cameras; and Stabilo pencils.

These Stabilo pencils are a fairly recent innovation, and they can give a rather clean line on any surface. They are used in animation for tracing the lines around characters or objects onto animation cels. They are more convenient to use for this purpose than pen and ink, but they require more skill on the part of the artist than does normal inking.¹⁴

Further information on individual animation techniques was hoped to be found in an analysis of the bar and exposure sheets, brochures, and other material returned by the respondents. Very little useful information was found in the brochures, except that the size of a studio

¹⁴Personal interview with Orlan Hill, Calvin Productions, Inc., March 5, 1968.

has little to do with the type of clients attracted. Some of the smaller studios were found having clients such as United States Steel, General Electric, The Gulf Oil Corporation, Chrysler Motor Company, Alcoa Aluminum, and others.

The bar and exposure sheets returned in the study were interesting, even though they were few in number. Actually only six bar sheets were returned and only nine exposure sheets. All of the sheets returned were similar to those used in other studios or to the examples of bar and exposure sheets shown in many of the books found in the review of the literature. With the exception of Calvin Productions, Inc., all bar and exposure sheets were marked with a heavy line every 16 frames. The distance between these lines represents one foot of 35mm film. These types of markings on bar and exposure sheets can be very confusing when working with 16mm film, although these sheets may be used for 16mm filming. One foot of 16mm film is 40 frames long.

Bar and exposure sheets from Calvin Productions are marked with heavy lines every 10 frames. Orlan Hill explains that their productions are originally conceived in terms of projection time, not footage.¹⁵ After the story is completed, the sound recorded, then everything is thought of in terms of individual frames. The individual frames, after all, are what the animator and cameraman are principally concerned with. With the bar and exposure sheets identifiably marked every 10 frames, it is easy for the animator or cameraman to see at a glance which frame a

¹⁵ Op. cit., Hill interview.

given set of instructions refers to and also how far into the film in seconds these instructions are. Also, sheets marked at intervals of 10 can be used for 16mm filming and 35mm filming with equal ease.

A bar sheet and an exposure sheet is shown in Appendix D. These two examples are not quite typical of the counterparts normally used in the animation industry, but they do represent the best examples found or devised so far for their respective purposes. They include all of the elements found in other exposure sheets and bar sheets. These sheets can be easily read, and they provide a better frame-by-frame analysis of all the elements required for any given frame of film than do other types of bar and exposure sheets. Mr. Orlan Hill of Calvin Productions has expressed a great interest in these two examples; he indicated that at some time in the future, Calvin Productions may be changing from their present bar and exposure sheets to the types illustrated in the examples.¹⁶

¹⁶ Personal interview with Mr. Orlan Hill, Calvin Productions, Inc., May 16, 1968.

CHAPTER IV

LIMITATIONS OF THE STUDY

The 20.8 percent response to the study by those in the animation industry was not great enough to draw definite conclusions relative to this study. However, the enthusiasm expressed by those responding to the study and the similarity of responses seemed to indicate that the ideas expressed here are more typical than exclusive throughout the animation industry. When taken as a whole, the author feels that the study has great value to the beginning animator.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was (1) to examine current studio operations and training procedures, (2) to analyze the most popular technical animation equipment in terms of its suitability for animation filming, (3) to determine the most common material used for producing film animation, and (4) to outline the basic steps to be followed in the production process.

After determining these objectives, two terms "animation" and "cel animation" were defined. Cel animation and 16mm film were indicated as being of primary importance to the study. The author then proceeded to review the literature, conduct a questionnaire survey by mail of 120 studios engaged in animation, interview the staff of the animation department of Calvin Productions, and conduct experiments in animation with the Kansas State University animation equipment.

The questionnaire revealed that studios producing animation have been engaged in the practice for an average of fourteen and one-half years. Although animation was found to be generally an adjunct of a larger studio operation, almost half of the studios reported that more than 75 percent of their work was animation.

The job-title-positions of the respondents were proportionally almost identical in each studio and the average staff size was found to be twelve persons. In the very small studio, however, more than one position was found to be filled by the same person. No apparent

practical minimum staff size was found. One or two man studios seemed to enjoy equal solvency along with fifteen or twenty man studios. Also, personnel engaged in animation generally worked exclusively in animation, although the studio as a whole may be predominately a live film studio.

Differences were found between how animation personnel were actually trained and how they felt they should have been trained. The respondents reported that 77 percent of them had been trained by apprenticeship and 20 percent trained in professional art school. The remaining 3 percent were trained either in a university or a combination of the other training methods. By contrast, only 44 percent of the respondents actually felt that apprenticeship alone was the best animation training and an additional 44 percent felt that training should consist of art school first, followed by apprenticeship. The remaining 12 percent were split between university and other combinational methods.

Studios were apparently unable to name a single published source of animation knowledge which might help train new members to the animation profession. The impression given on this point was that presently there is not available a current, comprehensive reference book on animation, or possibly the respondents were not actually familiar with available reference books.

Animation personnel seemed to feel that clients, desiring animated films, are not well informed on animation techniques yet felt that they should be. Some of the respondents offered constructive advice on this point, but no single strong suggestion developed as to how clients could be helped in understanding animation. The most frequently

mentioned aid for clients was for the creation of a new more comprehensive text on animation.

This suggestion foreshadowed the next question on the questionnaire which specifically asked if a new book was needed. The overwhelming majority indicated that such a book was needed greatly.

A total of thirty-four animation stands were found in use by the respondents. Of these, eighteen were Oxberrys, four Acme, nine Richardson-Bowlds, and three were built within the studios. With the exception of the Oxberry stands fitted with an aerial image unit and perhaps the studio built stands, all animation stands incorporated approximately the same mechanical facilities.

Eighteen Oxberry cameras were found in service and all were mounted on Oxberry stands. Thirteen Acme cameras were found being used and only four of them were on Acme stands. Two Maurer 05s, one Mitchel, and one Bell and Howell 2709 also were found in service. The Arriflex S was reported being used in two studios and one studio indicated that an Eastman Cine Special was being used as an alternate camera. All of these cameras had registration pins built into the camera gates. This is an apparent necessity. Lenses were generally standard equipment as supplied by the manufacturer. It is interesting to note that three companies had no camera equipment at all, but sublet the actual filming of their productions to a camera service.

Lighting generally consisted of two types of instruments. They were either quartz iodine or the baby fresnel type. The quartz iodine lights were found being used predominately, the wattage generally

being 650 watts.

The three registration systems reportedly used for handling art work were Acme, Oxberry, and Signal Corps. The Acme system was being used by a majority of the studios with the Oxberry system being almost as popular.

The studios did not design and build a significant portion of their equipment. The general trend seems to be to purchase commercial equipment. As mentioned, however, three studios did construct their own animation stands.

The majority of animation reported was produced on 16mm film, however, most respondents were found producing at least some part of their films on both sizes of film stock. The respondents indicated that they felt that 16mm film was becoming more popular.

Cel animation was definitely reported the favored form of animation by the industry. A total of 75.6 percent of all animation was produced with the use of cels. This form was preferred by respondents because it was the most standard method, was the most flexible, and supplies were readily available.

The type of film used for pencil testing varied somewhat, but Eastman Plus-X was the most popular stock indicated for this purpose. Also, all pencil tests were found to be shot on 16mm film, regardless of the fact that the final production may be shot on 35mm film.

There was no variance in the type of film stock used for original filming. Ektachrome Commercial 7255 was used exclusively for 16mm filming and Eastman Color Negative 5251 was the standard stock for 35mm

filming.

Some small variation was noticed in the type of material on which original sound was recorded, but the vast majority of the studios favored 16mm magnetic film.

Another seemingly invariable peculiar to the animation process was the type of paints used in cel animation. All of the studios reported using Cartoon Color from the Cartoon Colour Company of Culver City, California.

Artists were found timing their own sound tracks in more than 60 percent of the reporting studios. Film editors performed the task in the other studios. Magnetic tracks were preferred.

No significant revelations concerning special animation techniques were revealed by the study. Existing literature still represents the most comprehensive source for this information. And, this has not been well recommended by those in the industry. Perhaps the study was overly ambitious on this point. However impractical for some people, it appears that intensive study in a large animation studio may be the best method of gaining a complete background in animation techniques. A current, complete text book might make this phase of animation much easier for the neophyte animator. Most studios indicated that they produced animation essentially by the same methods, however, nine studios mentioned that certain aspects of their production methods were trade secrets.

Technical improvements were indicated as having changed or expanded the operations of seventeen studios. No one particular

technical advance seemed responsible for this. Apparently all phases of equipment and materials have been improved, adding to increased production.

Bar and exposure sheets examined for the study were generally all of the same type. Most of them were designed primarily for use with 35mm film.

Beyond the study's findings as revealed by the questionnaire, the author would like to stress the importance of two other contributions of the study. They are the bibliography and list of manufacturers of animation supplies. These are the most complete lists of their kind known to the author, representing categorically the best existing information relative to the animation process. These lists, in themselves, can save the beginning animator many hours of research time. It is unlikely that few studios have at their disposal such a complete bibliography.

The reader must be aware by now that animation is a very complex and flexible artistic process, somewhat more closely related to painting than normal film production. It can be seen that published information is limited both in quantity and scope. Each volume contributes only a portion of the knowledge needed to explain the animation process. The response to the study by industry was apathetic at best. However, the author would like to emphasize that studios responding, overwhelmingly indicated that a current, comprehensive text book on film animation was needed. Therefore, it is submitted as a future proposal, that this study be combined with the most significant contributions of previous studies into one comprehensive technical volume detailing the process of

film animation. Such a volume would have its greatest meaning if written in close collaboration with an expert in the field of animation.

ACKNOWLEDGMENT

The writer wishes to express his sincere appreciation to Dr. F. Virginia Howe, of the Department of Technical Journalism, for her helpful advice, criticism, and direction of this study.

BIBLIOGRAPHY

BOOKS

- Basic Titling and Animation. Eastman Kodak Company, First Edition, Third printing, 1965.
- Blair, Preston. Advanced Animation. New York: Walter J. Foster, 1949.
- Feild, Robert D. The Art of Walt Disney. New York: The MacMillan Company, 1942.
- Halas, John, and Roger Manvell. Design in Motion. New York: Hastings House Publishers, 1962.
- _____, and Roger Manvell. The Technique of Film Animation. New York: Hastings House Publishers, 1959.
- Halas, John, and Bob Privett. How to Cartoon for Amateur Films. London and New York: Focal Press, 1951.
- Komhauser, Arthur, and others. Research Methods in Social Relations Part Two: Selected Techniques. New York: Dryden Press, 1951.
- Levitan, Eli L. Animation Art in the Commercial Film. New York: Reinhold Publishing Corporation, 1960.
- _____. Animation Techniques and Commercial Film Production. New York: Reinhold Publishing Corporation, 1962.
- Manvell, Roger. The Animated Film. London: The Sylvan Press, 1954.

PERIODICALS

- Bodger, Lowell A. "Production Advantages of Limited Animation," American Cinematographer, 42:358-359, 371-372, June, 1961.
- Bosustow, Stephen. "The Animation Cameraman," American Cinematographer, 46:731-733, November, 1965.
- _____. "Creative Production Control," American Cinematographer, 46:241-243, April, 1965.
- Bouwman, George H. "Animation at the Horace Mann School," Educational Screen and Audiovisual Guide, 6:28, February, 1965.
- East, Douglas A. "Computer Animation," Industrial Photography, 16:26, 32, 108-110, March, 1967.
- Fallberg, Carl. "How Cartoon Director Uses Camera Thinking," American Cinematographer, 46:168-169, 184-187, March, 1965.
- _____. "Production Techniques of the Animated Film," American Cinematographer, 46:110-111, 118-120, February, 1965.
- Flemming, Rex. "Limited Animation Can Meet or Beat Live Shooting Costs," American Cinematographer, 46:574-579, September, 1965.
- "Flicks from Figures," Photo Methods for Industry, 7:60-61, 79, July, 1964.
- Lee, Francis, and Vern Palen. "Special Effects Without Mattes," American Cinematographer, 41:668-669, 694-695, November, 1960.
- Madsen, Dr. Roy. "Animation: Its History, Techniques, and Applications," Industrial Photography, 16:22-23, 52-56, March, 1967.
- Palen, Vern W. "Aerial Image Techniques," American Cinematographer, 44:524-525, 550-552, September, 1963.
- _____. "Animation Major Factor in Production of TV Ad Films," American Cinematographer, 36:588-590, October, 1959.
- Pickens, Tom. "Automation in Animation," American Cinematographer, 43:172-173, 176, 178, 199, March, 1962.
- Pittaro, Ernest. "Camera Animation," Photo Methods for Industry, 9:58-60, 75-76, September, 1966.

Rhodes, Leon S. "The Creative Potential of the Animation Cameraman,"
American Cinematographer, 47:40-43, January, 1966.

Woolery, Adrian. "Production Procedures for Animated Commercials,"
American Cinematographer, 43:415, 436-438, July, 1962.

APPENDIX A

The Questionnaire

1. How long has your firm been engaged in film animation?
2. What percent of your firm's total film production is animation?
3. What percent of your animation production is:
Entertainment?, Technical?, Educational (other than technical)?,
Business?, Television Commercial?, Titles?, Other (indicate form)?
4. How many people hold the following positions on your staff:
Producer?, Director?, Design, Layout and Background Artists?,
Key Animator?, Assistant Animator?, Inker and Colorist?,
Cameraman?, Editor?, Other personnel and title?
5. How many of your staff received their training in the following
manner:
Apprenticeship?, Professional Art School?, University?, Other
(indicate form of training)?
6. What kinds of training do you feel the most valuable in preparing
new personnel for animation?
What printed reference material is most valuable for training?
7. Do you feel that your clients are sufficiently informed on anima-
tion techniques? Yes? No?
8. Do you feel a need for a more comprehensive reference book on
animation than is now available? Yes? No?
If yes, in what area do you feel the greatest need?
9. What animation stand do you use (make and model)?
Cameras (make and model)?
Lenses (make and focal length)?
10. What kind of lights do you use?
Wattage? Quantity? Brand?
11. What cel registration system do you use? Oxberry () Acme ()
Other (note type)?
12. Do you have your own lab facilities? Yes () No ()
13. What pieces of animation equipment have been designed by your own
staff?
Why?
14. What percent of your firm's entire animation production is:
16mm? 35mm? Other (mm)?

15. Do you feel that 16mm animation is becoming more popular?
Yes () No () If yes, why (check appropriate answer)?
Television, Increase in Educational and training films ()
Better equipment and film () Other (comment)?
16. What percent of your animation work is: Cel animation?
Puppets? Models? Paper Sculpture? Other (what type)?
17. What film stock do you use for:
Pencil tests? Original? Original sound?
18. Give supplier and address of paints and inks used for:
Cels? Air Brush? Backgrounds?
19. Do your artist time their own sound tracks? Yes () No ()
Which type of track do you prefer? Optical? Magnetic? Why
this preference?
20. Please explain any special method of your technique which is
unusual or differs from conventional animation.
21. Do you consider any aspects of your business a "trade" secret?
22. Please explain what, if any technical developments of the last
decade or so that have changed or expanded your operation.

APPENDIX B

Studios Surveyed

Academy Films
748 No. Seward Street
Los Angeles 38, Calif.

Aluminum Company of America
Motion Picture Unit
1501 Alcoa Building
Pittsburgh, Pa.

Ambassador Productions, Inc.
729 No. Seward Street
Hollywood 38, Calif.

American Film Productions, Inc.
16000 Broadway
New York 19, N. Y.

Anicatic Productions, Ltd.
15 West 46th Street
New York, N. Y.

Anifilm Studios, Inc.
1150 Sixth Avenue
New York, N. Y.

Aniforms, Inc.
210 Fifth Avenue
New York, N. Y.

Animated Productions, Inc.
1600 Broadway
New York, N. Y.

Animation Associates, Inc.
520 Fifth Avenue
New York, N. Y.

The Animators
1104 Keenand Building
Pittsburgh, Pa.

A.T.U. Productions, Inc.
130 West 57th Street
New York, N. Y.

Aurvid Productions
International Treasures
P. O. Box 413
Philadelphia, Pa.

A.V. Corporation
2518 North Boulevard
P. O. Box 66824
Houston, Tex.

B and B Animation, Inc.
210 East 47th Street
New York, N. Y.

Bandelier Films, Inc.
1837 Lomas Boulevard, N.E.
Albuquerque, N. M.

Bart Sloane Films
136 West Lancaster Avenue
Paoli, Pa.

Basch Radio & Television Productions
25 West 45th Street
New York, N. Y.

Bill Melendez Productions, Inc.
429 North Larchmont Boulevard
Los Angeles, Calif.

B.O.R. Animation Company, Ltd.
282 Seventh Avenue
New York, N. Y.

Bukar & Larisch, Inc.
10 East 49th Street
New York, N. Y.

Byron Rabbit Films, Inc.
1540 Broadway
New York, N. Y.

Cal Dunn Studios, Inc.
141 West Ohio Street
Chicago, Ill.

Calvin Productions, Inc.
1105 Truman Road
Kansas City, Mo.

Cambria Studios, Inc.
8735 Melrose Avenue
Los Angeles, Calif.

Canyon Films of Arizona, Inc.
834 North Seventh Avenue
Phoenix, Arizona

Calalcade Pictures, Inc.
959 North Fairfax Avenue
Hollywood, Calif.

Cellomatic
711 Fifth Avenue
New York, N. Y.

Chapman 5 Productions, Inc.
3805 West Magnolia Boulevard
Burbank, Calif.

Charles Elms Productions, Inc.
163 Highland Avenue
North Tarrytown, N. Y.

Cine Associates, Inc.
3132 M Street N.W.
Washington, D. C.

Colodzin Productions, Inc.
609 Fifth Avenue
New York, N. Y.

Colonial Williamsburg
Audio-Visual Department
Williamsburg, Va.

Commonwealth Film &
Television, Inc.
723 7th Avenue
New York, N. Y.

Consolidated Film Industries
959 Seward Street
Hollywood, Calif.

Continental Film Productions
Corporation
2320 Rossville Boulevard
Chattanooga, Tenn.

Coty Television Corporation
Suit 2217
1270 Avenue of Americas
New York, N. Y.

Creative Arts Studio, Inc.
814 H. Street, N.W.
Washington, D. C.

Creative Motion Pictures Corporation
550 Fifth Avenue
New York, N. Y.

Creston Studios
1027 North Cole Avenue
Los Angeles, Calif.

D 4 Film Studios, Inc.
56 Elmwood Street
Newton, Mass.

Dolphin Productions, Inc.
4 East 53rd Street
New York, N. Y.

Douglas Film Industries
10 West Kinzie Street
Chicago, Ill.

D & R Productions, Inc.
301 East 47th Street
New York, N. Y.

The Dura-Sell Corporation
41 East 42nd Street
New York, N. Y.

Ed Graham Productions, Inc.
4721 Laurel Canyon Boulevard
N. Hollywood, Calif.

E M C Corporation
7000 Santa Monica Boulevard
Hollywood, Calif.

Fantasy Features, Inc.
353 West 57th Street
New York, N. Y.

Film Associates, Inc.
4600 S. Dixie Highway
Dayton, Ohio

Filmfair
10920 Ventura Boulevard
Studio City, Calif.

Film Formatics, Inc.
72 West 45th Street
New York, N. Y.

Filmline Productions Associates
6060 Sunset Boulevard
Hollywood, Calif.

Filmack Studios
1327 South Wabash Avenue
Chicago, Ill.

Filmways of California
4001 Overland Avenue
Culver City, Calif.

Fine Arts Productions, Inc.
729 Seward Street
Hollywood, Calif.

Focus Presentations, Inc.
400 Park Avenue
New York, N. Y.

Format Productions, Inc.
12754 Ventura Boulevard
Studio City, Calif.

Friar Graphics, Inc.
8228 Georgia Avenue
Silver Springs, Md.

Gryphon Productions, Inc.
1212 Avenue of Americas
New York, N. Y.

Hal Dennis Productions
6314 La Mirada Avenue
Hollywood, Calif.

Hal Seeger Productions, Inc.
48 West 48th Street
New York, N. Y.

Hankinson Studio, Inc.
72 West 45th Street
New York, N. Y.

Hanna-Barbera Productions
3400 Cahuenga Boulevard
Hollywood, Calif.

Harris-Tuchman Productions, Inc.
751 N. Highland
Hollywood, Calif.

The Hubley Studio, Inc.
165 East 72nd Street
New York, N. Y.

Hu Chain Associates
15 East 48th Street
New York, N. Y.

Imagination, Inc.
531 Pacific Avenue
San Francisco, Calif.

Inter-Continental Broadcast Media
236 West 55th Street
New York, N. Y.

Jack Kinney Productions, Inc.
1025 N. McCadden Place
Hollywood, Calif.

Jerry Ansel Productions, Inc.
330 East 33rd Street
New York, N. Y.

J N P Incorporated
234 East 47th Street
New York, N. Y.

John Sutherland Productions, Inc.
201 North Occidental Boulevard
Los Angeles, Calif.

Louis De. Rochemomt Associates, Inc.
18 East 48th Street
New York, N. Y.

Lux-Brill Productions, Inc.
321 East 44th Street
New York, N. Y.

Max Lasky Film Productions
3705 Lonsdale Street
Cincinnati, Ohio

Mogubgub, Ltd.
6 East 46th Street
New York, N. Y.

National Film Board of Canada
3255 Cote de Liesse Road
Montreal 3, Quebec, Canada

Norman Wight Productions, Inc.
27963 Cabot Road
South Laguna, Calif.

Ohio State University Department
of Photography
Motion Picture Division
1885 Neill Avenue
Columbus, Ohio

Pablo Ferro Films
45 West 45th Street
New York, N. Y.

Pacific Title & Art Studio
6350 Santa Monica Boulevard
Hollywood, Calif.

Mr. A. Paganelli
21 West 46th Street
New York, N. Y.

Pantomime Pictures, Inc.
8961 Sunset Boulevard
Hollywood, Calif.

Pelican Films, Inc.
292 Madison Avenue
New York, N. Y.

Playhouse Pictures
1401 North La Brea Avenue
Hollywood, Calif.

Pittaro Productions, Inc.
P. O. Box 428
Flushing, N. Y.

Purcell Productions, Inc.
236 West 55th Street
New York, N. Y.

Quartet Films, Inc.
5631 Hollywood Boulevard
Hollywood, Calif.

Ralph Lopatin Productions, Inc.
1728 Cherry Street
Philadelphia, Pa.

Ray Patin Productions
3425 Cahuenga Boulevard
Hollywood, Calif.

Reela Films
17 N.W. 3rd Street
Miami, Fla.

Reid H. Ray Film Industries, Inc.
2269 Ford Parkway
St. Paul, Minn.

Rene Bras Productions
778 Madison Avenue
New York, N. Y.

Robie Studios
Box 1
Noel, Mo.

Roger Wade Productions, Inc.
16 West 46th Street
New York, N. Y.

Sel Animation, Inc.
45 West 45th Street
New York, N. Y.

Sixteen Screen Service Company
6710 Melrose Avenue
Hollywood, Calif.

Soundac Productions, Inc.
P. O. Box 2167
Hollywood, Fla.

Southern Illinois University
Film Production
Carbondale, Ill.

Symmetry Corporation
3132 M Street
Washington, D. C.

Technamation
3445 Cahuenga
Hollywood, Calif.

Technical Animations, Inc.
11 Sintsink Dr. E.
Port Washington, N. Y.

Ted Eshbaugh Studios, Inc.
1020 East 163rd Street
New York, N. Y.

Telefects
268 West 47th Street
New York, N. Y.

Telemated Motion Pictures
8 West 40th Street
New York, N. Y.

Terrytoons
38 Centre Avenue
New Rochelle, N. Y.

Totem Productions, Inc.
220 East 23rd Street
New York, N. Y.

Trans-Lux Television Corporation
625 Madison Avenue
New York, N. Y.

TV Graphics, Inc.
369 Lexington Avenue
New York, N. Y.

TV & Motion Picture Productions
707 Dawn Street
Richmond, Va.

Unicorn Productions
8451 Melrose Avenue
Los Angeles, Calif.

United Artist Television, Inc.
555 Madison Avenue
New York, N. Y.

UPA Pictures, Inc.
4440 Lakeside Drive
Burbank, Calif.

Videart Incorporated
62 West 45th Street
New York, N. Y.

Video Films, Inc.
1104 East Jefferson Avenue
Detroit, Mich.

Versatile Television Productions, Inc.
324 Broadway
Cape Girardeau, Mo.

Walt Disney Productions
500 South Buena Vista
Burbank, Calif.

Warner Brothers
Television Division
4000 Warner Boulevard
Burbank, Calif.

Wilbur Streech Productions, Inc.
135 West 52nd Street
New York, N. Y.

Wonderland Productions
760 Cahuenga Boulevard
Hollywood, Calif.

APPENDIX C

Sources of Equipment and Materials

Cameras Only

The Arriflex Corporation of America
257 Park Avenue South
New York, New York 10010

Bell & Howell
7100 McCormic Road
Chicago, Illinois 60645

J. A. Mauer, Inc.
37-01 Thirty-first Street
Long Island City, New York

Mitchel Camera Corporation
666 West Harvard Street
Glendale, California 91204

Animation Stands Only

Rauer Cine Equipment Company
10641 Meuse
Detroit, Michigan

Animation Cameras and Stands

(Acme)
Producers Service Corporation
1145 North McCadden Place
Hollywood, California

(Acme)
Photo-Sonics, Inc.
820 South Mariposa Street
Burbank, California 91506

Caesar-Saltzman Professional Sales Division at Willoughby
110 West Thirty-second Street
New York, New York 10001

The Oxberry Corporation
25-15 Fiftieth Street
Woodside, New York 11377

Everything for Animation

Animation Cranes and Supplies
Regal Products
1459 North Seward
Hollywood, California

F & B Ceco, Inc.
315 West Forty-third Street
New York, New York 10036

Florman and Babb, Inc.
68 West Forty-fifth Street
New York, New York

Gordon Enterprises
5362 North Cahuenga Boulevard
North Hollywood, California

SOS Photo-Cine-Optics, Inc.
387 Park Avenue South
New York, New York 10016

Films and Animation Cels

Eastman Kodak Company
343 State Street
Rochester, New York

Animation Cel Paints

Cartoon Colour Company
9374 Culver Boulevard
Culver City, California

APPENDIX D

Bar and Exposure Sheet Samples

COPY PAGE 2 OF 11 PAGES

COPY	AAARR	YUUUUUU	GGGGGGGG	IIIIIIII	NNNNNNNN	AAAANNNNDYY
ACTION	CH SUEZY SHRIKES	← CH TRAPS HEAD BY	← CAR MOVES TOWARDS ANDY	← SUE MOVES TOWARDS ANDY		
EFFECTS	SC #5					
SOUND	AND OUT MUSIC					
FRAMES	120	125	130	135	140	145

SCENE # 5 # 6

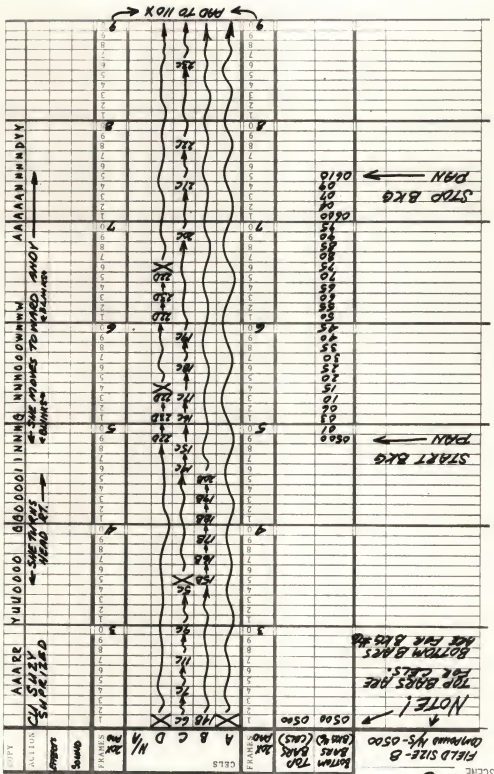


"LONG PLACES"

COPY	YYEEEEAAAA	NNNNNNNN	AAAANNTA	GGGGGGGG
ACTION	CH ANDY IN CAR LOOKING TOWARDS SUEZY			
EFFECTS	← SC #6 START			
SOUND	MOTOR NOISE FROM SC 5 CONTINUING THRU SC 6			
FRAMES	150	155	160	165

BAR SHEET SAMPLE

EXPOSURE SHEET SAMPLE



TITLE "GOING PLACES" #5
 SCENE FIELD SIZE - B
 Dm/Frame N/S - 0500
 BOTTOM 700
 BARS BACK
 (M/S) (C/S)
 0500 0500
 NOTE: TOP BAGS ARE FOR TESTS. BOTTOM BAGS ARE FOR BKG
 COPY CH. SIZE SURPRIZED
 ACTION SHE THICKS HEAD RT
 COPY YUUDDD
 AAARE
 BDDDDJJNNB NNNGGOWWW
 AAAHHNDYY
 H/A
 H/B CC
 H/C
 H/D
 H/E
 H/F
 H/G
 H/H
 H/I
 H/J
 H/K
 H/L
 H/M
 H/N
 H/O
 H/P
 H/Q
 H/R
 H/S
 H/T
 H/U
 H/V
 H/W
 H/X
 H/Y
 H/Z

APPENDIX E

A Comparison in Percentages of the Amount of Production
by the Respondents in 16mm and 35mm Film

(TABLE IV REVISED)

TABLE IV

A COMPARISON IN PERCENTAGES OF THE AMOUNT OF PRODUCTION
BY THE RESPONDENTS ON 16mm AND 35mm FILM

16mm Film	35mm Film
90	10
75	25
5	95
50	50
1	99
99	1
100	0
100	0
85	15
10	90
90	10
40	60
50	50
95	5
20	80
0	100
80	20
30	70
25	75
90	10
10	90
1	99
90	10
99	1
10	90
Average Percent 56	44



THE ESSENTIALS OF PRODUCING 16mm CEL ANIMATED FILMS

by

JOHN ROGER STOCKARD

B. A., University of North Carolina, 1955

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF ARTS

Department of Technical Journalism

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1969

The purpose of this study was (1) to examine current studio operations and training procedures, (2) to analyze the most popular technical animation equipment in terms of its suitability for animation filming, (3) to determine the most common material used for producing film animation, and (4) to outline the basic steps to be followed in the production process.

The terms "animation" and "cel animation" were defined. Cel animation and 16mm film were indicated as being of primary importance to the study. The author then proceeded to review the literature, conduct a questionnaire survey, by mail, of 120 studios engaged in animation, interview the staff of the animation department of Calvin Productions, and conduct experiments in animation at Kansas State University.

The findings are grouped under the four major objectives of the study as set forth in the statement of the problem. Those concerned with current studio operations are:

1. Animation, generally an adjunct of a larger studio operation, has been produced an average of fourteen and one half years per studio.

2. The personnel job-title-positions are almost identical per studio, although the smaller studios may use the same person in more than one position.

3. The average staff size is twelve persons.

4. Respondents reported 77 per cent of their staff were trained by apprenticeship, 20 per cent by art schools, and 3 per cent by other methods.

5. Apprenticeship was considered the best training by 44 per cent

of the respondents and another 44 per cent felt art school followed by apprenticeship was best.

6. No single published source of animation knowledge was established, but the respondents overwhelmingly indicated a need for a new, more comprehensive animation book.

The findings concerned with animation equipment are:

1. Oxberry animation stands and cameras were by far the most popular in use.

2. Cameras used for animation must be fitted with registration pins in the camera gate.

3. Animation may be produced without owning film equipment.

4. Studios used commercially available equipment, generally.

Findings concerned with animation materials were:

1. Most studios produced on both 16mm and 35mm film stock, with slightly more being produced on 16mm film.

2. Three fourths of the animation reported was produced on cels.

3. All pencil tests were shot on 16mm film, generally Eastman Plus-X.

4. Ektachrome Commercial 7255 was used invariably for 16mm filming and Eastman Color Negative 5251 for 35mm filming.

5. Respondents generally recorded sound on 16mm magnetic film.

6. Cartoon Colors were used exclusively for painting cels.

Findings concerned with the basic steps in the animation process were:

1. Existing literature is, at present, the best source of knowledge

of the animation process.

2. Animation procedures vary little from studio to studio.

3. Technical improvements in equipment and materials have expanded or improved present studio operations.

4. Studios use essentially the same type of bar and exposure sheets.

5. Trade secrets were claimed by 36 per cent of the studios.