CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

THE ILLUSION OF MOTION
IN STILL PHOTOGRAPHY

An abstract of the project submitted in partial satisfaction of the requirements of the degree of Master of Arts in Art

by

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PREFACE

The project contains two audio-visual units. These units are designed as teaching aids for the instruction of high school photography. The teaching aids are concerned with the photographic image of motion or subject movement. Visual material on 35 mm slides is used in combination with narration on tape cassette.

The project is dedicated to those Southern California high school photography teachers who recognized a need for more adequate teaching aids for the instruction of basic still photography. Their initial need for the teaching aids, their continued guidance, and their subsequent evaluation of the slide-tape units has been a major contribution to the completion of the project.
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CHAPTER I

IDENTIFICATION OF THE PROBLEM

Recent critical studies of Southern California high school photography students' work led to the development of several new teaching aids. The need for these teaching aids became apparent as student surveys and teacher observations revealed numerous student errors in photographic techniques.

Many local members of the Photography Instructors Association in Los Angeles, Orange, and Ventura Counties recently discovered mutual teaching problems. The specific problems were not unique to the local area, but have been mentioned in several national photography magazines concerned with photography education. The author, a photography instructor at Verdugo Hills High School in the Los Angeles City School District, attempted to itemize the teaching problems in his own classroom. He presented his photography students with a survey at the conclusion of their photography classes in order to determine the areas they found most difficult to master. Initially, most students were reluctant to admit they had difficulties with any phase of photography. This tendency to maintain a stance of sophistication created a barrier to discovering the actual problem areas. While the students claimed that there were no problem areas, examination of their photographic prints often revealed many technical errors. An analysis of the entire photographic process was necessary to determine the specific problem areas.
Student production of photographs is the result of a continuous chain of processes. Assignments require the students to accurately record images on film. Using their cameras outside of class, they must frame and focus the image, determine the correct exposures and finally capture the image on film at the right instant. In the photography lab they continue the production by using chemical procedures to develop the film image. The resulting negatives are projected or enlarged on photographic paper which is also developed to an image by chemicals. This chain of processes is quite technical, and the results are cumulative and dependent upon the preceding processes.

Further problem analyses by the author in his classes revealed that laboratory techniques such as film processing and print production usually receive adequate supervision and review to prevent repeated student errors. The problem appeared to be in another area. Unsupervised camera usage often led to technical errors and, in turn, to poor photographs.

High school photography teachers belonging to the Photography Instructors Association of Southern California meet regularly to discuss photography education problems. Several recent teacher discussions resulted in wide agreement that high school photography students often fail to observe basic camera handling procedures. All of the teachers also agreed that basic camera techniques are being taught, but not adequately or with retention in application. As mentioned before, most high school camera assignments require students to work outside of class, in unsupervised situations. The students often forget basic camera techniques. These errors are seldom dis-
covered until later when processing steps reveal the problem. Further review of basic procedures seldom occurs and the mistakes remain uncorrected. The actual problem is the teaching of basic still photography techniques more effectively.

Existing teaching aides are available to most high school photography teachers, yet many are difficult to use in the classroom. Most aids are in book or pamphlet form. Their format requires lengthy selection and editing by the teacher before classroom presentations. Visual aids contained in the books are often too small to be seen by an entire photography class. Sequences of technical photography instruction must often be reorganized by the teacher. The author found many books have information that is too general for technical assistance. Other books with specific techniques often apply to situations different from the actual classroom. The author and other Los Angeles City high school photography teachers agreed that many existing teaching aids are inefficient since they are either incomplete or designed for unusual applications. Most school districts also have curriculum guides to assist photography teachers. Unfortunately the guide for the Los Angeles City School District, Art For Senior High School, needs revision. It was published in 1961 and offers few visual resources or new technical concepts. As a result of this situation, Los Angeles high school photography teachers are required to gather nearly all of their materials for teaching aids from many varying sources. Such aids range from teacher prints, student prints, books, library portfolios, and commercial data pamphlets. Movies are also available, however, current Los Angeles City School District film libraries are
limited, and quite dated. Many movies do not offer current technical information. A number of the technical photography films for Los Angeles high schools are actually World War II training films used by the U. S. Navy. These films offer little assistance for high school photography instruction.

A presentation of new instructional material often requires high school photography teachers to reorganize visual and verbal material from textbooks. While the initial presentation is often awkward and difficult to organize, subsequent review of the material is frequently impractical. A primary goal of photography education is to permit high school students to produce high quality photographic prints of their own. Unfortunately the presentation of existing inefficient teaching aids often defeats this goal. Student photographic skills provided by more effective teaching aids may help accomplish the goal.

As indicated earlier, specific areas of instruction which need additional help are the techniques for camera usage. One particular area which has generated great student and teacher interest is the photography of moving subjects. While action photography is a popular assignment at many local high schools, the resulting photographs often reveal a need for more effective camera instruction. Many beginning photography students believe the only way to record movement is to use an expensive adjustable camera with very brief shutter speeds. This concept is too limited to permit action photography by students with simple nonadjustable cameras. The production of teaching aids to expand instructional effectiveness has therefore become the central
goal of this particular project. The area of technical assistance provided by this project concentrates on camera usage to aid students to produce the illusion of motion in their still photographs.
CHAPTER II

DEVELOPMENT OF THE PROBLEM

As the problem of inadequate teaching aids was defined by the author and other members of the Photography Instructors Association, requirements and goals for new aids were formed. The major goal of the teaching aids developed in this project is to provide needed technical assistance to beginning high school photography students. The aids should permit students to acquire new technical skills with their cameras. The ultimate goal is directed toward increased production of high quality photographic images. The desirable features of developing new teaching aids centered around the need for concise, well organized programs. Ease of presentation and efficiency in the classroom also remained important goals. Well organized units should permit subsequent review of the materials, as well as ease of initial presentation.

Several solutions to the problem seemed possible, but in each case various requirements had to be considered. These requirements were:

1. Teaching aids had to be available to both class-size groups and individual students for initial instruction.

2. The sequential units should also allow for repetition and review by students of varying interests and abilities.

3. The instructional materials should be easily reviewed by students without teacher assistance.
4. The units of instruction should be self-testing.

5. Students should be able to evaluate their own progress.

Other practical requirements have been considered:

1. The size and structure of the unit must be compact and portable.

2. Storage and maintenance requirements must not complicate subsequent presentations.

3. Availability of new visual materials and revisions will increase the longevity of the units.

4. The initial cost, as well as the cost of revisions should be reasonable.

5. Simple duplication of additional units for use in other schools is desirable.

The limitations of current teaching aids for photography instruction do not include lack of availability. Perhaps the problem is that there is too much available technical data about photography.\(^{(35)}\)

The biggest problem of developing new teaching aids has been the selection and editing of the many separate technical sources. Nearly all the existing teaching aids have shortcomings:

1. Student print collections often deteriorate or are easily damaged.

2. Storage and indexing of prints are difficult.

3. Individual books seldom contain all the required instructional materials. Teachers often find themselves juggling numerous cumbersome books in order to offer a few visual examples.

4. Many high school students do not want to read technical
information. Classroom readings of assigned texts are seldom successfully completed.

Sound movies are sometimes suggested as the latest, most efficient medium. Yet, in still photography today, technology has advanced more rapidly than current movie production. Currently available movies about still photography techniques are often dated or incomplete. The latest movies are priced beyond school's budgets, and loan copies are seldom coordinated with lesson plans.  

New instructional materials in commercial filmstrips and slides are now available in many subject fields, yet fail to satisfy the needs of photography instruction. Current filmstrip productions do not seem to keep pace with the constantly changing technical photographic data.  

Commercial data pamphlets are perhaps the most complete area of technical aids for photography. Unfortunately, teachers seldom have sufficient information when it is needed. Also, pamphlet formats do not allow effective presentation to students.  

A review of current teaching aids provides the following conclusions: Present aids contain the necessary content, but lack the usable format necessary for effective classroom presentation. Sources are too diverse to allow for ease of presentation. A typical presentation of technical photographic concepts might find the instructor combining the use of a series of prints, several books, a short series of related slides and numerous technical data pamphlets. Such presentations are complex and become awkward. Opportunities to successfully review the instructional materials are few. Tentative solutions to produce new aids do not negate the value of existing aids,
however. The new aids would not, in most cases be independent new sources. They would usually consist of collections and refinements of existing teaching aids. The basic content of the new media approaches can retain the material found in the original sources, but should be improved in the format and organization. A digest of present aids may be reduced to more concise, easily viewed materials.

Initially, three possible formats for teaching aids were considered. All three of the formats would have consisted of visual material with explanatory narration. The three tentative solutions considered were: 35 mm slides with recorded audio tapes; filmstrips with recorded audio tapes; and sound movies. All three provided several advantages over existing teaching aids. 35 mm slides were chosen for the most usable format for the following reasons:

1. Slides are easily produced at relatively low cost.
2. Slides offer greater flexibility for editing and sequential changes in the units. This reason continued to be a major advantage throughout the development of the project.
3. Slide systems also offer convenient storage and can be easily indexed.
4. Slides can be easily duplicated to allow multiple sets of teaching units.

These advantages of 35 mm slides initiated a collection of technical slides to be used as photography teaching aids by the author. Several technical areas relating to photography education were investigated. These general topics concerned cameras, light, film, and production of photographic prints. The preliminary selections of
slide images were presented to the author's graduate committee in the Art department of California State University, Northridge. The early attempt to cover many technical photographic concepts was finally considered impractical during meetings of the author with his graduate committee. Graduate committee meetings determined that too much technical material was being covered without the required depth to improve student learning of photographic skills. The preliminary slide collections had grown too voluminous yet they were nowhere complete. A practical suggestion in committee meetings to thoroughly investigate one specific unit of photography instruction led to the author's decision to limit the technical content of the teaching aids. The initial proposal to develop new photographic teaching aids with 35 mm slides and audio tapes became more practical as the instructional content was narrowed. The proposed teaching aids would concentrate on the specific camera controls used to capture the illusion of motion in still photography.
CHAPTER III

PRODUCTION OF THE TEACHING AIDS

Initial selection of the audio-visual format and the technical content were major decisions for the author and his committee. Production of the slide-tape package became complex as selections of images were made from student work, teacher print samples, and numerous photographs in books and periodicals.

To convert the many types of original images to slides a 35 mm single lens reflex camera was used, along with Ektachrome transparency film to allow color as well as black and white reproductions. A tripod eliminated camera movement during exposures, and a bellows unit between the camera body and the lens permitted close-up copies of small images. The camera's own behind-the-lens meter was used to accurately determine the exposures. Original images were held flat and perpendicular to the camera on a commercial copy stand. (43) Light sources for the exposures were often sunlight. Indoor tungsten illumination required the use of supplementary color correction filters. Subsequent chemical processing and mounting of the 35 mm slides were completed by both the author and commercial film laboratories. Copying the original visual sources was perhaps one of the lengthiest production procedures. Further study of the resulting slides indicated a further need to mask and crop edges of many images. Cropping was sometimes possible by reshooting the image at a higher magnifica-
tion ratio. Unusually long or tall slide images were masked with mylar prior to mounting.

Preliminary sequences of slides were assembled to illustrate the technical concepts. These early slide sequences were shown to the author's high school photography classes at Verdugo Hills High School in Tujunga, California. Student discussions evaluated the slides in terms of suitability for the instructional program. Much editing and new selection of slide images were made in the classroom.

A slide duplication unit was used with the single lens reflex camera and bellows to revise the preliminary images. Ektachrome Slide Duplicating Film 5038 proved to be the best choice for the duplicates. The film does not increase tonal contrast of the originals, nor is there objectionable graininess in the copies. The duplicating unit enables the photographer to accurately position original slides before the camera. The bellows allows close-up focusing of the camera on small portions or complete slides. As desirable slides were copied, redundant images were eliminated and poor quality selections were replaced by new choices. A large collection of slides illustrating the technical concepts allowed variations on themes without repetition of individual slides.

A basic outline of technical concepts was developed by the author to establish the sequence for viewing the slides. The outline, included in the appendix, was initially narrated by the author in his high school photography classes. The outline used camera techniques and controls found in several photography textbooks. The concepts and sequences became more accurate and concise following numerous
reviews by the graduate committee and high school classroom discus-
sions.

After review and revisions of the slide sequence at Verdugo
Hills High School, the slide unit was duplicated and sent to several
other photography teachers for inclusion in their classroom instruc-
tion. The slides illustrating techniques to control motion in still
photography were accompanied by a more detailed outline of technical
concepts. The trial units used spoken narration from the written
outline. Initial units were used in several Los Angeles City high
school photography classes in the San Fernando Valley area to deter-
mine changes needed to strengthen the teaching aids. Reviews of the
early units took place at recent local meetings with the photography
teachers at Photography Instructor Association (PIA) gatherings.
These reviews did not use specific tests of the instructional materi-
als. Lengthy discussions among the high school photography teachers
identified several concepts needing more emphasis and the need for
reinforcement of images. Most teachers agreed that the concepts
should place additional emphasis on techniques for nonadjustable cameras
since many high school students have very basic cameras. Revised
units with new images and extended treatment of camera controls were
used in the Kennedy-San Fernando Community Adult School photography
classes and John Burroughs High School photography classes in Burbank,
California. While early slide units were accompanied with a written
outline to aid narration by the photography teachers, the later units
used a tape recorded narration. Response to these units helped in
the editing and refinement of the technical concepts. Taped narration
in intermediate units clearly defined technical concepts but sometimes failed to relate to specific slide images. The tapes were revised when the scripts were expanded to draw more attention to specific features of motion in the slides. The length and duration of the teaching unit was compared to existing teaching aids. Several units studied averaged about forty slides each and narration varied from 15-30 minutes. The new technical unit seemed to be much more comprehensive. This feature indicated that the unit would certainly exceed forty slides, however a maximum limit was set at 100 slides. Great numbers of slides would require changing of reels during the presentation and would probably promote viewer fatigue rather than increased interest. The final technical sequence includes 72 slides and is accompanied by a tape lasting 19 minutes.

The slide-tape unit was again used in Verdugo Hills High School photography classes, as well as at Carl Sandburg Junior High School in Glendora, California. The use in a junior high school photography class revealed that the unit could be effectively used for several age groups of students. While the technical unit was initially designed for high school photography classes, favorable response was received from junior high through adult photography students. Student interest in photography and technical abilities appeared to be a more important factor than age level. It was decided that the unit can be used in any beginning or intermediate photography class.

As the development of the technical series progressed, a second series of slides was designed. These images, while not integral to the technical concepts being taught, offered historical information
for student enrichment and awareness. The historical unit revealed the changes in photographic images of motion that were permitted by the progression of technology since 1839. Recent developments in artistic photography are also shown. A variety of photographic images of motion are also shown as they relate to other modern art forms.

As work progressed, the original historical unit became so extensive that several hundred slide images accumulated. In fact, there were so many images, that at one point, the unit was divided. In the first section, only early historical material was presented. The second section dealt with recent developments in photography of motion. In order to achieve better continuity, the two historical units were later condensed and combined. At the present time, the historical sequence contains 62 slides and is accompanied by a 20 minute narration.

Each of the teaching units is designed to be shown in one average class period of 50 minutes. This time allows for equipment set-up, introductory remarks, the presentation, as well as review and discussions.

In the end, a final production of the slide-tape units was required in order to clean up technical errors such as poorly framed slides. The tapes were then retaped on an open-reel recorder by an experienced speaker. Since cassettes are easier to use than reel tapes, the new master tapes, with improved vocal qualities, were once again duplicated on audio cassettes. In order to achieve the best results, some slides required additional masking and cropping to avoid visual distractions during the presentation. During this period
of final production and refinements, duplicate sets of slides were made for distribution.

The final slide packages resulted in two audio-visual teaching aids. The original and most important unit continued to explore technical controls for photography of motion. Beginning with basic techniques for beginners and simple cameras, the unit continues with additional information for more advanced photographers or students with more refined cameras. The technical sequence was designed to include basic technical concepts relative to all types of cameras, whether they are simple or refined. The primary purpose of the technical teaching unit is to present and review basic concepts and camera techniques to students. The intended goal is to assist students to produce their own photographic images of motion. This technical unit remains the core of the teaching aids and is essential to the proposed teaching goals. The technical slide-tape series is a complete unit and can be used independently of the historical series. The historical series is considered a supplementary unit and offers reinforcement and enrichment to students wanting more information about action photography. The unit has proven to be helpful in motivating students to produce more high quality photographs of motion. When the two units are used together in the photography classroom, the increase in motivation by the historical unit may increase the productivity of the technical unit.
CHAPTER IV

USE AND EVALUATION OF THE AIDS

Throughout their development and revision, the slide-tape units were in continual use in photography classrooms in local high schools. For ease of evaluation, the units, once presented to a photography class, were seldom shown to the same class in a later, revised state. No class received repeated exposures to the instructional units. As the units were refined, they were usually introduced to new and different classes taught by the same teachers of earlier groups. Comparisons of the separate classes as they studied motion in photography were made by the photography teachers to rate the effectiveness of the revisions.

Part of the presentation of the teaching aids included an assignment for the students to continue to pursue the motion techniques with their cameras. Weeks later, group critiques of student prints of motion by both teachers and students noted the use of concepts taught in the slide-tape unit. Successful application of the camera techniques was compared to student efforts with moving subjects prior to the teaching program. The use of the technical slide-tape unit usually produced the use of a greater number of camera controls by students than in previous assignments without the technical unit. This occurrence was one measure of the effectiveness of the technical unit. Increasing occurrences of the applied technical concepts were noted at all the schools using the final slide-tape package. Several
high school teachers in Los Angeles were able to note some weaknesses in the trial or preliminary teaching aids. Their high school photography students still tended to attempt most of their pictures of movement with only the fastest shutter speeds. Later emphasis of revised slides on images of blur as well as stopped action promoted a greater variety of student images. Continued questions and increased interest in photography of motion by high school students seeing the technical slide-tape unit prompted the addition of the historical slide-tape unit to provide background material for motivation. Based on this student interest, the development of the historical teaching unit was more than justified even though it had never been considered essential to the technical series.

A pre-test was used several times to gain a more effective evaluation of the technical unit. The pre-test, in the appendix, had a dual purpose: prior to the presentation, a vocabulary list of terms about motion inquired about students prior knowledge of the concepts; this list also served to alert the students to the usage of terms in the presentation. They seemed to take notice of the terms they had not previously understood. After the presentations, discussions often reviewed the concepts and terms. If students did not volunteer responses for discussion, a post-test or questionnaire, as shown in the appendix, was used by the teacher to elicit responses. In many cases, observation of student discussions enabled the teachers to summarize student responses.

Perhaps the best test of the effectiveness of the technical unit was the student's increased knowledge of camera controls.
Application of new acquired camera skills could be seen in the student photography assignments which followed the presentation of the technical unit. Students with non-adjustable cameras frequently gained enough interest to attempt motion photographs that they had previously considered impractical or impossible. Many students with various adjustable cameras accepted the challenge of new concepts and produced new results within several weeks. Occasional student references to the unit still occurred months after the initial presentations. The student and teacher surveys used in the post-tests have always indicated some interest in action photography, but early results in students' photographs were often lacking or disappointing. These early results were used primarily for revision of later units. As the comments about student work became more favorable, the need for revisions declined, as well as the need for additional tests. Nearly all participating teachers agreed that the best test of effectiveness was the results of the student work itself. Since the primary goal of the teaching aids was to have students produce their own photographs, the quality and quantity of student photographs resulting from the subsequent camera assignment were carefully observed and evaluated by the author and other high school photography teachers. Most students did complete the assignment and some produced remarkable results. Several excellent student applications of the technical concepts were used in the final revision of the technical slide-tape unit. At recent PIA meetings, several of the high school teachers compared the results of the student camera assignment to the assignments they had given previously without the technical program. Results were favorable
in most cases. General agreement among the participating teachers indicated a greater number of students with simple cameras had attempted pictures of motion following the technical unit presentation. A greater variety of images of motion seemed to occur among the students participating in the program. The area which defies measurement, however, is the various teachers' inescapable attempts to present the material in their own way. Many teachers tend to add their own personal touches to instructional materials. While the technical concepts in the unit remain fixed, the degree of motivation provided by the teacher and the historical unit certainly may have had an influence on the student success in their camera assignments. Most participating teachers agreed with the author that the historical unit provides abundant images to encourage or motivate the students to make a greater use of the camera skills taught in the technical unit. Student response in classroom discussions also seemed to verify this finding.
CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The original goal of the project was to aid photography students in their production of photographs showing motion. In these terms, the project has been moderately successful. The format of the project was designed for efficient instruction in the classroom. The collection of images permits rapid introduction of new concepts by the teacher and allows for repetition and review by the students. In terms of both teacher and student effectiveness, the units have served well as teaching aids. Participating teachers as well as the author found the initial presentation of the units to be practical and efficient. Students found the units easy to review. Slides in file pages with accompanying scripts can be studied without teacher assistance. The structured units require little teacher preparation before classroom presentation. The teaching aids have dealt with the historical and technical concepts quite thoroughly, and therefore other teaching resources do not appear to be needed to complete the classroom presentation. While the aids may not necessarily replace other methods of instruction, they offer an effective alternative to existing technical materials.

The 35 mm slide and tape format has received favorable responses from the local Los Angeles high school photography students and teachers using the program. Other formats may have been effective yet the slide format yields more than adequate success. Initial
production attempts used slides for convenience, yet later considerations still favored slides over movies or film strips. The flexibility of the slide-tape units allows relatively easy revisions. Individual slides can be added, eliminated, and sequences can be varied. This advantage over fixed units continues to be a major justification for the format. Movies or film strips may contribute to neat and uniform packages, however, their fixed structure prevents revisions without redoing the entire production. The use of slides also offers the student an opportunity to contribute to the aids. The project has used student slides several times. Students, realizing this, have been more interested and motivated to make their own contributions in slides.

The actual production of the units was not a trivial matter. The actual preparation of the slide-tape units is lengthy, and requires special skills and equipment. While the photography teacher can always grab up several existing teaching aids to present material, new slide units cannot be prepared so hastily. The hours of gathering visual material for slides as well as the time of processing cannot be ignored. This time element can be an extreme disadvantage for slide units if new teaching aids are needed immediately. Even though countless hours may be spent gathering slides, this burden may seem justified by the resulting increases in classroom efficiency.

The content of this program is still limited. Many similar units would be required to cover the many additional technical aspects of teaching photography. The author intends to develop other technical slide-tape units describing camera controls such as depth of field.
and selective focus. This will again require lengthy preparation. Unfortunately, it is not feasibly possible for one instructor to attempt to build all the required photography units without considerable assistance. Many books, pamphlets, and print files can eventually be converted to slides for more effective presentation. Until then, some of the conventional existing teaching aids will continue to predominate over new teaching aids.

The author has hoped for assistance to gain new teaching aids. Where is such assistance available? Present Los Angeles City school budgets certainly will not permit the purchase of new aids as they are developed commercially. Ideally, several different local high school photography teachers could work together and contribute to a series of teaching units. A more complete set of units could be built from the efforts of many teachers. While possible, this last recommendation is still highly unlikely. While many local Los Angeles photography teachers realize inadequacies in present teaching aids, many will probably continue to teach as separate independent entities.

The need for new teaching aids for photography has been clearly established locally and nationally. It is now the duty of the author and other local high school photography teachers to combine their efforts to gain district support for photography education and to pool their individual productions of photographic instructional aids. This is no time for photography instructors to stand alone. Continued cooperation among local PTA members may promote additional gains in photography education. One can only speculate what is possible if local high school photography teachers and PTA members would unite in their cause to improve photography education.
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APPENDIX A

PRE-TESTS OF THE TEACHING AIDS

Before the presentation of the technical slide-tape unit, students will view a series of 10-20 selected slides from the unit. They are given a list of terms related to the concepts of motion in still photography. The students are asked to match the terms to the slides that the terms best describe. All students are expected to have some prior knowledge of part of the list.

Following the pre-test, the students view the technical slides with tape narration. They are encouraged to ask questions to review the material.

(SAMPLE TEST)

You are about to see a short series of slides showing motion in still photography. The following list of terms describes some of the features seen in the slides. Try to match the terms to the number of each slide as you view it. Some slides may have several descriptive terms. If you think that more than one term matches the slide, make several marks for that slide. Some terms may be used more than once.

MOTION TERMS:                      SLIDES:
A. blurred action                  1. ____________________________
B. stopped action                  2. ____________________________
C. panning                        3. ____________________________
D. distant movement                4. ____________________________
E. close movement                  5. ____________________________
F. action directly away from       6. ____________________________
   the camera                      7. ____________________________
G. action directly toward the camera 8. ____________________________
H. oblique movement                9. ____________________________
I. right angle movement            10. ____________________________
J. camera movement                 11. ____________________________
K. peak action                     12. ____________________________
L. fast shutter speed              13. ____________________________
M. slow shutter speed              14. ____________________________
N. zoom lens                       15. ____________________________
                                 16. ____________________________
                                 17. ____________________________
                                 18. ____________________________
APPENDIX B

POST-TESTS OF THE TEACHING AIDS

Evaluation of student understanding of motion concepts:

The initial evaluation will be based on the students' ability to identify and match written terms and concepts with sample slides similar to those in the program. The format of the pre-test may again be used if individual testing is preferred. An oral quiz to match terms to slide images may also be used.

Additionally, the students will be assigned to select at least one of the major concepts of photography of motion and to illustrate it with their own photographs. The visual material will be evaluated in regard to the students' application of the concepts. Several weeks time should be allowed for the students to do their camera work, process film, and to make the final photographic images. During a critique of their photographs, the students should discuss which camera controls were used to complete the assignment. Student and teacher questionnaires should be completed to help evaluate the slide-tape program.
STUDENT QUESTIONNAIRE
(to be completed after the completion of the camera assignment)

The photography teacher should try to promote verbal responses in classroom discussions to rate the effectiveness of the teaching aids and the camera assignment. If discussions produce few comments, a written survey of these questions may be used.

1. How much did you know about photography of motion prior to the program? much ____ some ____ little ____ none ____

2. What effect was the most difficult to achieve?

3. What was your most successful result?

4. What specific new skills did you learn from the program?

5. Did you like certain parts of the slide show? Which parts? Why?

6. Did you dislike certain parts of the slide show? Which parts? Why?

7. What changes in the slide show would you like? Why?

8. Did you like certain parts of the camera assignment? Which parts? Why?

9. Did you dislike certain parts of the camera assignment? Which parts? Why?

10. How do you think the camera assignment may be improved?

(The photography teacher may attach any other spontaneous student comments or suggestions about the program and the assignment.)
TEACHER QUESTIONNAIRE
(to be completed after completion of the camera assignment)

1. Did the students have ______ of the motion concepts?
   (a) much previous knowledge
   (b) some previous knowledge
   (c) little previous knowledge

2. Student response to the images in the slides:
   (a) enthusiastic approval
   (b) acceptance
   (c) indifference
   (d) negative response

3. Give similar ratings to the verbal concepts in the tape.

4. What was the most successful effect of motion achieved?

5. What was the hardest effect to achieve?

6. How many enjoyed the assignment? For what reasons?

7. How many disliked the assignment? For what reasons?

8. Were the visual results better than those achieved in previous assignments?

9. Did the program provide advantages or disadvantages over previous assignments?

10. Teacher's comments and suggested improvements . . . .

11. Were students' skills, knowledge, interest levels noticeably improved by the program? Describe briefly . . .

12. May copies of your best student work be included in future revisions of the program?
APPENDIX C

OUTLINE OF THE TECHNICAL UNIT

Techniques to Control Motion in Still Photography

The speed of moving subjects is relative. Other factors, as well as speed, must be considered. Pictures of motion may be captured with a nonadjustable camera.

Subject blur: If a photographic subject moves during the exposure of film, its image is recorded as a path of movement.

Basic controls of movement:

I. DIRECTION. Speed of the subject is related to the direction of movement.
   A. Motion at right angles to the camera view gives the greatest illusion of movement.
   B. Motion toward or away from the camera yields the least apparent movement.
   C. Oblique paths of motion produce moderate illusions of movement.

II. DISTANCE. Distance from subject to camera also determines the amount of movement in the photograph.
   A. Distant subjects appear to have the least movement.
   B. Close subjects have the most apparent movement.
   C. Telephoto lenses produce the same appearance as a close subject.
III. PEAK ACTION. Some types of action have a slight hesitation or change of direction when they appear to cease moving. If the photographer anticipates this pause, he may make the exposure at the time of least movement.

IV. PANNING or CAMERA MOVEMENT.
A. If the moving subject is kept centered in the viewfinder during the exposure, the moving subject may be stopped.
B. Again the movement is relative to the camera movement. The camera sees the subject as a still object. The background is moving relative to the camera and appears as a moving blur.

Additional concepts involve adjustable cameras and/or special equipment.

V. SHUTTER SPEED.
A. Fast shutter speeds produce little or no blur. They freeze or stop action.
B. Moderate shutter speeds produce some blur.
C. Slow shutter speeds produce much blur in images of moving subjects.
D. Time exposures record the image as paths of movement.

VI. ELECTRONIC FLASH. Brief duration of the flash (usually about 1/1000 second) determines the length of the exposure. The resulting stopped action is similar to effects produced by fast shutter speeds.
VII. REPEATING STROBE LAMPS. The light source during the exposure flashes several times a second. The subject is recorded as a series of multiple images.

VIII. ZOOM LENS. During a relatively long exposure, the focal length of the lens is changed. This introduces a change of size of the subject. As the subject shrinks or grows, it appears to be moving.
Techniques to Control Motion in Still Photography

Slide 6

Introduction

1. Subject movement.
2. Blurred images:

1. THREE KIDS

From the beginnings of photography in 1839 to the present, a major problem for the photographer has been his ability to record the image of movement in photographic subjects. As subjects moved during exposures, the resulting blur often destroyed the image.

The central figure seen here has nearly disappeared as it moved during the exposure. This is normal for long exposures. Years ago all moving subjects usually resulted in blurred images.

Fortunately technical developments have allowed shorter exposure times and consequently less blur of the subject. Cameras have been improved and modern photographic films permit the photographer to record or
capture movement even with simple nonadjustable cameras. Let us consider how to photograph movement with a nonadjustable camera. Several aspects of motion must be considered as well as the speed of the subject.

(Four basic concepts to aid all cameras)

The four aspects of motion we will explore are DIRECTION OF MOVEMENT . . .

the DISTANCE OF MOVING OBJECTS FROM THE CAMERA . . . PEAK ACTION . . . and CAMERA MOVEMENT.

2. TRAFFIC

The first of these important concepts is DIRECTION. Here we see an example of movement at right angles to the camera's view. As the cars move rapidly through the viewer's field of vision, they tend to blur into continuous paths of movement. This direction of movement produces the greatest illusion of motion.

3. TRACK

In another example of right angle movement the runners cross the field of vision rapidly and their movement is difficult to capture.

4. RACE CARS

Looking at these racing cars, we see the right angle direction of movement emphasizes and may even exaggerate the speed of the subject.
5. **LONG JUMP**

Here's another direction of movement. As the jumper approaches the camera directly, the relative movement is reduced. Motion toward or away from the camera yields the least apparent movement.

6. **MOTORCYCLE**

The motorcycle also approaches the camera in a direct manner. Since the subject neither enters nor leaves the view of the camera, the movement is minimal.

7. **SLIDE**

Here the subject is going away from the camera. The boy going off the slide shows minimum movement.

8. **SURF**

Here in the surfing photograph, the direction of movement de-emphasizes the speed and movement of the subject. The relative movement is reduced since the figure remains in nearly the same area throughout the exposure. The subject may seem almost motionless.

If movement toward or away from the camera appears too static or still . . .

9. **MOTORCYCLE**

and movement at right angles makes the subject seem to move too rapidly such as this motorcycle . . .
10. **DIAGONAL MOTORCYCLE**
   The photographer might choose to use subjects moving at an oblique angle. The jumping motorcycle is an example of oblique movement.

11. **BICYCLES**
   The racing bicycles also show oblique or diagonal movement.

12. **SKATEBOARD**
   Here again the skateboard rider shows oblique movement. It is dynamic, much more than movement toward or away from the camera, yet the direction of movement allows the photographer to capture the action much easier than movement at right angles to the camera. Be certain to observe the various directions of moving subjects as you attempt to photograph motion.

13. **SCENE**
   As important as direction is the concept of DISTANCE. The distance from the subject to the camera will determine the amount of movement seen in the photograph. Here movement of foreground objects on the right edge is caused by wind. Objects on the left edge are more distant and appear to move very little. Finally, the most distant objects appear to have no movement at all.
14. JET PLANE
If the moving subject is far enough away, little or no movement is apparent. The rapidly moving jet plane was easily captured on film since it remained so far away from the camera.

15. CROP DUSTER
A subject as close as this plane however, crosses the view so rapidly that the movement is great and may be difficult to capture.

16. RACE CAR
Telephoto lenses produce the same effect as a short subject to camera distance. Here the photographer remained very close to the race car as it passed. The motion is severe.

17. RACE CAR
Here the race car appears very close to the viewer. The use of a telephoto lens permitted the action to be brought visually very close to the viewer even though the actual distance may be great. Since the telephoto lens brings the subject visually closer to the viewer, the movement will be greater than normal distant views. Contrast the severe movement of the race cars to these motorcycles.

18. MOTORCYCLE RACE
Here the motorcycles remain relatively distant from the camera, resulting in only moderate movement. Remember the greater the distance,
the easier it will be to capture moving subjects. Moving subjects very close to your camera will appear very dynamic yet will be difficult to capture on film.

19. JUMPING GIRL

A third concept that will allow you to control movement is called PEAK ACTION. This jumping girl illustrates some types of action which have a slight hesitation when they appear to move very little.

20. JUMPING BOY

Here again the jumping boy shows this peak action. During this brief pause, the photographer has the opportunity to stop the action.

21. JUMP ROPE

Here the photographer captured the rope jumpers at the height of their jump. If the photographer anticipates the peak of action, he may make the exposure at the time of least movement. You must allow for your reaction time and the movement of the shutter.

22. SOCCER

If the photographer waits until he sees the action he may often be too late to capture the action. If the photographer waited a moment later, he would have lost the lively action of these soccer players as they practice.
23. KIDS IN HALL  
Try to stop jumping subjects at the greatest height or the peak of their movement. Not every attempt will be successful but your success will improve as you learn to anticipate the action.

24. DRAG  
A fourth way to control action with your simple camera is to use CAMERA MOVEMENT. This camera movement which follows the subject is called PANNING. Study the background here and you will see streaks or blur. The streaks in the background are caused by camera movement.

25. MOTORCYCLE DRAG  
Panning was again used in the picture of the motorcycle dragster. Again you can recognize the use of camera movement by the blur of the background. If the subject is kept centered in the viewfinder during the exposure, the moving subject may be stopped.

26. COASTER  
The kids on the coaster are recorded with little movement while their dog, moving at a different rate, blurs as well as the background. Again the movement is relative to the camera movement.
27. DRAG

Study this panned photograph of the roadster. The camera sees the subject as a still object. The background is moving relative to the camera and appears as a moving blur.

28. JUMPING HORSE

If the path of the subject is complex, the camera will not be able to stop all the directions of the movement. This combined vertical and horizontal movement of the jumping horse retains some blur.

29. MOTORCYCLE

Here the bouncing front end of the motorcycle also shows complex movement. The horizontal pan follows the forward motion but blurs the vertical motion as well as the background.

30. SKIER

To stop the skier the photographer continued to follow the movement during the exposure. During panning you must not stop the camera. Avoid the tendency to stop the camera movement at the instant of the shutter release.

31. BOAT

Remember: panning is just one of four basic techniques to control motion. Try to use all four controls to aid the use of your simple camera. All four, DISTANCE, DIRECTION, PEAK ACTION, and CAMERA MOVEMENT, may help to control and capture moving subjects in your
photographs even if your camera has no variable controls.

(Additional controls, for adjustable cameras.)

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<td><strong>32. WALKERS</strong></td>
<td>If you have an adjustable camera you have an additional control. The length of exposure may be controlled by the shutter speed. Here variations of movement by the walking figures are emphasized with a long exposure.</td>
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<td><strong>33. FROZEN MOTORCYCLE</strong></td>
<td>Fast shutter speeds produce little or no blur. This motorcycle was stopped during an exposure of 1/1000 of a second. Such extremely brief exposures can freeze the action and make the subject appear to be still.</td>
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<td><strong>34. PITCH</strong></td>
<td>Fast shutter speeds freeze or stop action. Here again a brief exposure of 1/1000 of a second was able to freeze the movement of the pitched baseball.</td>
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<td><strong>35. DRAG</strong></td>
<td>Fast shutter speeds such as 1/500 and 1/1000 of a second may halt spinning wheels. Even though the wheels are spinning rapidly, the camera sees little or no movement during the brief exposure.</td>
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36. DUNE BUGGY
The fast shutter speeds may stop the action completely. This car was caught in the air.

37. FALLING BOY
No, he's not balancing on a tight wire. He's falling. Again the movement was stopped by a very fast shutter speed and the boy seems to float in midair. Falling objects seem to remain stationary if shutter speeds are very brief.

38. MOTORCYCLE
Moderate shutter speeds such as 1/125 of a second or slower will produce some blur as in the splash of mud in this motorcycle picture.

39. MOTORCYCLE
The moderate speeds may arrest some movement but may still show blur in spinning wheels. Notice how the spokes disappear when the exposure is 1/125 of a second or longer.

40. SURF
Slow shutter speeds often produce much blur in images of moving objects. The movement of the surf is blurred while the surrounding still subjects remain in sharp focus. This feature occurs when exposures exceed 1/30 of a second.

41. TIGER
Motion will be recorded as a path of movement if the exposure times are long. The tiger and background blurred as the photographer panned during a 1/15 of a second exposure.
If the exposure times become quite lengthy, images of moving water will blend into flowing forms. A long exposure can produce a photographic image you would not usually see with the unaided eye.

Let's compare the use of different shutter speeds. Note the difference in the next two slides.

Compare this snowball caught by a fast shutter speed . . .

to the blurred spray of water that was recorded by a more moderate exposure.

The following two slides illustrate the same subject recorded by two different shutter speeds.

In the first slide notice the baseball runner whose image was nearly dissolved during a long exposure and compare it . . .

to the second runner who was caught in midair by a fast shutter speed. You may have many choices of shutter speeds. Try the various speeds and decide which produces the type of images you prefer.
47. DRAG  Try various fast speeds to stop action as in this picture of the car caught with its front wheels off the ground ... 

48. WRESTLERS  or freeze action completely. The wrestlers are recorded completely still.

49. WATER  Try slow speeds to emphasize the flow of moving water in waterfalls.

50. WATER  Long exposures may require the use of a tripod to prevent camera movement. Had the camera moved during this long exposure, all of the picture would have blurred. Actually only the moving water blurred.

51. WATERFALL  If the camera remains still during the exposure, only the flowing water will blur. The exposure was long enough to allow the waterfall to be recorded as a continuous path of motion.

52. BOATS  Here the camera was allowed to move on a rocking boat as the subjects moved during an exposure of 1/15 of a second. The combined paths of movement became quite complex.
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<td><strong>53. SKATER</strong></td>
<td>Here again camera movement was combined with subject movement. Subject movement that coincided with camera movement remained still. Subjects not coinciding with the camera movement blurred during the long exposure.</td>
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<td><strong>54. FLOWING WATER</strong></td>
<td>Consider the nature of your subject and choose shutter speeds to emphasize the traits you prefer. You may like the soft forms caused by moving water during long exposures.</td>
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<td><strong>55. ROCK AND WATER</strong></td>
<td>Here the flowing water changed the position of the grass while the shutter remained open. You may want blur rather than stopped action. Movement need not be frozen to be effective.</td>
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<td><strong>56. RIDER</strong></td>
<td>You may be accustomed to seeing stopped action yet this blurred horse and rider help describe movement quite well. The blur produced by slow shutter speeds may aid you to express new images about movement.</td>
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<td><strong>57. FIREWORKS</strong></td>
<td>Long exposures of one second or more permit images that show extended movement. Look at the trails of light caused by the fireworks.</td>
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<td><strong>58. LAVA</strong></td>
<td>Here the glowing lava flow was recorded during an exposure of several seconds:</td>
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59. SKI SLOPE

This time exposure shows the continuous path of skiers as they carried flares down the slope at night. So much light was collected by the camera during the five minute exposure that the night scene appears to be taken in daylight.

60. LIGHT

You may also record other paths of movement by using your own sources of moving lights. This path of light was caused by one single small light as it was moved during a several second exposure.

61. PENDULUM

A flashlight in a darkened room can trace irregular patterns such as the previous photograph or regular patterns as these created by a hanging light on a swinging pendulum.

62. MULTIPLE LIGHT

Again you may want to combine camera movement with subject movement during the exposure. The method here is similar to the other time exposures except the camera was moved in irregular patterns during the exposure.

63. WALKERS

The various shutter speeds can produce many different types of images. Be adventurous and you may record all sorts of new images. Don't neglect the slow speeds. They can produce...
unusual pictures such as these blurred walkers.
Notice the sandal that remained clear during the exposure.

(Special equipment used to record movement.)

64. HAMMER

Special equipment is often used to stop action. Here electronic flash was used to freeze rapid movement. When the action is very rapid the camera may have difficulties stopping the action.

65. BASKETBALL

The basketball picture also used electronic flash. Action may be frozen even though the shutter may remain open for a relatively long exposure. The brief duration of the flash, usually about 1/1000 of a second, determines the length of the exposure.

66. BASKETBALL

Only the action seen during the very brief flash is recorded on the film. The resulting stopped action is similar to effects produced by the very fast shutter speeds.

67. BIRDS

Here electronic flash has been used to stop the movement of these birds' wings. The duration of the flash was about 1/10,000 of a second or a time much shorter than is possible with camera shutter speeds alone.
Here's another form of action stopped with electronic light sources. While the previous images were recorded by a single flash, the tennis player was recorded by a strobe light with repetitious flashes. The light source flashes several times a second while the camera shutter remains open.

The multiple images of a single bouncing golf ball were also produced by a repeating strobe light.

A final aspect of movement to be considered is shown here. This blurred football picture has been produced with a zoom lens. The strange paths of movement are produced by an unusual use of the lens.

Similar but less extreme paths of movement are seen in this crowd. Again the movement is produced by a zoom lens. This requires a relatively long exposure. The focal length of the lens is changed during the exposure which produces a change of size of the subject.

As the subject shrinks or grows, it appears to be moving. The use of a zoom lens can introduce new paths of movement in the subject that
would not ordinarily be seen in pictures taken with normal lenses.

Even though these last samples were produced by special equipment and others by adjustable cameras, remember that motion may be controlled and captured with simple cameras. Using the concepts described, now try to produce some of your own pictures of movement.
APPENDIX E

NARRATION OF THE HISTORICAL UNIT

History of Motion in Still Photography

Slide #

1. PARIS

Many changes in photographic images have occurred during the brief history of photography.

One of the earliest photographs is this street scene in Paris produced by Daguerre in 1839. The photograph is typical for its time. The lack of daytime traffic in the picture shows the inability to capture movement on the photographic plates.

The only pedestrian recorded was a man having his boots polished, which caused him to remain in the same place for most of the exposure. By 1841 the process had been accelerated and shorter exposures allowed distant moving carriages and pedestrians to be seen in daguerreotypes.

2. NIAGARA FALLS

In 1851 the wet collodion process was invented by Frederick Scott Archer. The wet collodion process was the fastest process until dry
gelatin plates thirty years later. While Daguerre initially used exposures of 15 to 30 minutes, the new process used exposures of 30 seconds to 2 minutes. This outdoor scene of Niagara Falls recorded the still subjects but was unable to stop the movement of the horse's head or the distant water. The photographer's ability to record movement had increased but still had limitations.

3. WINDMILLS The photograph of the windmills also shows the limits of early photography. Even though the blades of the windmills were distant, their movement was too extreme for the photographer to capture.

Photographers had considerable trouble with wind and moving water in their pictures. By the late 1850's, some photographers were quite proud to be able to record waves and cloud patterns in their seascape pictures.

4. MARKETS Busy street scenes remained a challenge for years. Photographers often recorded no more than ghost images of moving traffic and pedestrians. Only a hint of the actual number of walking figures remains in this market scene.
The only chance the photographer had to capture movement was to remain distant from his moving subjects. The photographer often used high vantage points with traffic coming toward the camera and not at an angle to it.

Indoor portraits were a challenge to both the photographer and his subjects. Subjects were required to remain very still, sometimes for minutes!

Their discomfort is seldom hidden. The photographic poses were rigid and any semblance to the live subjects was often accidental.

Early portraiture seldom permitted any feelings or personality to be shown. This girl demonstrates that spontaneity was impossible. She had to remain motionless and shows little similarity to modern images of carefree children. Technology did not permit candid portraiture for many years.

Family or group portraits were even more difficult. Youngsters often could not remain still for the required exposure.
This mother had to hold her youngest child still, yet his head did not remain still long enough for the photographer's exposure.

9. FAMILY

This outdoor scene may have required shorter exposures than the previous photograph, yet the movement of the young children is still too severe to capture. Not until the invention of the gelatin emulsion in 1878 was it practical to use exposure times less than one second.

10. VIOLIN

The portrait of the boy with the violin shows the rigidity of poses which continued until the turn of the century. Visible behind his chair is the base of a head clamp which many photographers used to prevent subject movement.

11. HORSE

By the 1870's several photographers had begun scientific studies of subject movement. In 1872 Eadweard Muybridge made the first lateral photograph of a trotting horse.

12. CART

Numerous photographic studies were completed in following years by Muybridge. In this scene of four pictures it can be seen that the increasing speed of the horse...
13. CART

... made photography more difficult. Nevertheless Muybridge did successfully stop action in many of his studies.

14. WALKERS

While Muybridge used as many as 24 separate cameras to record the sequence of movement, the French photographer, Marey, produced multiple images of his subjects on a single photographic plate.

Here are three of his studies. In the bottom picture the model wore black, with white stripes down one leg and one arm.

15. MAREY

This group of pictures shows Marey's arrangement for motion studies. The camera, which looked much like a gun, was placed at the center of a circular track. The resulting images of movement on a circular plate could be projected. By 1882 both Marey and Muybridge had made motion picture cameras and projectors.

Today we still use the same principle. Persistence of vision blends the separate images into one continuous flow of movement.
A third scholar of motion studies was the painter Thomas Eakins. He used many of Marey's techniques and worked with Muybridge in Pennsylvania during the 1880's. His photographic models provided the gestures and action to be seen in later paintings.

Both Muybridge and Eakins continued to make motion studies with animals. A University of Pennsylvania grant enabled them to photograph and publish their data on animal locomotion.

Muybridge refined his techniques and showed his motion studies throughout the United States.

By 1888 the first photo finish in a horse race was successful upon Muybridge's suggestion.

By the turn of the century still photography had achieved great advances. While cinematography seems to be a major result of high speed photography, a strong interest in still images has continued to the present.

The still camera has made the previously invisible objects visible to many viewers.

Electric discharges such as this ...
20. LIGHTNING  ... or this lightning flash may seem commonplace to present day viewers. But we know such images only through photography. Our eyes cannot capture motion as easily as the camera.

21. SPLASH  Efforts in high speed photography were increased in the twentieth century. The invention of electronic flash in 1925 aided many photographers to reduce exposure times.

Dr. Harold Edgerton of M.I.T. has successfully documented the splash of a drop of milk with electronic flash.

22. MILK  These studies of falling objects were started by Edgerton in the 1930's and continue to the present. The exposures have been reduced to microseconds.

23. BULLET  Falling objects and splashes are now commonplace in Edgerton's studies. The technology has progressed to allow Edgerton to record still images of flying bullets.

24. CURRENTS  Other laboratory studies have produced images of convection currents. Again extremely brief exposures are possible with electronic flash.
The camera is no longer limited by exposure times. We can now record all sorts of images such as this sonic wave produced by a bullet. This photograph, produced by Schardin in 1952, is an actual photo of the movement. Earlier photographs recorded by Dr. Mach in the 1880's showed only shadows of the projectiles and sonic waves.

Scientific studies and advanced technology have permitted the still camera to stop or record any movement. Exposures are now unlimited. The still camera can either compress or extend time sequence.

This tennis picture indicates that a camera with a repeating strobe light easily surpasses the early motion studies of Eakins, Muybridge and Marey.

Equally important as the ability to record extremely short intervals of time is the ability to produce images of extended time spans.

Here the photographer was able to trace the pattern of a helicopter's rotors at night.
28. PENDULUM
A similar image is seen here as the camera recorded a continuously changing arc of a lighted pendulum.

29. DOTTED LINE
Using this same pendulum technique, artists and photographers have modified and refined time exposures until they can produce images such as this.

   The principle is the same. The addition of colored light and the interruption of the light source by a repeating shutter yields a colored dotted line.

30. OSCILLATIONS
Scientific technology has offered new images for the artist and photographer. Oscillations previously known only to scientific equipment are now produced by the artist and photographer with modern cameras.

31. STAR TRAILS
Another example of the extension of time by the camera is these star trails.

   While the viewer normally sees individual points of light, an extended time exposure yields these paths.
32. MT. WILSON  Yet if star trails are not desirable, still images of stars are possible. This photograph taken at Mt. Wilson in 1920 used synchronized clock mechanisms to permit the camera to move precisely with the stars.

Once daylight photography of motion had serious limitations. Yet night photography of motion is now entirely possible. The camera has become more than just a device to make pictures. It is also a "time machine." It can make invisible objects visible and can create whole new time systems for the viewer.

33. GENERAL GRANT

The images of motion also changed in photojournalism. Until the 1890's, graphic arts processes did not permit the printing of photographs in newspapers. Some of the earliest photographs used for documents of events are those of our civil war. During the 1860's, thousands of wartime photographs were produced. This O'Sullivan photograph shows General Grant in conference with his officers. Notice the blur of the surrounding troops and horses.
Exposure times were still too lengthy and equipment was too awkward and slow to allow action coverage. This inspection of troops photograph shows considerable detail in the distance but moving foreground figures disappear during the exposure.

Twentieth century materials and equipment changed the appearance of photojournalism considerably. Photographs no longer documented just the results of events. Photographs actually showed events as they occurred. The Hindenburg crash in 1937 was not anticipated, but was captured on film by numerous photographers.

Robert Capa was on the scene to photograph the Normandy invasion in 1944. Miniature cameras and fast films allowed war correspondents to capture many images of war.

From World War II to the present, we have been shown hundreds of wartime photographs. Technology has not been the limiting factor for the wartime photojournalist.
38. LARTIGUE

Most of the material considered so far has dealt with photography of motion related to commercial photography, science, historical documents and photojournalism.

Two other important areas must be considered in the twentieth century. These recent developments concern the amateur photographer and the artist as photographer.

As photography became more widespread and practical, nearly every family made their own attempts with cameras. A young French boy, Jacques Henri Lartigue, recorded his family and friends as they played with gliders and race cars.

39. RACE CAR

Lartigue's excellence in photography resulted from a combination of good timing, alert eyes, and very refined equipment.

40. GLIDER

Many of Lartigue's photographs showed action. His amateur photographs remain today as exciting documents of early attempts to fly.

41. CAR

Surprisingly, Lartigue abandoned photography when he was 21 to become a painter. Who knows what would have occurred had he continued with photography.
42. BICYCLE  Another Frenchman, Henri Cartier-Bresson, became an artist with the camera. In recent times he has given us many photographs depicting what he calls the decisive moment.

43. WALKER  People flow in and out of his photographs. Cartier-Bresson's challenge was to capture movement at the most exciting time.

44. PICASSO  Artists have frequently been included in photographs. Two which reveal much about the artist are shown here. The first shows Picasso as he paints with light. It is a dynamic picture. It captures the artist in his process of drawing yet shows the linear results as well.

45. DALI  The other action photograph of an artist shows Dali in his surreal surroundings. The active setting, staged by Philippe Halsman, was recorded with electronic flash.

46. BOY  Early photographers were concerned with literal communication. Many modern photographers are now using camera techniques as an expressive tool. Ralph Eugene Meatyard often intentionally blurs his subjects for a ghost-like effect.
| 47. SERIES | Duane Michaels produces narrative sequences. One of his series shown here in these two slides . . . |
| 48. SERIES | shows strange changes and transitions in his subjects. |
| 49. HEADLESS | Early twentieth century photography reflected the limitations of technology. Today the artist-photographer feels few boundaries or limits. He often discards the rules and principles to produce unusual photos such as this time exposure. |
| 50. KINETIC ART | Very recent developments have shown an interest in kinetic and optical effects. Much like modern painters and sculptors the modern artist-photographer frequently produces abstract images. Composition is often more important than subject matter. Here basic elements of colored light and motion yield dynamic patterns. |
| 51. KINETIC ART | This interest in materials and energy is not rare in our technological times. It is exciting to see the moving forms combined to produce new visual art. |
52. **OPTICAL**
Light shows in the 1960's have provided considerable interest in visual art that changes. Still photography, while not able to show a continuous flow of changing lights, is capable of capturing separate fleeting images.

In turn these photographs can be used for continued visual experiences.

53. **SPLASH**
New refinements in lenses and lighting allow the photographer to capture the behavior of changing materials. Here the splash of paint takes on a new character as it is frozen by film.

54. **DYES**
These flowing dyes are in the process of constant change. The camera as an artist's tool can preserve the many subtle changes. Motor drive cameras, shooting several frames a second, can record a rapid succession of images.

55. **LASER**
Even the laser has found its way into camera art. Who knows how extensive its applications will become.

56. **HORSES**
Phillip Leonian has taken camera technology to great advantage in his motion studies. Special shutters produce a strange flicker of action in
his still photographs. Multiple legs of the horses recall images of the Italian Futurist painters. But Leonian does not stop here. He has many kinds of images of motion.

57. DANCER

Another special camera permits Leonian to combine camera movement, subject movement and movement of the film. During long exposures, new unexposed film passes the shutter.

58. FACE

This special film transport system was initially used for panoramic scenes or aerial photography. It's possibilities are endless when combined with moving subjects.

59. TRICOLOR

Another recent camera technique uses subject movement to produce a rainbow of colors. Three separate exposures are taken of the same subject using a succession of filters before the lens.

The total of the three exposures will mix the three primary colors to natural coloration. This occurs only if the subject does not move. Any portions that move during the exposure produce unnatural mixtures.
A close up picture also demonstrates this technique. Notice how the still rocks retain their natural coloring. The moving water caused uneven filtration and produced new colors.

Another artist photographer, Gary Ruble, produces what he calls "power flicks."

Ruble's photographs record motion during extensive night time exposures of several hours. The scenes are large and the movement is complex.

Compared to the earliest photographs it may appear as though we have gone a full circle. Initially Daguerre's exposure times were very long and moving figures disappeared in the final image. Ruble's "power flicks" also show these traits. Daguerre's images were restricted by technology, Ruble and other modern photographers have no such limitations. Today's photographers are free. They can produce the image of motion they want.