THE VERSATILITY OF THE OVERHEAD PROJECTOR IN CLASSROOM TEACHING

by

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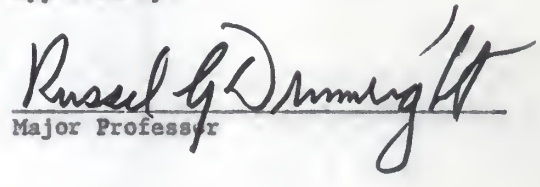

Major Professor

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IMPORTANCE OF THE PROBLEM

Due to the increased population of our country and the ever-increasing emphasis on education in recent years, educators have become aware and concerned about the fact that newer and more effective teaching methods are constantly needed in order to train the youth of today to be effective members of our society.

Learning begins with the stimulation of the senses. When more than one sense is involved, the likelihood that learning will take place is increased. Words, either written or spoken, are often inadequate to convey the precise meaning intended. Since understanding is rarely for long in the mind of the student, instructors are better able to reach them by the use of audio-visuals.

The results of numerous studies indicate that from 73 per cent to 85 per cent of everything we know was learned through the eyes, while only 7 per cent to 13 per cent was learned by way of the ear. If a person is willing to accept these findings as reasonably accurate, then it becomes immediately apparent that the visual medium is most important to an effective and informative presentation. When properly used, audio-visuals enable the students to understand better and learn more - up to 35 per cent more in a given time with a 55 per cent longer retention period.[1]

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[1]The Overhead Projector, Audio Visual Aids in Training, Part I. (Chicago: Office of the Army Signal Officer, Headquarters Fifth United States Army, 1962), p. 2.

One of the country's major oil companies[2] lists the factors behind how we learn as:

Through Taste . . . . . 1 per cent

Through Touch . . . . . 1½ per cent

Through Smell . . . . . 3½ per cent

Through Hearing . . . . . 11 per cent

Through Sight . . . . . 83 per cent

This same company also stated that the learner's ability to retain the information studied could be analysed as follows:

What they read . . . . . 10 per cent

What they hear . . . . . 20 per cent

What they see . . . . . 30 per cent

What they see and hear . . . . . 50 per cent

What they say as they talk . . . . . 70 per cent

What they say as they do a thing . . . . . 90 per cent

Within this same study, the percentages of recall with various types of instruction were given as:

Method of Instruction	Recall Three Hours Later	Recall Three Days Later
Telling when used alone	70 per cent	10 per cent
Showing when used alone	72 per cent	20 per cent
When a blend of telling and showing is used	85 per cent	65 per cent

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[2]Socony - Vacuum Oil Company Studies

One such development in recent years is the increased use of audio-visual aids in classroom teaching; and of these aids, perhaps the most versatile is the overhead projector.

A great deal of research has been done by both civilian and military agencies to determine the value of the overhead projector as a teaching aid and to develop projectuals to accompany many different courses, but little has been published on how to use this device in particular situations and areas. This is due to the idea that since the overhead projector is extremely versatile, it can best be used by letting the individual teacher use his own initiative and ingenuity in designing and using materials in such a way that will best satisfy his own particular needs.

The one thing that has been learned from previous research is that the overhead projector is merely an aid to the teaching process and that it cannot be used effectively as a replacement for the teacher or the text.

Even though there are some disadvantages in using any teaching aid, it will be found by anyone using the overhead projector that its advantages far outweigh its disadvantages, especially when it is compared with other projection devices.

STATEMENT OF THE PROBLEM

It was the purpose of this study to collect and compile information and data concerning the versatility of the overhead projector from sources not readily accessible to the classroom teacher.

PROCEDURE OF RESEARCH

The method of investigation for this study consisted of the reading of related materials found in books and journals in the Kansas State University library. In addition, many companies supplied literature and brochures upon request which were analysed for usable content.

Personal or direct observation of mathematics classes in the Manhattan High School over a three year period was also used.

EQUIPMENT NEEDED

Depending on how extensively the overhead projector is to be used, the amount and types of equipment as well as the cost will vary greatly. All that is really necessary is a projector and some sort of projection surface, several sheets of clear acetate plastic, and either grease pencils or felt tip markers.

Equipment may vary widely. As an example, over a dozen companies have been found, each of which manufactures several models of projectors from 250 to 1000 watts as well as the accessory equipment. This equipment consists of such items as the various transparency films, prepared transparencies in different fields, pointers, film strip adapters, tachistoscopes, and polarizing lens attachments. In addition, some companies recently have begun manufacturing self-contained rear projection units and light tables to aid in the make up of transparencies.

Because of the wide selection of equipment available, the cost of equipping a classroom can be as little as $100.00 or well over

$1000.00, depending on individual needs and availability of funds. This may seem like a rather large investment, especially for the small school system, but considering the number of years that an item of this nature will be used along with the fact that there are a number of items that the individual teacher can make for himself, the cost is relatively low. In addition, state and federal funds are now available to help in equipping classrooms.

HOMEMADE ACCESSORIES

As was mentioned before, there are a number of things that the individual teacher can make for himself which help to keep the costs to a minimum. Some of these items are: a light table, pointer, adapters for using film strips and slides, transparencies and mounts, and with a little ingenuity, a polarizing lens arrangement to give the illusion of motion within the projectual.

ADVANTAGES

In working with the overhead projector and the various types of transparencies and overlays in mathematics classes, a number of significant advantages have been discovered over other types of visual aids, and especially over other types of projection devices.

First of all, the projector is in front of the group enabling the speaker to maintain direct eye contact with the group at all times. Such a position is a considerable help in maintaining student interest

and when classroom discipline is a problem. An additional advantage is that the teacher may use a more normal tone of voice in his presentations.

There is no need to darken the room during a presentation. With the use of the more modern high-intensity bulbs, merely shading the projection surface is sufficient, thereby allowing the students to take notes at the same time the material is presented. This aspect also reduces the time necessary in setting up a classroom before a presentation as well as reducing the likelihood of student inattention and drowsiness. In addition, both audience and presenter are fully visible at all times and there is no real reason that the picture must be kept on the screen at all times.

The students see what is written as it is written and everyone sees the same thing, thereby eliminating the delay caused by the instructor having to face the chalkboard to write something and blocking it from view until it is completed. This delay is unnecessary and is often a cause of class disturbance when students become restless and begin talking. The projected image will tend to hold the attention of the class better. The interest of the class is on the work and not on the teacher personally.

Where space is a problem or where chalkboard space is limited, the overhead projector can be used as a replacement for the chalkboard or as an extensfon on the existing board space.

Use of this device can result in a considerable saving of class time. For instance, if there is a test to be handed back that several different classes have taken, it is much simpler and faster to put the answers on a transparency thereby saving the existing chalkboard space for further explanations.

The overhead projector can be used with any age group and with any type of subject matter. Remembering that this is only a visual aid, it is the instructor's presentation that will vary with the group and the aids can be made to suit the presentation.

The overhead projector is extremely simple to operate and maintain. Only one person is required to operate the machine and anyone who can hold a pencil can make a presentation by writing either on the glass top or on clear plastic sheets. The overhead projector tends to complement the presenter rather than replacing him and at all times, the presenter controls the projector, taking a prominent part in the presentation. Due to the simplicity of its controls, no special skills or training are necessary in order to make an effective presentation. Even the most rudimentary art skills can produce dramatic, effective transparencies. In addition, this device will operate indefinitely without overheating and damaging the transparencies and without offering any discomfort to the operator. With reasonable care being taken in everyday operation, the only maintenance required will be the occasional replacement of the lamp.

The overhead projector also lends itself well to programed instruction. First of all, it is an ideal tool for introducing students to any type of programed instruction. Since the instructor actually handles the programed text and uncovers or discloses the responses at a rate that he feels is satisfactory, the possibility of looking ahead at the desired responses or "cheating" is thereby eliminated. It is also an ideal tool for the individual teacher who wishes to develop his own programed units, for it can cut the working time almost in half. Finally, it is ideal for this type of presentation in that it allows the students to work at their own rates. But perhaps the overhead projector might serve its most important function by making programed instruction an integral part of classroom teaching, thus getting rid of the stereotyped idea that it is for individual use only.[3]

And above all, the overhead projector permits variations and originality in the instructor's presentations. One example of this is to intermix positive and negative transparencies so as to ease the eyes of the audience. Color, which is used primarily to clarify points made on the screen, can also be added to lend variety to the presentation. Using a pointer, especially when explaining graphs and tables, also adds variety. Another method that is often used to add

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[3]Dr. James I. Brown, "The Overhead Projector ... Prime Aid for Programed Instruction," Education Age, I, (September, 1964), 30.

variety as well as a method of keeping audience attention is to vary the length of time that the visuals are left on the screen.

The overhead projector is extremely flexible in its applications. It can be used to help present new material or it may be used to aid in a summary or review. It might be used in test giving or when the teacher returns tests and it might also be used to give individual help to a student or a group of students without disturbing the rest of the class. It might also be used by the students themselves in showing their work or in making suggestions. The horizontal stage allows the operator to write or draw extemporaneously and at the same time to use a pointer to call attention to details of the presentation. The operator can project a variety of transparent, translucent, or opaque solids, animated devices, and fluids, or he can use the overlay method of presentation with several layers of film, unmasking them in progressive disclosure or building them up to form a composite image.

Among the list of translucent objects that may be used in presentations are clear plastic rulers and protractors with black markings and the transparent slide rule.

Opaque objects, which project only as a silhouette, may also be used quite extensively in science and mathematics classes. A few examples are gears, magnets, and the abacus.

There is a wide variety of materials available to either the individual or to the school system. These include different machines, prepared masters, prepared transparencies, different types of films

to satisfy different needs, different mounts for use on different machines and in different situations, and hinges for the use with overlays. There are also devices available by which a person can add color to his presentations.

Transparencies up to 10 inches by 10 inches can be used, thereby greatly simplifying the preparation of the artwork for the transparencies and in most cases, photographic reduction of the original artwork is not necessary for the production of transparencies.

The transparencies themselves are light, long-lasting, easy to clean, and easy to store or transport for ready reference. Once a transparency is made, its form is permanent. Even though the plastic sheets may pick up static electricity in dry weather, they are by no means a hygroscopic material.

DISADVANTAGES

As with any other device, the overhead projector has advantages and disadvantages. First of all, prepared masters and prepared transparencies are extremely costly and they may not serve the exact purpose the instructor has in mind. At the time when this was written, prepared masters cost from $1.00 for a single set of 23 masters up to $140.00 for a set of over a hundred masters to cover an entire course. Prepared transparencies would cost from $1.50 for a single mounted transparency to over $600.00 for a set of eighty which would cover an entire course.

A person attempting to make his own set of transparencies for a particular course will find that the process is largely a matter of practice and experience, and that at its best, the drawing of the masters and mounting of the transparencies is extremely time consuming. The grease pencils and colored pencils are also very soft and are easily broken if not properly handled.

In addition, it is often hard if not impossible to achieve proper placement of the projector and the screen in the room so that everyone has an unobstructed view of the projection. This is especially true in older buildings where future needs were not considered in their design and construction. Figure 1 provides an illustration of a typical classroom showing how placement of the projector and the speaker can make a difference in how much the audience can see without interference. The drawing on the left shows a classroom where the audience has a clear view of the screen while the drawing on the right shows an audience which has a partially obscured view as indicated by the shaded positions. The dashed lines on each drawing indicate the lines of sight past the projector and speaker to each side of the screen.

Another way to overcome obscured vision is to leave the projector at the front of the room but either raise the screen or suspend it from the ceiling at an angle above the head of the projectionist. This is the ideal way to use the overhead projector, especially when the amount of space between the front row of seats and the front chalkboard is limited, but this in itself poses another problem. By using this

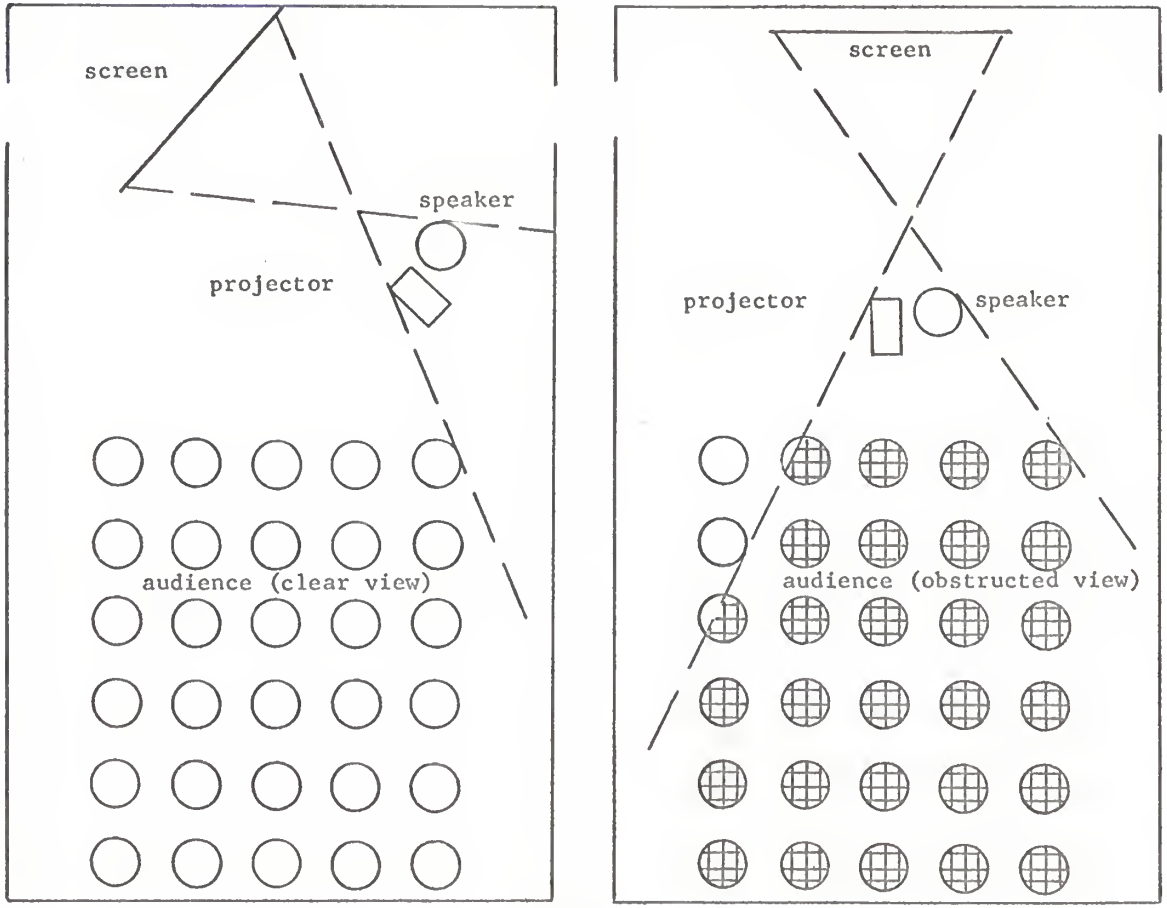

FIGURE 1

PROPER AND IMPROPER PLACEMENT OF THE PROJECTOR AND SCREEN WITHIN A CLASSROOM FOR OBTAINING AN UNOBSCURED VIEW

technique, the user will often achieve a distorted image on the screen. This distortion is the effect known as keystoning in an image and is caused by the line of projection not being perpendicular to the screen. The result is an image that is wider at the top than it is at the bottom. Figure 2 shows this difference between the normal and the keystoned image and Figure 3 illustrates the proper way to position the projector and the screen when it is in the elevated position so that the line of projection is perpendicular to the screen.

Another way to overcome the problem of limited space and obstructed view is to use a rear projection device as is illustrated in Figure 4. With this device, the image is first projected at an angle onto a mirror behind the screen. The light rays are then reflected forward onto the back side of a translucent screen at which time the image is viewed on the front side by the audience. Since the image is projected onto the back side of the screen and the light necessary to illuminate the screen must actually pass through it, a greater light source is required within the projector. The screen and mirror are normally enclosed in some sort of protective casing to help shield against the entrance of outside light, and also to keep the mirror in the proper position relative to the screen. In addition to being a space saver, this method has two other very definite advantages. First of all, the whole device can be made to be movable and secondly, the size of the projected image can be considerably enlarged without having to move the projector any great distance. This is true because of the fact that the

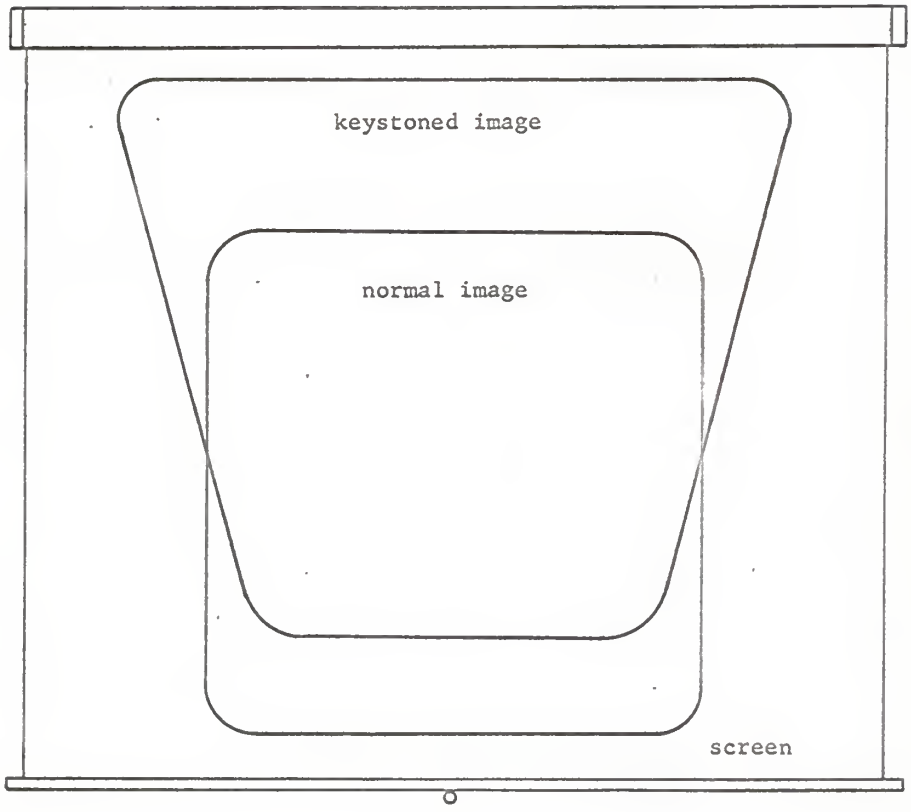

FIGURE 2

NORMAL AND KEYSTONED PROJECTION IMAGES

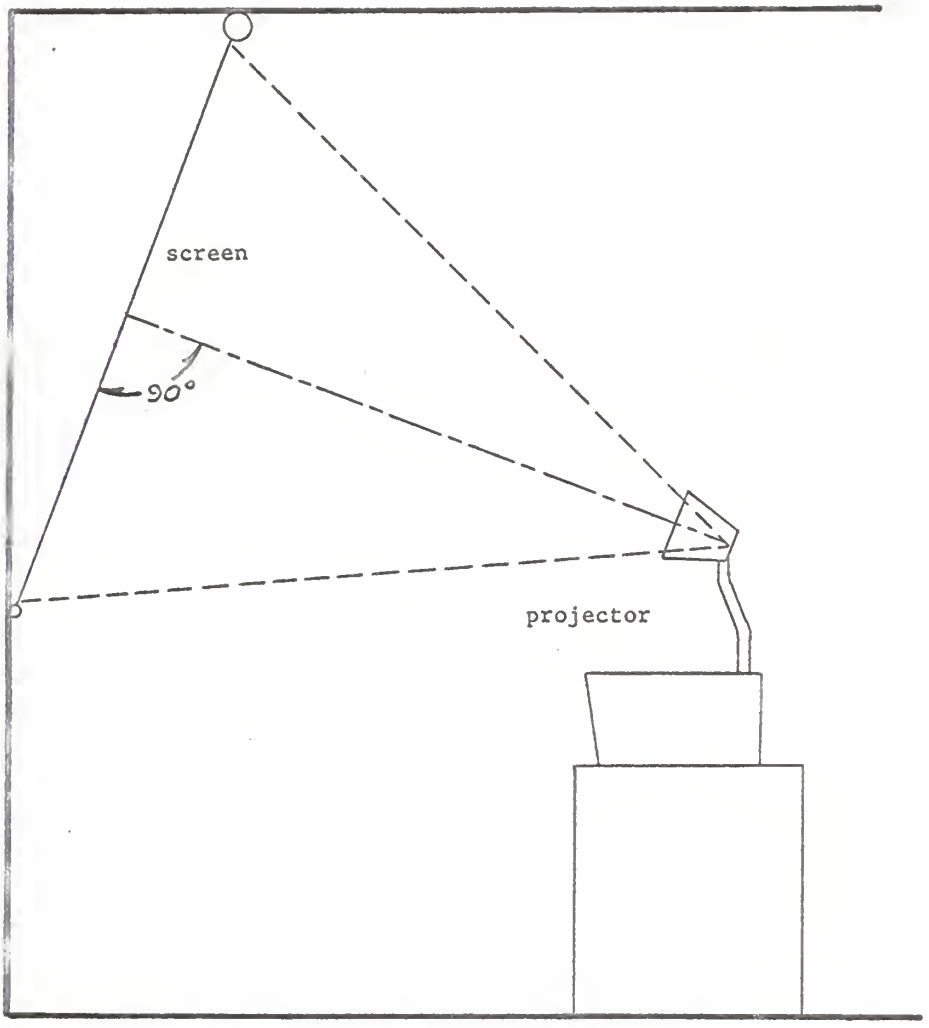

FIGURE 3

PROPER PLACEMENT OF THE PROJECTION SCREEN IN RELATION TO THE LINE OF PROJECTION TO AVOID KEYSTONING OF THE IMAGE WHEN USING THE ELEVATED SCREEN

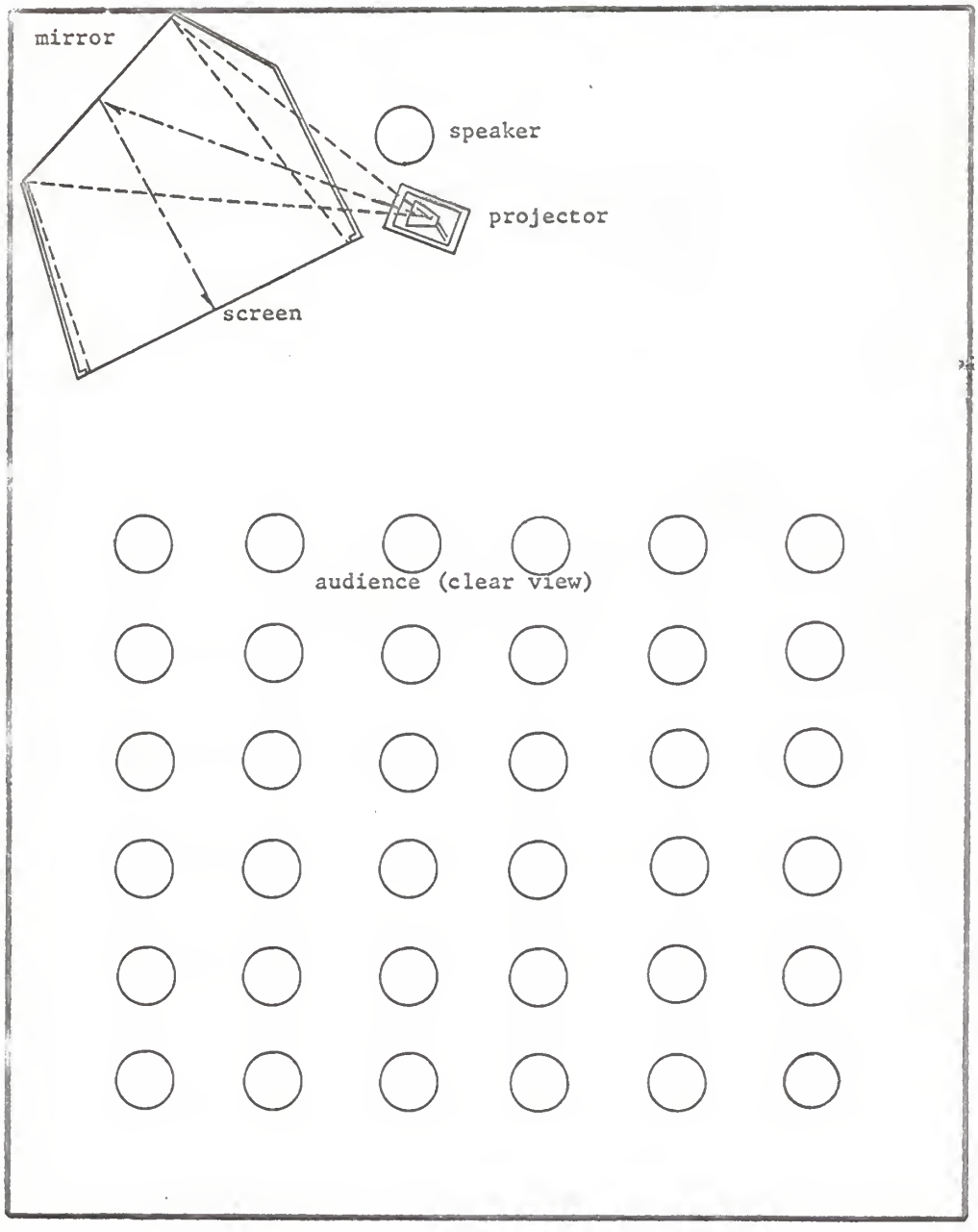

FIGURE 4

THE PLACEMENT AND OPERATING PRINCIPLES OF A REAR PROJECTION DEVICE

image will enlarge proportionally with the distance from the screen and with the rear projection device, the light rays are partially doubled back toward the projectionist.

Another problem that is frequently encountered when using the overhead projector is that the lettering or writing on the projectual is not large enough to be seen by those persons in the rear of the audience. This can be overcome however by the use of a simple template guide which will help the individual determine the proper size lettering which can be seen clearly at the maximum viewing distance from the screen. Figure 5 shows an example of such a guide.

For example, if the screen size is 40 inches by 40 inches and the maximum viewing distance is 36 feet, then the minimum image height on the original must be as high as the clear area on the template at the points. In the figure shown this height is illustrated by the letter "A" which was drawn in to help clarify this example.

With the same screen size, but a longer viewing distance, this image height must increase. With the same viewing distance, but a larger screen, this image height may decrease.

Proper viewing distance and screen size for an existing transparency may also be found with this same template method.

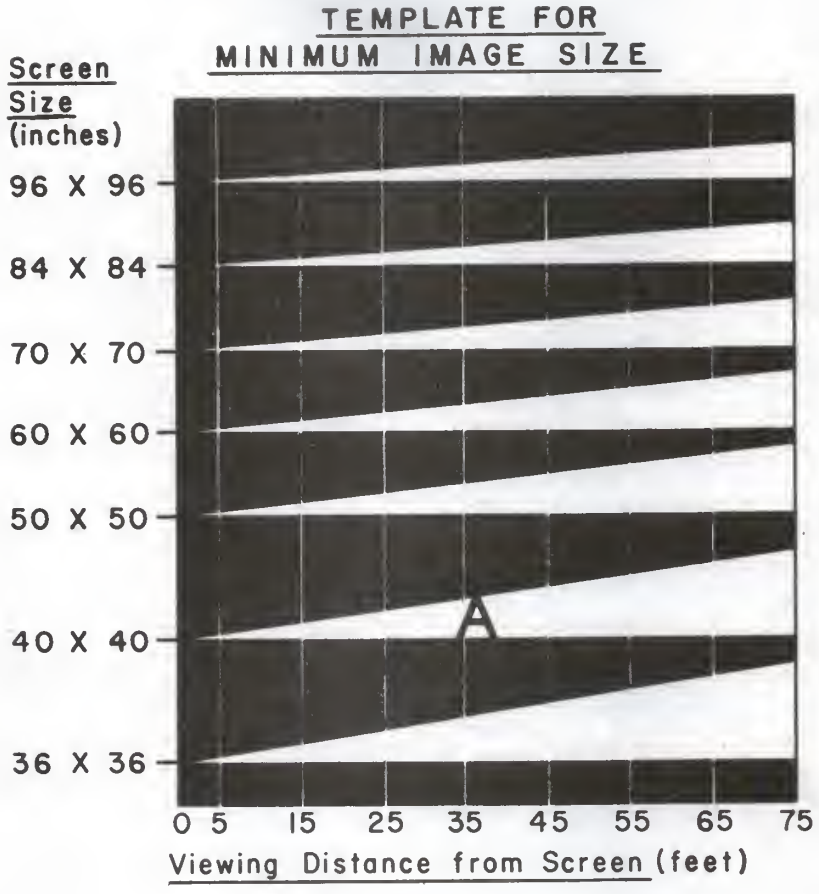

FIGURE 5

TEMPLATE FOR DETERMINING MINIMUM IMAGE SIZE ON THE BASIS OF SCREEN SIZE AND MAXIMUM VIEWING DISTANCE FROM THE SCREEN

MAKING AND MOUNTING THE TRANSPARENCIES

The permanent transparencies constructed for use in this study were all done on Thermofax type 125 extra quality positive transparency film so that color could be added by colored pencils. This particular type of film also has a thickness which makes it more durable with repeated usage than other types. There is also a negative type of film available at a lower cost and various one color films at higher prices, but for general use, the positive film is probably best from an overall standpoint.

To distinguish between the positive and negative type of transparency films, the positive type develops an opaque image on a clear background while the negative type will develop as a black image on a clear background.

The two main reasons the Thermofax process was selected over other duplicating processes were cost and convenience. The overall cost of a set of transparencies, including tapes, film, the mounts, and the coloring devices is much lower than any of the other duplicating processes. On the average, it costs approximately 17 cents to make one transparency so that it is ready for presentation, but even at that, the cost is only about half that of the other processes. The next reason was convenience because it is a dry photographic process that allows the transparencies to be used immediately after development without any need for drying.

For the individual wishing to make his own transparencies, there are some things to be considered before he actually starts to work.

First of all, subject matter must be considered. What ideas or concepts need to be presented? What specific points, processes, operations, or ideas need visualizing, and in what order? Is the purpose to present information or is it to present problems in order to find a solution? Is more than one subject to be presented? Are there other speakers to consider?

The next item to consider is the audience. What is their background and vocabulary? What related experiences have they had? How large an audience can the teacher expect and how does he want them to react?

Finally, he must decide on the method of production. This might be the handmade process, the spirit duplicator method, a photographic process, a "lift" type process, the diazo (ammonia) process, or the Thermofax process. A complete explanation of how each of these processes works and the equipment necessary is to be found in the tables in the appendix. The teacher must also consider the number of transparencies needed as well as the time involved and the overall cost.[4]

Depending upon what the individual feels would make the most effective presentation, either the single transparency or the multiple overlay style may be used.

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[4]Transparency Preparation Methods. (Fort McPherson, Georgia: Pictorial Division, Signal Section, Headquarters Third United States Army, 1962), p. 19.

The single transparency may be either mounted or unmounted. This is strictly a matter of choice and certainly does not add to or detract from its effectiveness, but the cardboard mount will give the transparency more strength and support and it will also keep it from warping or curling. Figures 6 and 7 show the procedure for laying the transparency squarely on the mount and then taping all edges securely to the mount.

One very effective way to use the single mounted transparency is to use the trap door method for a progressive disclosure or development of material as is shown in Figure 8. To use this method of presentation, a series of thin cardboard flaps are attached to the base mount by the use of tape or transparency hinges. These flaps are then raised by the instructor at his discretion to disclose some concept or procedure. This is a very useful tool when it is important that everyone sees and understands the same things at the same time or when showing a necessary sequence of events. One should be aware of the fact that when more than one figure is placed on a transparency, the projected image is reduced in size. This means that either the projected image must be enlarged or the audience moved closer to the screen.

If the overlay system is to be used, there are two things to be considered. First of all, it must be decided what will have to be placed on each transparency in order to make the most effective presentation. Secondly, how are the overlays to be attached to the

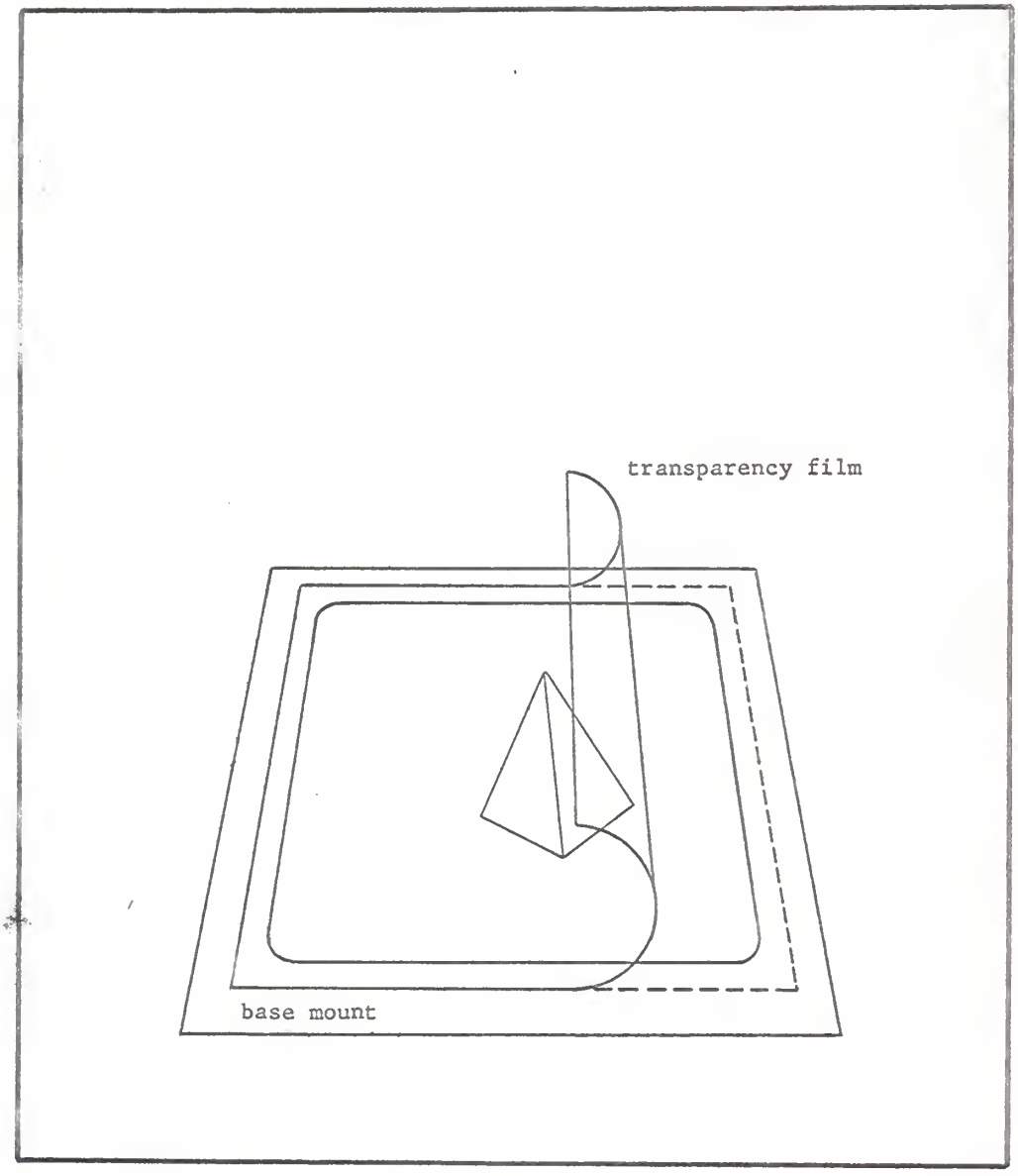

FIGURE 6

AN ILLUSTRATION OF THE PROPER METHOD OF LAYING
A TRANSPARENCY ON A BASE MOUNT

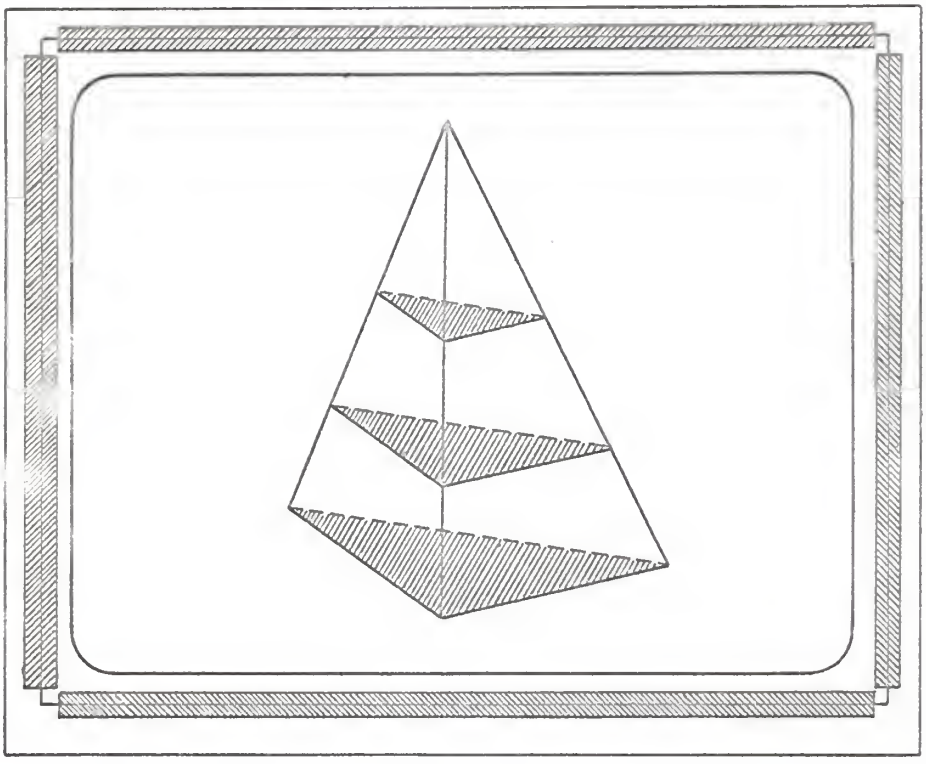

FIGURE 7

AN ILLUSTRATION OF A COMPLETED SINGLE TRANSPARENCY WITH ALL EDGES BEING TAPED SECURELY TO THE BASE MOUNT

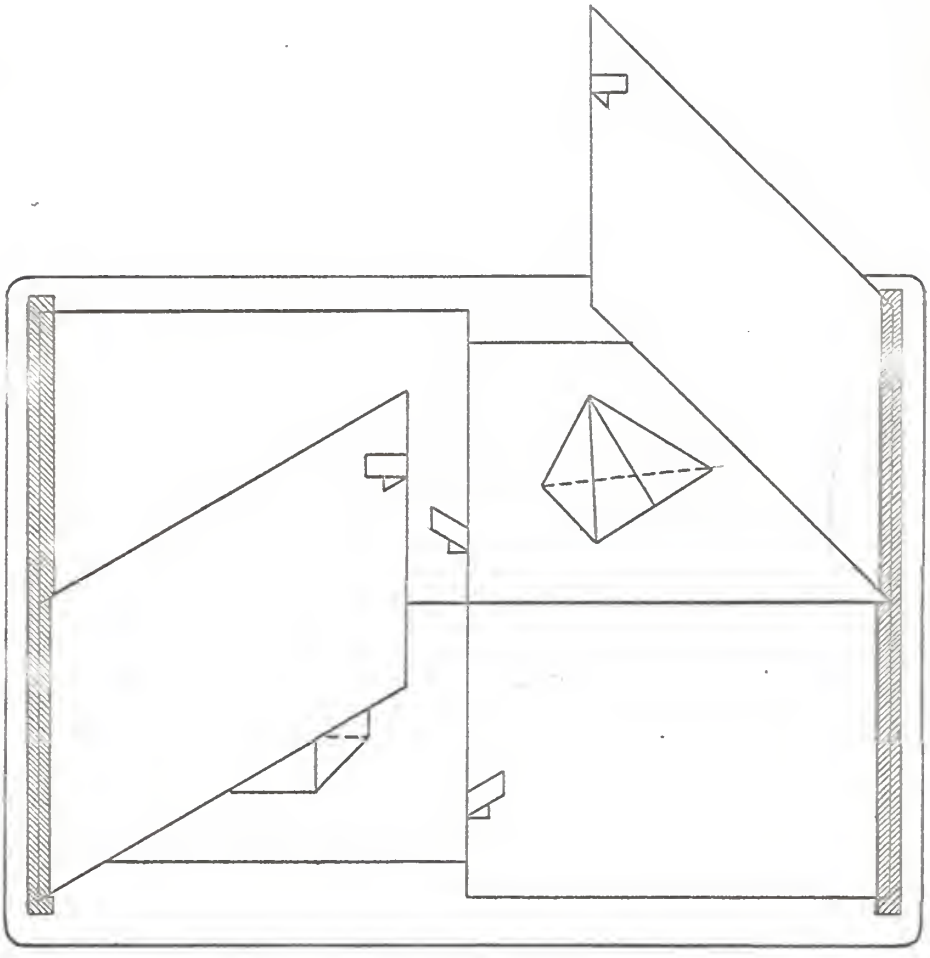

FIGURE 8

AN ILLUSTRATION OF A TRANSPARENCY UTILIZING THE TRAP DOOR PRINCIPLE FOR PROGRESSIVE DISCLOSURE OF MATERIAL

base mount? Since the transparencies are clear, there is no significant loss in light intensity for any given number of overlays.

The one big problem with overlays however is how to affix them to the base mount. This hinging effect may be accomplished either by the use of tape such as a good adhesive masking tape or mending tape, or by the use of commercial transparency hinges. During this study, it was found that the aluminized mylar hinges made by the Tecnifax Corporation are much more durable and more attractive than the various tapes. Figure 9 illustrates how tape may be used to attach the overlay, or overlays, to one side of the base mount while Figure 10 shows how more than one overlay may be arranged about the sidesof the base mount. Still another way to use the overlays, either mounted or unmounted, is to attach them so that they will fold up on top of one another as is shown in Figure 11.

If the gummed, commercial hinges are to be used there are several steps that should be followed for their successful use. First, all overlays must be arranged so that the image of each one is in the proper position with regards to the one prior to it. The overlays must all be marked so as to insure proper placement of the hinges along the edges of the sheets. The gummed hinges are then attached so that about one-fourth inch of the hinge is attached to the plastic. The remainder of the hinge is then folded over on itself, allowing about a quarter inch to be attached to the bottom side of the plastic as was done on top. This will form a tab made up of two layers of the material

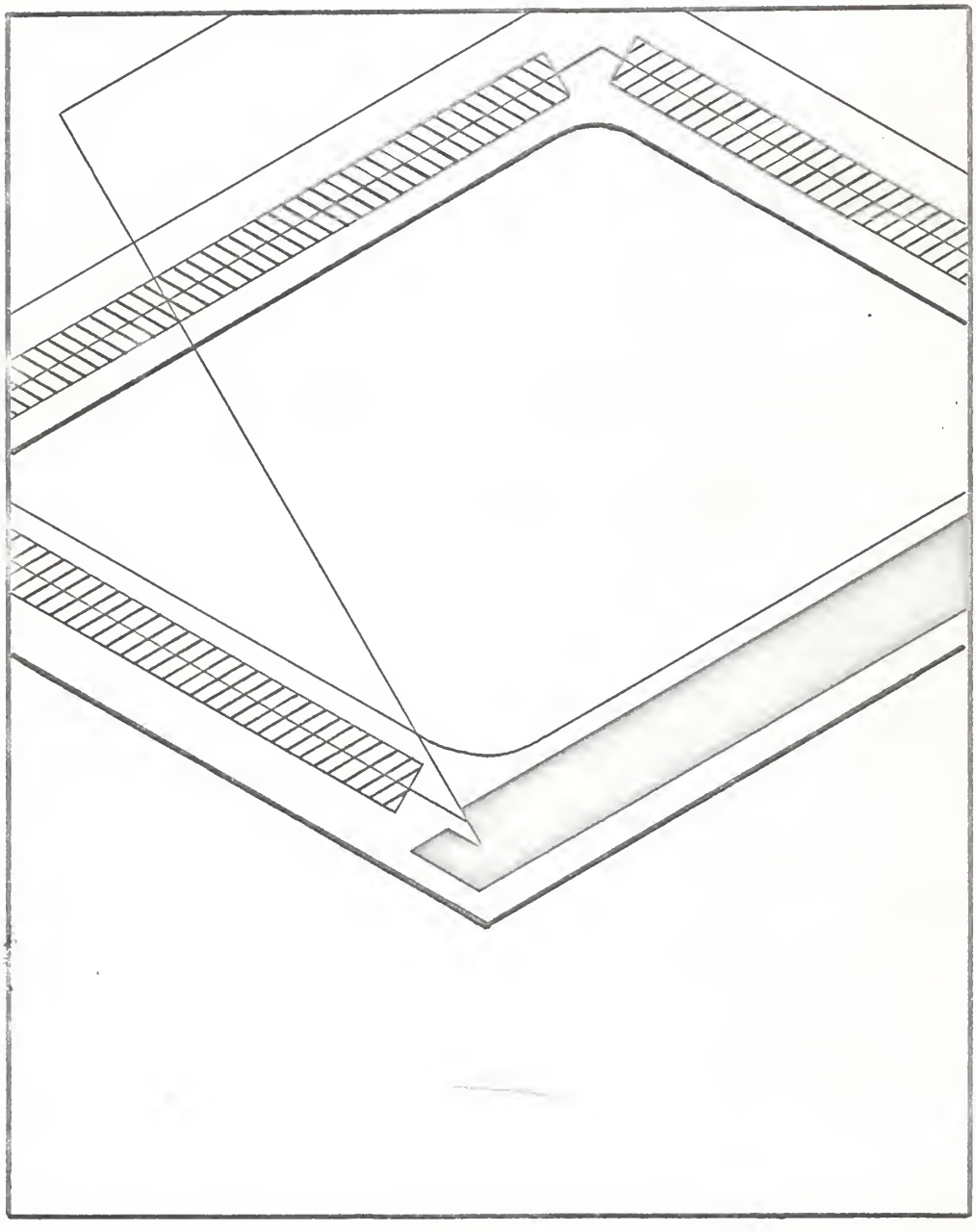

FIGURE 9

AN ILLUSTRATION OF HOW AN OVERLAY MAY BE HINGED
TO THE BASE MOUNT BY THE USE OF TAPE

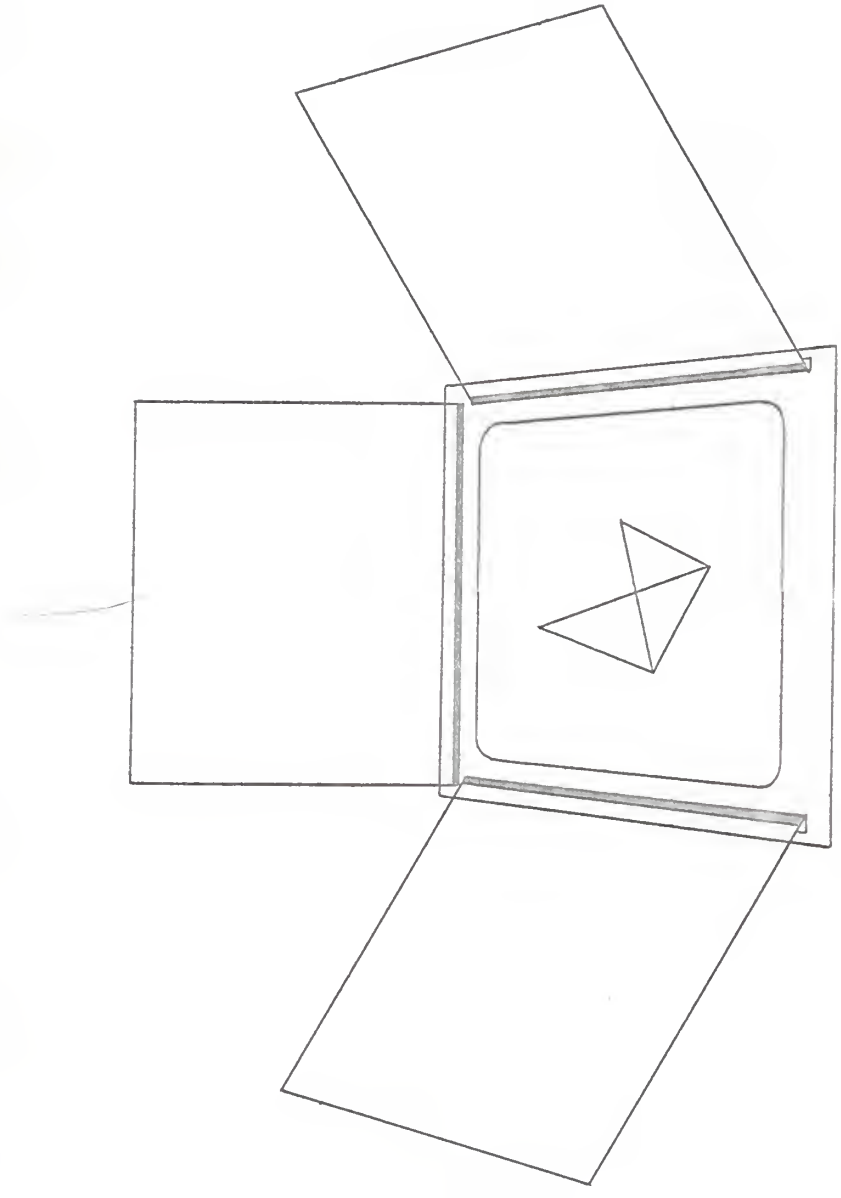

FIGURE 10

MULTIPLE OVERLAYS THAT HAVE BEEN TAPE-HINGED
ABOUT THE SIDES OF THE BASE MOUNT

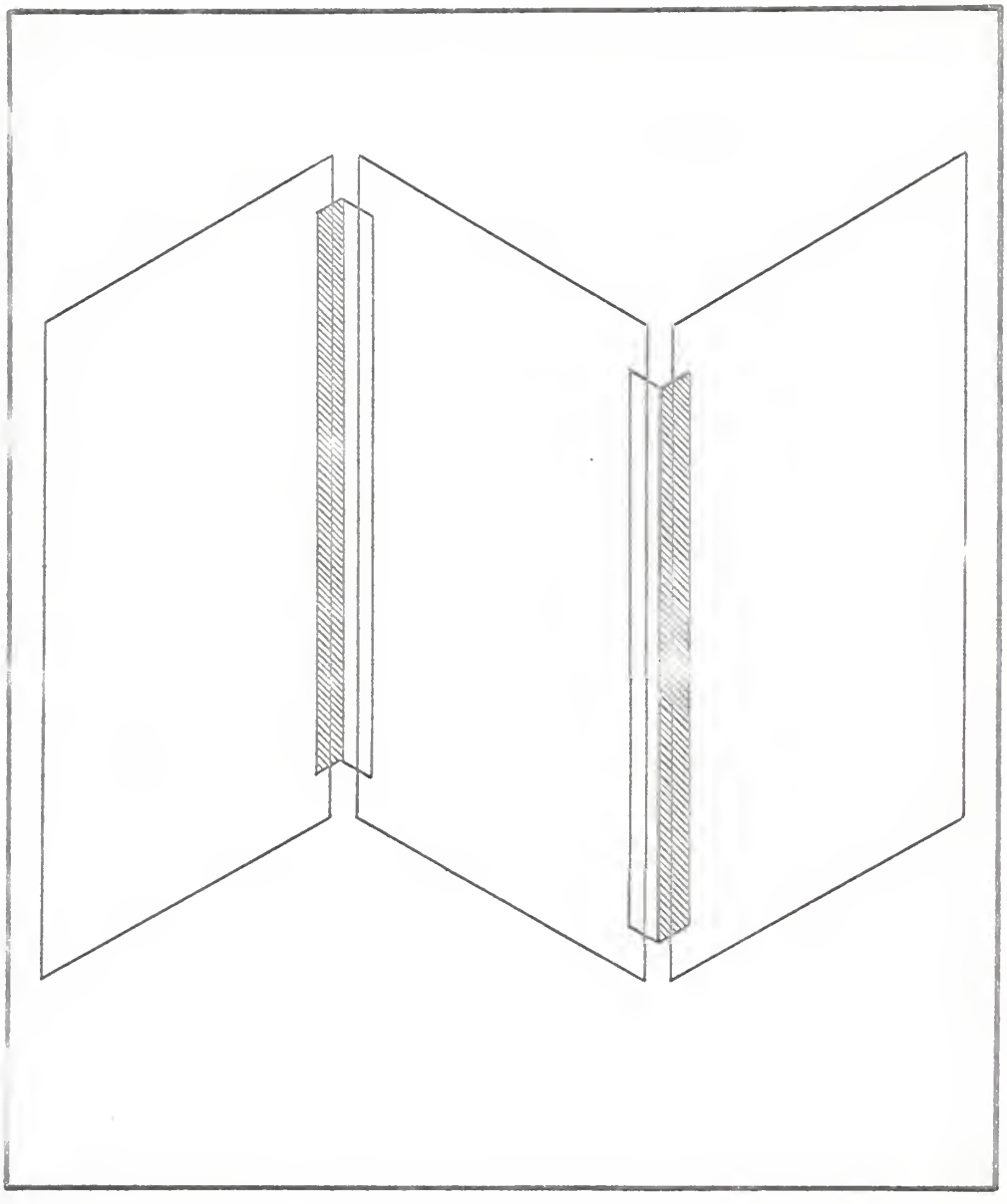

FIGURE 11

AN ILLUSTRATION OF THE TECHNIQUE OF TAPING TRANSPARENCIES
SO THAT THEY WILL FOLD TOGETHER TO
FORM A COMPOSITE IMAGE

and extending outward from the edge of the overlays approximately one-half inch. The overlays are then arranged in their proper positions again and the tabs are stapled to the base mount as is shown in Figure 12. This completes the procedures to be followed when using prepared hinges, and will result in a set of transparencies that are extremely neat and strong.

Color may be added to the transparencies in a variety of ways. When using negative type films, the teacher may add color by the use of colored adhesive films. To use this material, simply place the film over that area of the transparency to be colored and cut around the outline with some sharp instrument. The protective covering is then stripped from the adhesive side and the film is applied to the desired area of the transparency.

Color may be added to the positive type transparencies by the use of colored adhesive films and tapes, colored acetate inks, felt tip markers, colored grease or marking pencils, and by the use of color transparency films. When developed, these films will produce a transparency which is entirely in one color.

Filing of the completed transparencies may be accomplished by any one of several methods. One method is to simply group the transparencies by the chapter they correspond to in the text. Each transparency is then given a number to identify it with one particular section or part of that chapter. This necessitates the making of a master index so that the instructor will always know what he has and where it can be found.

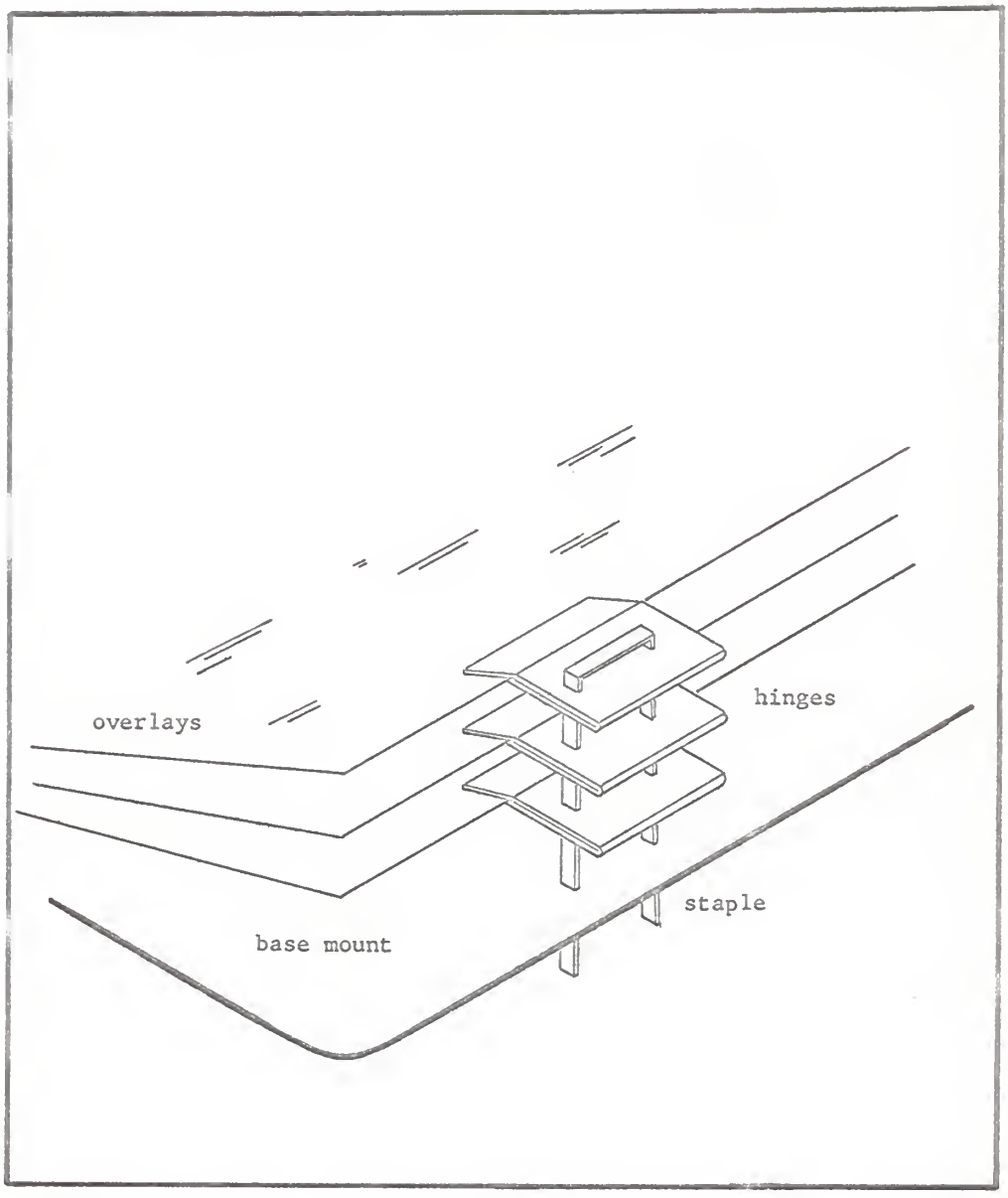

FIGURE 12

AN EXPLODED VIEW OF A SERIES OF OVERLAYS WHERE GUMMED COMMERCIAL HINGES DESIGNED FOR STAPLING TO THE BASE MOUNT HAVE BEEN USED INSTEAD OF TAPE

Another method of filing or organizing the transparencies in a course is by the use of edge-punched base mounts.[5] These are similar in appearance to the Hadley Uni-Sort Cards and the Royal McBee Keysort Cards used to file information according to predetermined classifications. To use this method, it is first noticed that the holes about the edges of the mount are numbered by groups. These groups may indicate classes, grades, week, month, subject, chapters, type of material, an original or master copy number, or a series number. The numbers are used to indicate some predetermined subdivision within each group. As soon as the instructor determines the data on each transparency, he then notches the holes in each group that correspond to the data he has affixed to the transparency. This is done with either a hand notcher or some sort of electric notching device. The transparency is then filed along with all others to be used.

When a transparency is needed for any one particular subject or area or when all transparencies in a certain area are desired, a "needle" or long, slender rod is inserted through the hole corresponding to the data or classification desired. The rod is then raised, allowing the properly notched cards to fall out for selection.

The mounts themselves are 10½ inches by 12 inches so that any standard file cabinet or drawers can be used. In addition, the mounts

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[5] J. Francis Rummel, An Introduction to Research Procedures in Education (New York: Harper and Brothers, Publishers, 1958), p. 269.

are heavy enough so that standing the mounted transparencies on edge is not harmful to them. This is actually to be desired rather than laying the transparencies down flat for storage.

For the person attempting to prepare his own Thermofax masters or originals, it should be noted that these can be drawn or written up on any low rag content paper using any type of carbon base marking device. For maximum results with the Thermofax process, white paper is to be preferred, but any light colored paper is acceptable as long as it is reasonably flexible.

SPECIAL DEVICES

There are a number of attachments which can be purchased for use on or with the overhead projector, but for the average person they can just as easily be handmade. With a little care taken in their construction, a slide adapter and a film strip adapter can be developed which are just as attractive and durable as any that can be purchased.

Figure 13 is an illustration of how a device for projecting photographic slides can be made from a piece of posterboard or some similar material. First, the cardboard is cut so that it completely covers the light table of the projector. A hole is then cut in the cardboard the exact size of the film in the slide and a piece of cardboard is then glued on either side of the hole to serve as a guide and centering device for the slide mounts. The distance between these

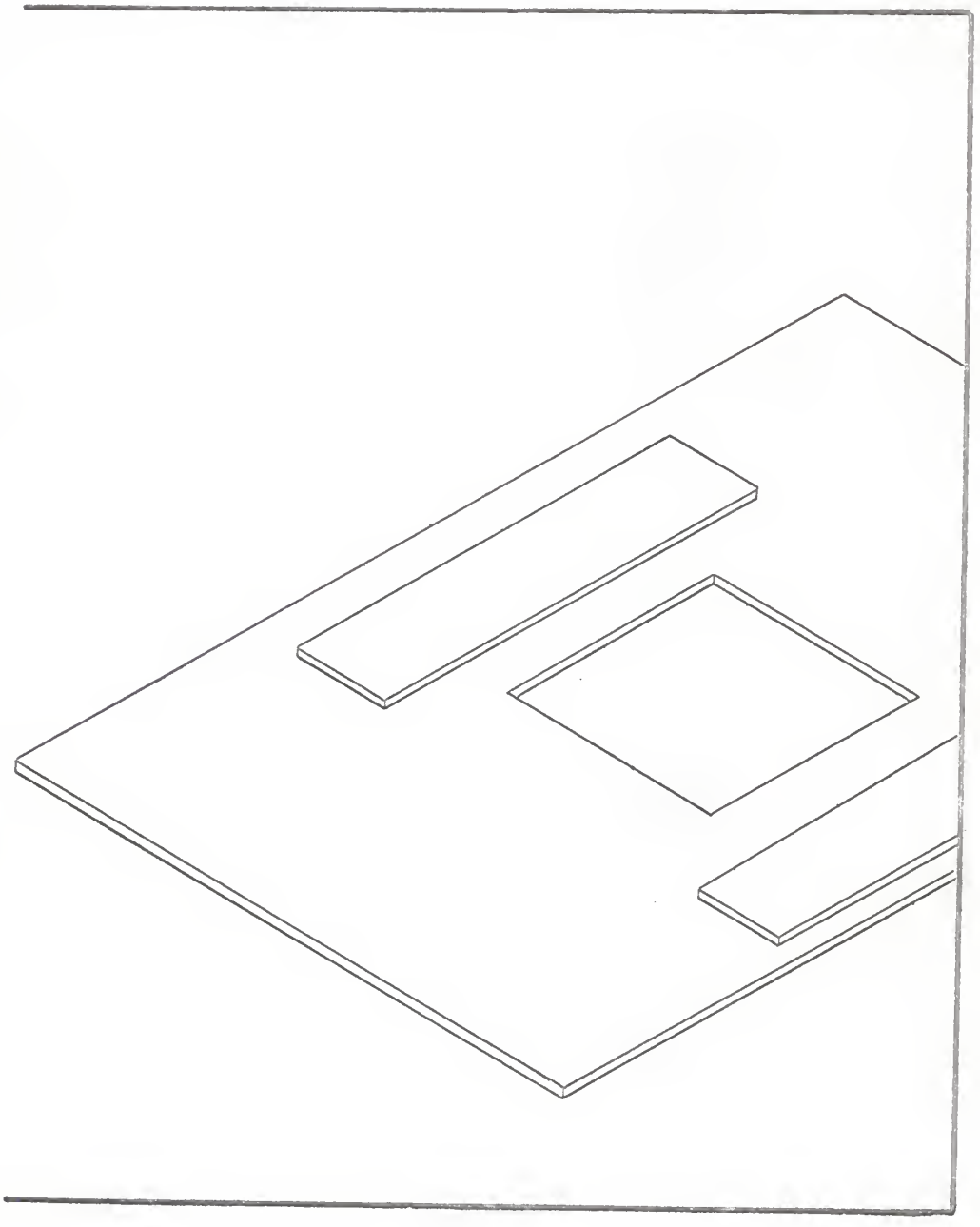

FIGURE 13

A DEVICE FOR ADAPTING THE OVERHEAD PROJECTOR
FOR USE WITH MOUNTED PHOTOGRAPHIC SLIDES

strips is equal to the outside measurements of the mounted slides.

Figure 14 shows how a similar device may be constructed for use with film strips. For this device, two pieces of cardboard are glued on either side of the aperature - the top pieces being slightly larger and forming a small overhang on each side. This will enable the film strip to remain centered over the aperature while at the same time remaining perfectly flat against the base. The film strip is then pulled through by hand at the desired rate.

Another device that can be easily made is a pair of rollers attached to opposite sides of the projector's light table. A 100 foot roll of clear plastic is then placed on one of the rollers with one end of the roll running across the top of the light table of the projector. With the use of this continuous roll device, a person can write for a full hour or more without having to erase or clean off the plastic.

Another device that is extremely useful is made up of two identical mounts placed together with a thin shim between them along two opposite sides. The transparency is taped to the inside of the bottom mount in the conventional way and the mounts are stapled together along the sides containing the shims. Cardboard strips are then slipped between the mounts through the open ends, thereby covering up any material on the transparency until the instructor chooses to disclose it. This device, as is shown in Figure 15, is particularly applicable to programed instruction or to the revelation method of

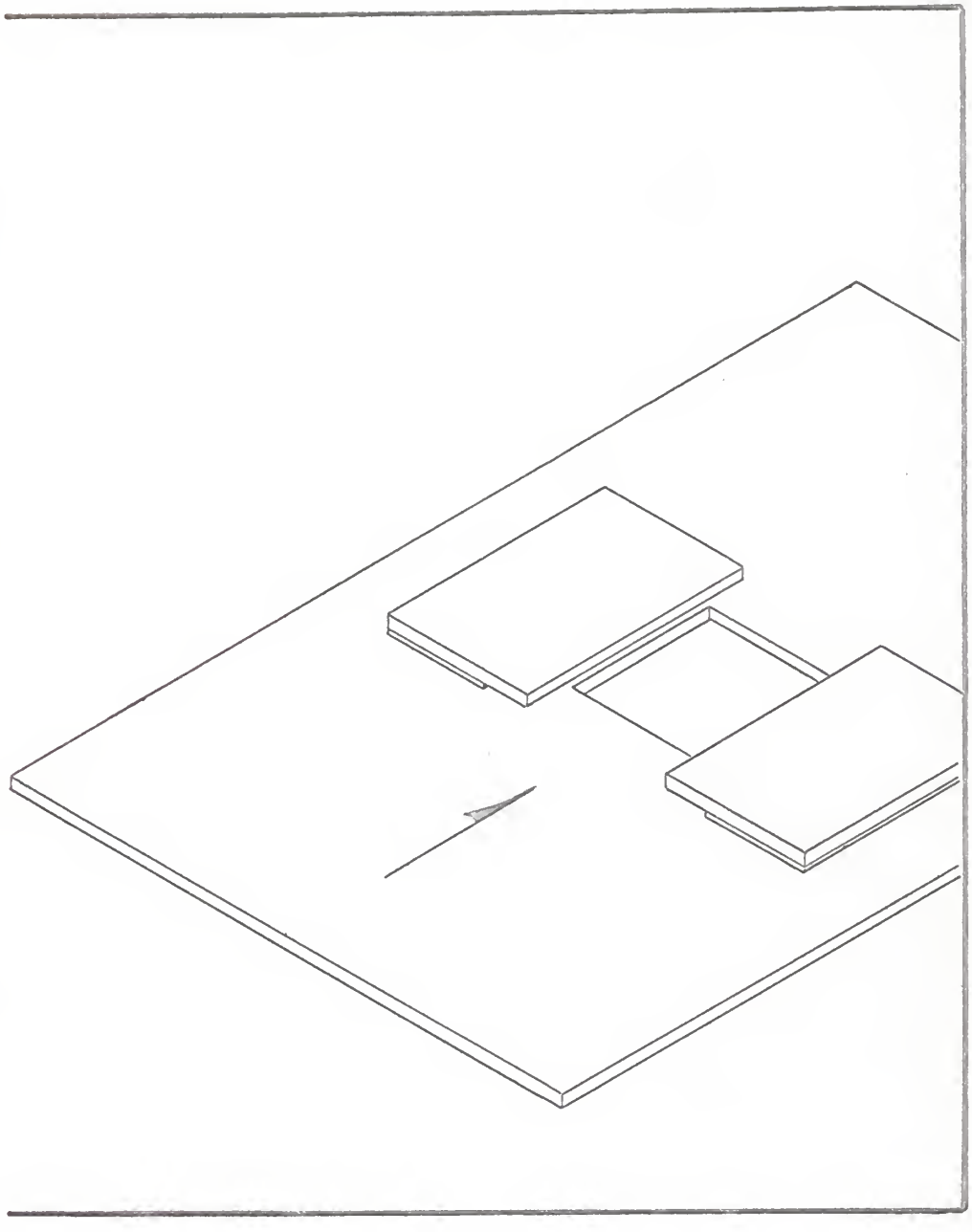

FIGURE 14

A DEVICE FOR ADAPTING THE OVERHEAD PROJECTOR
FOR USE WITH FILMSTRIPS

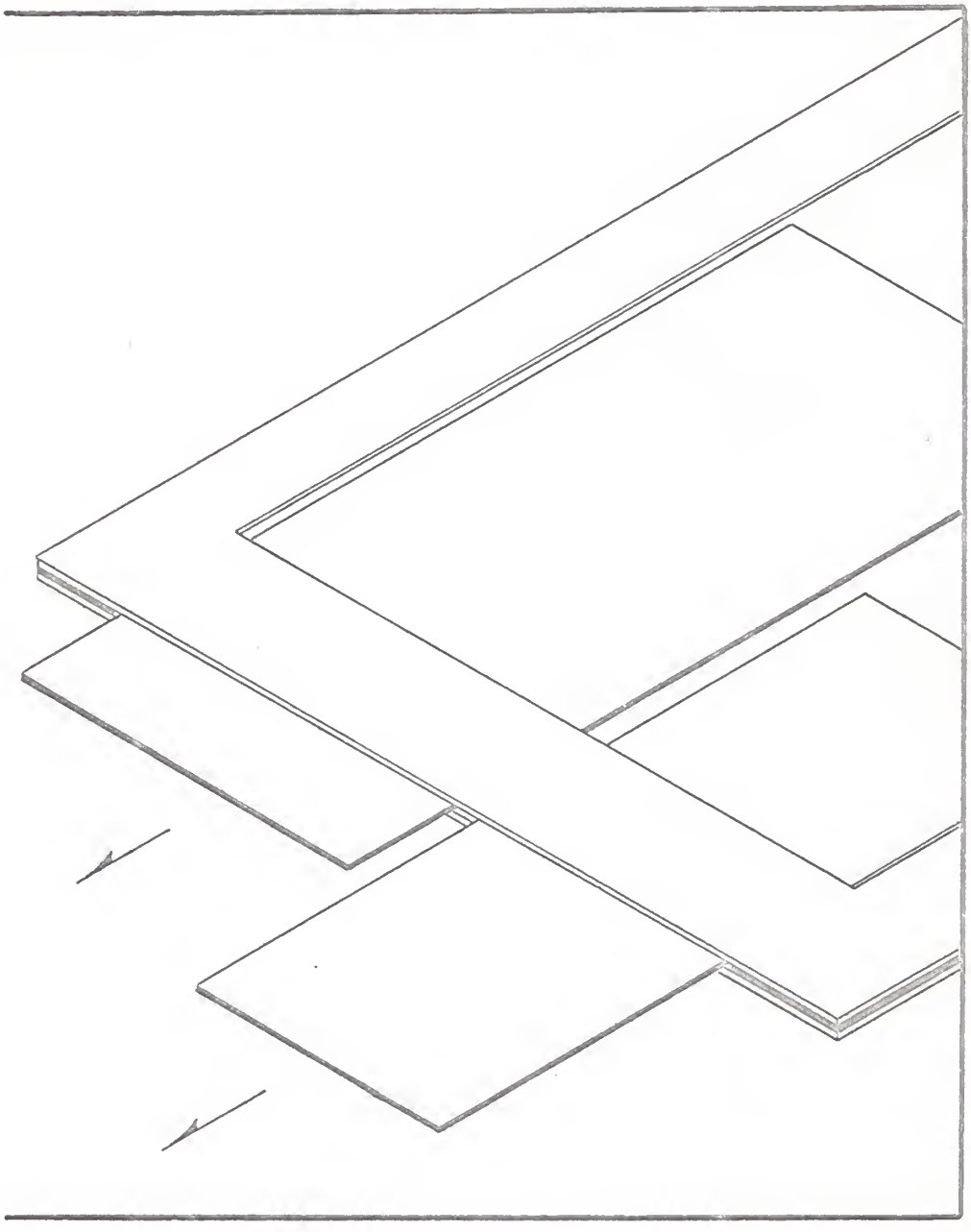

FIGURE 15

A DETAILED VIEW OF A DEVICE THAT CAN BE MADE WHEN PROGRAMED INSTRUCTION OR THE REVELATION STYLE OF INSTRUCTION IS TO BE EMPLOYED

teaching where only after a suitable response has been given is the answer disclosed.

Two more devices that are sometimes found in the classroom are the tachistoscope and the polarizing lens attachments.

The tachistoscope attachment to the overhead projector is a device closely resembling the shutter arrangement on a camera. The amount of opening cannot be varied but the length of time that the shutter is open can be controlled. This timing device can be either mechanically or electrically operated. There are also models available that are hand operated - where the operator must cock the shutter each time and then manually release it.

These devices are most commonly used in the teaching of reading but they can also find application in any subject where speed or time is an important factor or where rapid identification is one consideration.

By definition, polarization refers to the action or process of affecting light waves so that the vibrations assume a definite form or pattern. This is achieved by a specially ground lens that is rotated in a fixed position relative to the light rays entering. The importance of such a lens is that if an image is being projected along the light rays when passing through such a lens, the effect is an illusion of motion on the projection surface.

The polarizing lens attachment finds its application in the classroom as an attachment to the lens barrel of the overhead projector. Normally, the lens is rotated in a plane perpendicular to the light

rays by use of a small electric motor and gear arrangement. It can also be turned by hand, but either way, some allowance must be made to control the rate or speed of rotation. By varying the speed at which the lens is rotated, the apparent rate of motion of the projected material can be speeded up or slowed down.

One caution though; if a person is making his own transparencies he must incorporate motion symbols into the drawings and these must be of near professional quality if the proper effect is to be achieved.

SUMMARY

In this study, observations were made on the geometry classes at the Manhattan High School over a three year period to determine the usefulness of the overhead projector as a teaching aid. Illustrations and directions were presented in this paper for determining the type and amount of equipment needed in a classroom, items that can be made by the teacher, methods of making and mounting the transparencies, various styles of presentations, organizing and filing of the prepared transparencies, and special devices for use with the overhead projector. A large number of advantages, as well as a few of the problems and disadvantages, were determined and discussed, but since no statistical controls were applied, no definite conclusions could be reached.

On the basis of the observations made during this study, the only recommendation that can be made is for the further use of the overhead projector and the continued experimentation by other teachers in all teaching areas.

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Brown, Dr. James I. "The Overhead Projector ... Prime Aid for Programed Instruction," Education Age, I (September, 1964), 30 - 33.

The Overhead Projector, Audio Visual Aids in Training. Part I. Chicago: Office of the Army Signal Officer, Headquarters Fifth United States Army, 1962, 2.

Pearson, Neville. "Transparency, Types, Tools and Techniques," Audiovisual Instruction, X, (April, 1962), 228-231.

Rummel, J. Francis. An Introduction to Research Procedures in Education. New York: Harper and Brothers, Publishers, 1958.

Socony - Vacuum Oil Company Studies.

Transparency Preparation Methods. Fort McPherson, Georgia: Pictorial Division, Signal Section, Headquarters Third United States Army, 1962, 19.

APPENDIX

TABLE I

TRANSPARENCY TYPES, TOOLS AND TECHNIQUES[6]

HANDMADE PROCESS	ADVANTAGES	EQUIPMENT	MATERIALS	SOURCES
Writing on transparent "Plastic" sheets or rolls.	Extemporaneous, replaces chalk board with advantages of enlargement through projection. May be erased.	None	Plastic Cellophane	American Optical Co.
			China Marking or grease pencil	Chas. Beseler Co.
Heavier weight material may be easier to use.			Felt Tip Pen or marker	Robert J. Brady Co.
Writing on "etched" plastic.			Matte Acetate	Buhl Optical Co.
	Color as you write.		Drafton, Lumarith or similar.	Ozalid Division
			Krylon or similar clear spray to make material more transparent and permanent.	Projection Optics
				Tecnifax Corp.
	Color.		Colored pencils which project in color.	
Writing or drawing on clear plastic with transparent ink.			Transparent inks for writing on plastic.	
Writing or typing on wax (carbon) coated clear plastic	When prepared in front of the class you give the effect of writing with white light on a dark screen. Color may be added by placing colored plastics under the film. The effect is dramatic.		Projecto Carbon	
			Ordinary pencil or ball point pen will "scratch" the surface as you write.	
	Typewritten material (be sure you use large type), is easily prepared ahead of time.			

TABLE I (continued)

DUPLICATOR PROCESS	ADVANTAGES	EQUIPMENT	MATERIALS	SOURCES
Transparencies are made directly with the stencil of the mimeo type or from the master for the spirit type.	Transparency for projection made at the same time as hand out, recall or reinforcement duplicated copies.			
Printed, paste-up, typed or hand made master including line or half tone materials quickly transferred to mimeotype stencil and transparency plastic.		Gestefax Electronic Stencil Maker	Gestefax Stencil and Transparency Plastic	Gestetner Corp.
Spirit-type duplication master is prepared in the usual way, and a matte acetate sheet run through the duplicator. This sheet of plastic is then sprayed with clear plastic to set the ink and clear the plastic.	Color may be used.	Ditto Spirit Duplicator	Ditto Type Carbon Matte Acetate Clear Spray	Ditto Inc.

PHOTOGRAPHIC PROCESS	ADVANTAGES	EQUIPMENT	MATERIALS	SOURCES
Regular photo copies made of any original. The film is developed in the usual way. Either the negative or a positive print made from the negative may be used for projection.	By using a camera, material may be enlarged or reduced in size.	Camera--4x5 or Copy Stand Developing equipment Printer	Film High Contrast Full Color Developing Chemicals	Eastman Kodak Co.

TABLE I (continued)

PHOTOGRAPHIC PROCESS	ADVANTAGES	EQUIPMENT	MATERIALS	SOURCES
Polaroid Direct Positive Transparency .	A transparency ready for projection in two minutes. Polaroid Transparencies may be used with Diazo film for full color reproductions.	Polaroid Camera or Polaroid back for Press type Camera. Color Filters	Polaroid Transparency Film Dipit Vectograph film	Polaroid Corp.

(The finished Polaroid Transparency will be 3¼x4 or 4x5 in size and will project best on a 7x7 or smaller projector. Some 10x10 projectors have special adapters for 3¼x4 transparencies.)

"LIFT" TYPE PROCESS	ADVANTAGES	EQUIPMENT	MATERIALS	SOURCES
The printed image on clay-coated paper is "lifted" from the page and projected directly on the screen.	A wide variety of excellent material is available from magazines and other printed sources.			
Matte Acetate-Rubber Cement Both picture and rough side of matte acetate are coated with rubber cement. After drying, the two are placed in contact and bonded together. This sandwich is then soaked in water, peeled apart and sprayed with clear plastic.		Soft Brushes Burnishing tool	Matte Acetate Rubber Cement Cement Thinner Clear Plastic Spray	Art Materials Supply Shop in your Locality
Trans Para Film "Lift" A commercially prepared material used with heat to bond ink to plastic.		Dry Mount Press Special Plates for Lift Process	Trans Para Film	Seal, Inc.

TABLE I (continued)

"LIFT" TYPE PROCESS	ADVANTAGES	EQUIPMENT	MATERIALS	SOURCES
Thermo-Fax Lift The picture to be lifted and the Thermo-Fax Lift film are run through the Thermo-Fax Copier, soaked in water, separated and then cleared with color brightener.		Thermo-Fax Copier (any model)	Thermo-Fax Color Lift Film and Color Brightener	Minnesota Mining and Mfg. Co.

TRANSFERON-RELEX PHOTOCOPY	ADVANTAGES	EQUIPMENT	MATERIALS	SOURCES
Photo Reflex Copies can be made from almost any sort of original by using a copying device. The resulting transparency is an exact-size copy in balck and white. The original and copy material are placed together in the printer. Exposure is made and the film is developed in wet developer. Hand or automatic developing may be used depending on equipment. Since emulsion on film is thin, the drying time is short.	Copies from opaque materials printed on both sides, in any color. The resulting copy may be projected as it is or used as a master for diazo copies in black and white or solid color. Many models of printers copy directly from bound books and catalogs.	Printer (light source) Developer Unit	Transferon type film, negative and positive.	Chas. Beseler Co. Eastman Kodak Co. Seal, Inc. American Photocopy Equipment Co. Ampto, Inc. Anken Chemical and Film Corp. Copease Corp. Chas. Bruning Co. Copy-Craft, Inc. Cormac Photocopy Corp. A. B. Dick Co. General Photo Products Co., Inc. Ideax Corp. F. G. Ludwig, Inc. Keuffel and Esser Co. Nord Photocopy Corp. Peerless Photo Products Photorapid Corp. Frederick Post Co. Royal McBee Corp. Viewlex, Inc. Webster Bros. Laboratory

TABLE I (continued)

THERMO-FAX PROCESS	ADVANTAGES	EQUIPMENT	MATERIALS	SOURCES
Any material acceptable to Thermo-Fax may be immediately prepared for projection simply by using either positive or negative projection transparency film, or other types of Thermo-Fax transparency material. With a Companion Unit (a small exposure box), any type of material can be copied, including color.	A completely dry, very quick process. Paste-ups, hand written, typed material may be copied. Hand out re-inforcement recall material may be made from the same original. Copying machine may be used for "lift" process and for laminating materials.	Thermo-Fax Copier and Companion Book Copier	Projection Transparency Film, Standard Quality, Extra Quality, Positive or Negative. Direct Reading Positive Type. Rainbow Color Type.	Minnesota Mining and Mfg. Co.

DIAZO(AMMONIA) PROCESS	ADVANTAGES	EQUIPMENT	MATERIALS	SOURCES
The Diazo process involves the preparation of a master on transparent or translucent material, using letters, art work, etc. which is opaque and stops the light in the printing process. By preparing parts of the transparency on different masters, several colors may be combined in the finished print. The finished master is printed by exposure to strong light and then developed in ammonia fumes or by application of liquid ammonia and alcohol.	Brilliant color materials are easily prepared. These colors may be used as overlays to add color on By using the liquid developer, a clear sheet placed on the projector is developed as the audience watches. This "pop-on" technique is	Printer Developer	Good quality tracing paper for master. India ink, pens, ruling pens, ruler, drawing board. Lettering Guides Diazo film which is available in many colors and shades.	Chas. Beseler Co. Ozalid Division Robert J. Brady Co. Tecnifax Corp. Chas. Bruning Co.

TABLE I (continued)

DIAZO(AMMONIA) PROCESS	ADVANTAGES	EQUIPMENT	MATERIALS	SOURCES
			Transparent letters such as Foto Type and texture materials such as Zipatone or Art-type shading sheets may be used effectively	Viewlex, Inc. Zipatone Para-Tone, Inc. Foto Type, Inc. Bourges Color Corp. Keuffel & Esser
MOTION TRANSPARENCIES	**ADVANTAGES**	**EQUIPMENT**	**MATERIALS**	**SOURCES**
Technamation is a new technique which adds motion to any ordinary still transparency; motion in any direction, at any speed and any combination of direction and speeds. Liquids appear to flow, gasses explode, gears rotate, etc. Special polarized material, providing the motion desired, is applied over the regular transparency. A rotating polarizing filter on the projector makes the motion appear on the screen.	Motion is added in a dramatic way to still pictures or drawings.	Polarizing spinner on the projector	Technamation materials (linear motion, reversing motion, swirl action, blinking action, etc. are available).	Technamation Division Technical Animations Inc. Chas. Beseler American Optical Co. Ozalid Division Projection Optics Minnesota Mining and Mfg. Co.

[6]Neville Pearson, "Transparency Types, Tools and Techniques," Audiovisual Instruction, X, (April, 1962), 228-231.

TABLE II

SOURCES OF EQUIPMENT AND MATERIALS IN THE CHART[7]

American Optical Company, Instrument Division
Buffalo 15, New York

American Photocopy Equipment Company
2100 W. Dempster Street
Evanston, Illinois

Ampto, Inc., Anken Chemical & Film Corporation
Hicks Avenue,
Newton, New Jersey

Anken Chemical & Film Corporation
Hicks Avenue,
Newton, New Jersey

Charles Beseler Company
East Orange, New Jersey

Robert J. Brady Company
3227 M Street N. W.
Washington 7, D. C.

Charles Bruning Company
1800 West Central
Mt. Prospect, Illinois

Bourges Color Corporation
New York, N. Y.

Buhl Optical Company
1009 Beech Avenue
Pittsburgh 33, Pennsylvania

Copease Corporation
20 Fremont Street
San Francisco, California

Copy Craft, Inc.
105 Chambers Street
New York 7, New York

TABLE II (continued)

Cormac Photocopy Corporation
80 Fifth Avenue
New York 11, New York

A. B. Dick
5700 W. Touhy Avenue
Chicago 31, Illinois

Ditto, Inc.
2285 W. Harrison Street
Chicago, Illinois

Eastman Kodak
Rochester, New York

Foto Type
1414 Roscoe Street
Chicago, Illinois

General Photo Products Company
Box 23
Chatham, New Jersey

Gestetner Corporation
216 Lake Avenue
Yonkers, New York

Ideax Corporation
150 Fifth Avenue
New York, New York

Keuffel and Esser Company
Adams and Third Streets
Hoboken, New Jersey

F. G. Ludwig, Inc.
Coulter Street
Old Saybrook, Connecticut

Minnesota Mining and Manufacturing Company
St. Paul 19, Minnesota

Nord Photocopy Corporation
300 Denton Avenue
New Hyde Park
Long Island, New York

TABLE II (continued)

Ozalid Division, General Aniline & Film Corporation
Johnson City, New York

Peerless Photo Products
Route 25A
Shoreham
Long Island, New York

Photorapid Corporation
126 Fifth Avenue
New York 1, New York

Polaroid Corporation
Cambridge, Massachusetts

Frederick Post Company
3650 N. Avondale Avenue
Chicago 18, Illinois

Projection Optics
271 Eleventh Avenue
East Orange, New Jersey

Royal McBee Corporation
1700 Wisconsin Avenue N.W.
Washington, D. C.

Seal, Inc.
Shelton, Connecticut

Technical Animations, Inc.
11 Sintsink Drive East,
Port Washington, New York

Tecnifax Corporation
Holyoke, Massachusetts

Viewlex, Inc.
Holbrook
Long Island, New York

Webster Brothers Laboratory
2049 W. Chase Avenue
Chicago 45, Illinois

Zip-a-Tone, Para-Tone, Inc.
210-12 W. Burlington Avenue
LaGrange, Illinois

[7] Ibid., pp. 230-231.

TABLE III

A SOURCE LIST FOR USERS OF THE OVERHEAD PROJECTOR[8]

Materials and Services for Making Transparencies

Admaster Prints, Inc.
425 Park Avenue, S.
New York 16, N. Y.

Charles Beseler Co.
219 S. 18th St.
East Orange, N. Y.

Robert J. Brady Co.
3227 M St., N. W.
Washington 7, D. C.

Keystone View Company
Meadville, Pa.

Keuffel and Esser Co.
Hoboken, New Jersey

Ozalid Division
General Aniline & Film Corp.
Johnson City, New York

Tecnifax Corporation
Holyoke, Massachusetts

Thermo-Fax Visual Communications Group
Minnesota Mining and Manufacturing Company
St. Paul 19, Minnesota

Ready-Made Transparencies

Admaster Prints, Inc.
425 Park Ave. S.
New York, 16, N. Y.

Robert J. Brady Co.
3227 M Street N.W.
Washington 7, D. C.

State University of Iowa
Bureau of Audiovisual Instruction
Extension Division
Iowa City, Iowa

TABLE III (continued)

Ready-Made Transparencies

McGraw-Hill Book Company, Inc.
330 W. 42nd St.
New York 36, N. Y.

RCA Educational Services
Camden 8, New Jersey

Tecnifax Corporation
Holyoke, Mass.

Tweedy Transparencies
321 Central Ave.
Newark 3, N. J.

How-To-Do-It Literature

Fifth U. S. Army Headquarters
Signal Section
Fort Sheridan, Ill.

Keystone View Company
Meadville, Pa.

Ozalid Division
General Aniline & Film Corp.
Johnson City, N. Y.

Henry Stewart, Inc.
210 Ellicott St.
Buffalo 3, N. Y.

Technifax Corporation
Holyoke, Mass.

Third U. S. Army
(Central Film and Equipment Exchange
Ft. McPherson, Ga.

TABLE III (continued)

How-To-Do-It Films

Indiana University Films
Audio-Visual Center
Indiana University
Bloomington, Ind.

State University of Iowa
Bureau of Audiovisual Instruction
Extension Division
Iowa City, Iowa

Florida State University
(Audiovisual Center)
Tallahassee, Florida

Overhead Projectors

American Optical Company
(Instrument Division)
Buffalo 15, New York

Bausch & Lomb Inc.
(Instrument Sales Division)
635 St. Paul St.
Rochester 2, New York

Charles Beseler Company,
219 S. 18th St.
East Orange, N. J.

Buhl Optical Company
1009 Beech Ave.
Pittsburgh 33, Pa.

Keystone View Company
Meadville, Pa.

Laboratory Furniture Company, Inc.
Old Country Road
P. O. Box 590
Mineola, New York

E. Leitz, Inc.
468 Park Ave., S.
New York 16, New York

TABLE III (continued)

Overhead Projectors

Minnesota Mining and Manufacturing Company
900 Bush Ave.
St. Paul 19, Minn.

Ozalid Division
General Aniline & Film Corporation
Johnson City, New York

Projection Optics Company, Inc.
271 Eleventh Ave.
East Orange, N. J.

Tecnifax Corporation
Holyoke, Mass.

Victorlite Industries, Inc.
4117 W. Jefferson Blvd.
Los Angeles 16, Calif.

Auxiliary Equipment

Admaster Sales Corporation
425 Park Ave. S.
New York 16, N. Y.

H. Wilson Corporation
546 W. 119th St.
Chicago 28, Illinois

[8] Ibid., pp. 232-233.

THE VERSATILITY OF THE OVERHEAD PROJECTOR IN CLASSROOM TEACHING

by

CONRAD HUGH DEAN

B. S., Kansas State University, 1962

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1966

The purpose of this study was to collect and compile information from sources and areas not readily available to the classroom teacher as well as from the library in order to illustrate how the overhead projector can be applied to any teaching area with a little ingenuity.

The method of research used in this study consisted of the reading and analyzing of all books and literature available locally in the library. In addition to this, many companies sent related materials which were analyzed for usable content.

Personal or direct observation of the geometry classes at the Manhattan High School over a three year period was also employed as a means of gathering data.

Illustrations and directions were presented in this paper for determining the type and amount of equipment needed in a classroom, items that can be made by the teacher, methods of making and mounting the transparencies, various styles of presentations, organizing and filing of the prepared transparencies, and special devices for use with the overhead projector. A large number of advantages, as well as a few of the problems and disadvantages, were determined and discussed, but since no statistical controls were applied, no definite conclusions could be reached.

On the basis of the observations made during this study, the only recommendation that can be made is for the further use of the overhead projector and for the continued experimentation by other teachers in all areas.