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A Comparative Study of Teacher Prepared and Commercially Purchased Transparencies in Industrial Arts Education

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A COMPARATIVE STUDY OF TEACHER PREPARED AND COMMERCIALLY PURCHASED TRANSPARENCIES IN INDUSTRIAL ARTS EDUCATION

by
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This thesis submitted by Larry J. Yetter in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota is hereby approved by the Faculty Advisory Committee under whom the work has been done.

(Chairman)

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Signature Larry J. Yetter

Date July 23, 1969

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ABSTRACT

Most graphic arts laboratories in Industrial Arts Teacher Education Programs are equipped with darkroom, process camera and offset printing equipment. The utilization of this equipment for the production of overhead transparencies could update instructional materials for industrial arts courses.

Several processes for producing overhead transparencies were investigated by means of a documentary study of educational and industrial literature. The information gathered was then studied and experimentation was conducted to determine the feasibility of producing single color and multicolor transparencies in the graphic arts laboratory of the Industrial Arts Department.

The results of this study provided the following:

1. Technical information necessary for producing overhead transparencies.
2. A cost comparison between teacher prepared and commercially purchased overhead transparencies.

It was determined that teacher prepared transparencies are of high quality and are less expensive than commercially purchased transparencies.

In conclusions, the production of overhead transparencies in Industrial Arts Teacher Education Programs could enhance course content by giving instructors more flexibility in the selection of visual materials.

CHAPTER I

FORMULATION AND DEFINITION OF THE PROBLEM

Statement of the Problem

This study was concerned with determining the feasibility of preparing single color and multi-color overhead transparencies in Industrial Arts Education. An attempt was made to answer the following questions:

1. Are the supplies and equipment readily available to produce transparencies?
2. Will these teacher prepared transparencies favorably compare to commercially purchased transparencies in content, durability and cost?

Nature and Explanation of the Problem

Much has been written concerning the value of media in the classroom, and media manufacturers are flooding American classrooms with mechanical devices ranging from closed circuit television to overhead projectors; but there is a distinct absence of cross-validation of the contributions to learning that these machines are making.[1]

It is further evident that student attitudes toward instructional media must be measured in terms of acceptance of the method, course content and

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[1]Gerald S. Lesser and Herbert Schueler, "New Media Research in Teacher Education," AV-Communication Review, XIV (Fall, 1966), p. 320.

retention. If visual presentations do facilitate the learning process as compared to verbal presentations, then a strategy must be formed that will make the most efficient use of the media available for specific courses.[2]

The availability of media "software" for specific courses is of major importance. The acquisition of valid, professionally accepted curricular materials is of greatest importance to the commercial firms that produce overhead transparencies.[3]

Since Industrial Arts Teacher Education programs are involved in the teaching of darkroom techniques and offset lithography, the preparation of overhead transparencies would not involve a major change in laboratory procedures. The photography, plate making and darkroom procedures are the same as those employed in printing plants and graphic arts courses now in operation.[4]

Scope and Limitations

This study was limited to visual instructional materials suitable for projection on commercially manufactured ten inch by ten inch overhead projectors. Experimentation was conducted, utilizing commercially available equipment, chemicals, inks and plastics to determine the following:

1. What kinds of equipment and supplies are needed for the production of overhead transparencies in the Industrial Arts laboratory?

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[2]George L. Gropper, "Programing Visual Presentations for Procedural Learning," AV-Communication Review, XVI (Spring, 1968), p. 34.

[3]Letter from William G. Harris, General Manager of United Transparencies Incorporated, Binghamton, New York, January 2, 1969.

[4]Ibid.

2. What will be the cost of each transparency?

3. How will the cost of each transparency produced in the laboratory compare to commercially purchased transparencies?

Type and Methods of Research

A documentary study of educational research and industrial data was conducted to determine what materials, supplies and equipment are needed to produce overhead transparencies.

The experimental method of research was employed to determine how industrial methods of production could be duplicated in the Industrial Arts laboratory.

Need and Purpose of the Study

The purpose of this study was to investigate the process of producing overhead transparencies, to determine the practicality of their production in the Industrial Arts laboratory, and to compare the cost and quality of laboratory-produced transparencies to commercial mass produced versions. In addition, the purpose was to seek a method for producing transparencies superior to the heat transfer and the diazo processes. Heat transfer transparencies are fragile, difficult to store and are limited to the reproduction of same size original copy.

Diazo is also limited to same size as the original copy and produces negative transparencies from positive copy, unless sophisticated expensive equipment is purchased for the exposure phase. Diazo is limited to single color unless overlays are included and all diazo prints are susceptible to damage from sunlight.

The need for this study was dictated by the rising cost of mass production, the lack of suitable subject matter contained in commercially purchased transparencies, and the absence of local application in existing materials.

> The lack of existing instructional materials having local applications, the trends in new class groupings that require new types of resources, and a number of personal values, all justify the local application of audiovisual materials.[5]

The nature of technological advancements have changed our language to the extent that words alone are often ineffective communication. Together with these advancements, the limited experiences of most people make effective conveyance of technical ideas and concepts somewhat difficult. Commercially produced materials are general in nature to meet the needs of diversified audiences. Laboratory-prepared materials add local emphasis that is more meaningful to a class or group.[6]

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[5]Jerrold E. Kemp, Planning and Producing Audiovisual Materials (San Francisco: Chandler Publishing Company, 1963), p. 3.

[6]Ibid., p. 4.

CHAPTER II

REVIEW OF THE LITERATURE

Research has proven that visual materials do have a positive effect on the learning process and teaching time is reduced. Since we are aware that oral, written and visual presentations are all effective methods of communication, it is apparent that any or all of these methods can be combined in one format. Some of the advantages of a multi-method presentation include renewed student interest, ease in presenting a complex theory, and appeal to more than one of the human senses.[7]

Proceeding on the basic assumption that projectuals have a place in the classroom, L. Dayle Yeager conducted an experiment utilizing projectuals for the teaching of Junior High School electricity classes.[8] The students were divided into two groups, experimental and control, each consisting of eight classes. Four teachers were utilized for the study. Each teacher was to teach four classes, two experimental and two control. The basic objective of the study was to determine the impact of projectuals upon students, concerning increased initial learning, increasing overall retention and facilitating review procedures.

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[7]Norman R. Stranger, "Multi-Sensory Presentations", Visual Communications Instructor, III (October, 1968), p. 17.

[8]Lowery Dayle Yeager, "About Projectuals", The Journal of Industrial Arts, XXVII (September-October, 1968), p. 32.

In view of the objectives of the study, lesson plans including lecture material, software and time allotments were constructed for the selected units of electricity. These units included Basic Fundamentals, Magnetism, Ohm's Law and Power Formula, Circuits and AC-DC Electricity. The nucleus of the experimental presentation was twenty-nine overhead transparencies prepared by the researcher and the teachers. Evaluation consisted of five unit tests, a pretest, a posttest and a final test.

Conclusions resulting from this study included:

1. Teaching time was reduced by one-third in the experimental group as compared to the control group.
2. Achievement between the two groups was statistically insignificant.
3. Review time for the final examinations was reduced by one-third for the experimental group.

C. O. Neidt and D. D. Sjogren coordinated a four part control group designed to determine the nature of changes in student attitudes when other than conventional instructional methods are employed.[9]

Three of the groups, Programed Instruction, Educational Television and Small Class, each had an enrollment of 330 students. The fourth group, Large Class, consisted of 598 students. All were college students from Colorado State University, University of Colorado and the University of Missouri. All participants were regularly enrolled lower classmen, and each of the four groups was made up of an average of four different classes.

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[9]C. O. Neidt and D. D Sjogen, "Changes in Student Attitudes During a Course in Relation to Instructional Media," AV-Communication Review, XVI (Fall, 1968), p. 278.

Each course was divided into five equal units and an attitude scale was administered at the end of each unit. The scales were administered by graduate assistants. Five hundred attitudinal statements were compiled by reviewing current literature and by interviewing students who have had a recent programed learning experience. These 500 statements were further divided into three major areas: attitude toward method of instruction, attitude toward expectation, and attitude toward content.

After the results were tabulated, another scale was constructed, and by using "Equal Appearing Intervals", twenty-six items were placed on the final scale. The final results revealed that a decline in student attitude and interest was very evident in every course between the administering of each scale. However, those classes suffering the least in decline were programed instruction, followed by educational television, small class and large class.

The researchers feel that this study clearly indicates that student attitudes are related to teaching methods. They also feel that student attitudes will decline during a course if only one method of instruction is used.

Using only a ten minute 16 m/m film, Edward Levonian sought to determine the difference between auditory and visual retention.[10] Eighty-three high school students enrolled in a driver education course were chosen for this experiment. It was a regularly scheduled course in driver education, consisting of 15-year-old high school students of which about half were female.

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[10]Edward Levonian, "Auditory and Visual Retention in Relation to Arousal," AV-Communication Review, XVI (Spring, 1968), p. 60.

The traffic safety film used was a regularly scheduled part of the course. Immediately after viewing the film, the students responded to a fifteen item questionnaire consisting of seven auditory and eight visual yes or no interspaced questions. However, the students were not aware that they would be required to answer the same questionnaire one week later.

In the final tabulations for both time intervals, no retention occurred for 14.8 per cent of the auditory answers and 13.8 per cent of the visual answers. Thus, the tabulated results indicate that there is no significant difference in retention when materials are presented in either a visual or an auditory manner.

Further study of visual versus verbal presentations was carried out with a group of 673 elementary school children in Cleveland, Ohio.[11] These 673 students were drawn from the fourth, fifth and sixth grades and consisted of both Negro and White boys and girls.

Experimental conditions consisted of three groups: group one replied to verbal stimuli, group two replied to visual stimuli and group three to both verbal and pictorial stimuli. All stimuli were presented on black and white 35 m/m slides. Nouns such as rabbit, pillow and telephone were used in word and picture form for groups one and two. For group three, both the picture and the word appeared on the same slide. Thirty-five stimuli were flashed on a screen at ten second intervals and the students were required to respond with the first word that came to their minds.

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[11] Whitfield Bourisseau, O. L. Davis, and Kaoru Yamamoto, "Sense-Impression Responses of Negro and White Children to Verbal and Pictorial Stimuli," AV-Communication Review, XV (Fall, 1967), p. 265.

The results were tabulated in two categories, sensory and non-sensory. It was evident from the final tabulations that verbal rather than visual stimuli produce better sensory responses. However, further tabulations also revealed that visual stimuli were superior when specific and less abstract responses were sought.

Since most research efforts are conducted over a relatively short time span, conclusive retention values are not readily available. However, a five year study is presently in progress in the elementary social studies classes in Anaheim, California.[12] Consisting of three groups, television and related classroom teaching, large group television and a control group of conventional classes with no television, this study is designed to evaluate retention over a long period of time.

Each of the groups is presented with the same course content and write the same examinations. At the end of each year the group scores are tabulated and compared for achievement and retention.

Although this study is only in its third year, the results of the previous two years clearly indicate that the two TV groups are superior in achievement and retention, even though the control group achieved a significant gain in the second year.

In a more specific study of visuals, Chan, Travers and Van Mondfrans conducted an auditory versus colored visual research at the University of Utah.[13] One hundred and sixty-six psychology students were divided into

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[12]Kenneth D. Hopkins and D. Welty Lefever, "Comparative Learning and Retention of Conventional and Instructional TV Methods," AV-Communication Review, XIII (Spring, 1965), p. 30.

[13]Adrian Chan, Robert M. Travers, and Adrian P. Van Mondfrans, "The Effect of Colored Embellishment of a Visual Array on a Simultaneously Presented Audio Array," AV-Communication Review, XIII (Summer, 1965), p. 160.

groups of four to six and assigned to either group A or group B. The students in group A responded to colored syllables and taped syllables. Group B students responded to black and white syllables and taped syllables. Each group viewed eight syllables and listened to eight different syllables. After the presentation, each group wrote down, in separate columns, the syllables remembered from the audio and from the visual.

Results indicated that the total amount of learning for both groups was the same. However, more was learned visually by group A, than by group B, but at the expense of the audio portion. Both groups scored higher on the visual syllables than on the auditory syllables.

A series of visuals was constructed by Gilbert Schwartz and Harrison Goodall to facilitate teaching design in industrial arts classes. The design of any industrial product is a systematic process from need to working drawing. The steps between these two entities can best be illustrated visually since visual acceptance plays a major role in the design of consumer products.[14]

As with any of the methods of communication the presentor must be convinced of the value of visual presentations. In view of this, Richard T. Williams was appointed Director of Audiovisual Instruction for the Berlin, Connecticut School District. His specific job was to develop an Instructional Communications Center that could augment present instructional techniques.[15]

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[14]Gilbert Schwartz and Harrison Goodall, "Teaching the Design Concept With the Use of Visuals," Industrial Arts and Vocational Education, LVI, (January, 1967), p. 41.

[15]A. V. Lesmez, "Implementing Audiovisual Services By Phases," Visual Communications Instructor, III, (December, 1968), p. 12.

A pilot program was established within the school district to develop, improve and stimulate teacher-interest in the use of media in the classroom. Fifteen teachers were chosen to attend an eight week course in basic graphic skills. Before the course ended more than fifty per cent of the one hundred teachers in the Berlin district were involved in the program.

Evaluation of this pilot program was not exceedingly difficult since teacher enthusiasm ranked high. As Mr. Williams stated:

> The most encouraging aspect of this program is that the teachers feel that these activities enable them to use an increasing variety of instructional materials more effectively. Furthermore, since preparation of materials requires in-depth research, such activities increased their understanding of the subjects they teach. Because they were exposed to actual production procedures, teachers have become more aware of the availability of materials, their proper cost and the realistic amount of time to allow for actual production. Most of all these teachers are better able to evaluate all types of instructional materials for effectiveness.[16]

As a result of this initial program each school in the Berlin system is now equipped with individual facilities for the preparation of visual aids. Further, long range planning is attempting to clarify and anticipate future needs of the entire system, the teachers and the students.

Visuals are meant to draw attention to one concept. Therefore, accurate, careful planning must be exercised if effective visuals are to be prepared.[17] Simplicity and briefness are the basic guide lines for effective visuals. Color is a vital factor in any format but not to the extent that colors distract from the basic point presented:

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[16] <u>Ibid</u>., p. 13.

[17] Howard A. Floyd, "How To Pre-Plan Your Visual Aids," <u>Reproductions Review</u>, XVIII, (November, 1968), p. 14.

Intelligent planning of visuals within the framework of a standard guide, careful editing and allowance of adequate time for preparation will go a long way toward assuring the production of satisfactory visuals at minimum cost.[18]

To accurately estimate the cost of visual production it is necessary to take into consideration two factors. The first cost to be considered is the preparation of the master to be used in the actual production. Some items to consider in this phase are preliminary drawings, re-drawing and proofs. The second cost factor is the actual production of the visual, which includes materials and labor.[19]

A prime example involved three industrial executives employed by the same company and scheduled to make separate presentations at a joint conference.

Executive "A" ordered six, seven inch by seven inch overhead transparencies with ten single color overlays and five multi-color overlays. Due to the complexness of this order a professional art service prepared the drawings and the parent company reproduced the final copies. The breakdown of costs was $835 for the art work and $230 for the materials and labor to produce the transparencies, representing a cost of $177.50 for each transparency.

Executive "B" needed ten transparencies. Though less complex than the previous example, due to last minute changes necessitating a great deal of re-drawing and actual re-making of some of the transparencies, a tremendous amount of time and materials were wasted. Twenty-three

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[18] Ibid., p. 43.

[19] Howard A. Floyd, "Make Visuals In-House and Save," Reproductions Review, XIX, (April, 1969), p. 24.

transparencies were produced, but only ten were used. The ultimate cost of each usable transparency was $59.10.

Executive "C" also requested ten transparencies but insisted that they contain only brief concepts for support of his oral presentation. All operations were performed within the parent company and the resulting cost amounted to $12 for each transparency.[20]

Transparencies of excellent quality can be produced, utilizing existing graphics equipment. The designer of the transparencies needs only to keep within the boundaries of clarity and simplicity.[21]

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[20] Ibid., p. 40.

[21] Ibid., p. 43.

CHAPTER III

RESULTS OF EXPERIMENTS

This chapter is subdivided into four separate units. Each of these units describes in detail the methods used to produce overhead transparencies. In conjunction with the description, a sample transparency is included as well as a cost analysis. The Graphic Arts Laboratory was utilized for the processing of transparencies.

Black and White Positive Transparencies On Orthochromatic Film Type-3

The making of a transparency from orthochromatic film is best facilitated by using a graphic arts process camera. By using the camera, original copy may be enlarged or reduced proportionately.

After the copy has been selected, it is placed in the copy board of the camera. A ground glass is placed in position on the camera in place of the film holder. In this position the copy may be viewed in the ground glass and adjustments are made to the camera to either reduce or enlarge or reproduce the copy in exact size. Measurements of the copy are taken on the ground glass and a high degree of accuracy is attained. When a satisfactory size is arrived at, usually an image area of seven and one-half inches by nine and one-half inches, the ground glass is removed and the film holder is left in position to receive the film.

With dark room lights off and with only the red light on, a piece of orthochromatic film is selected and placed on the vacuum film holder. The film is positioned so that the emulsion side of the film is facing the copy when the camera is closed and ready to expose the film. At this point it is important to follow the specific instructions for the camera used as to exposure time and intensity of the light source.

When exposure is completed, the development of the film takes place in a solution recommended by the film manufacturer for from two to three minutes at 68° F. The film is then rinsed in a Stop Bath for fifteen seconds. At this point the film is emersed and agitated in an etch bath consisting of the following:

Solution A

Water (125-150° F) - - - - - - - - -	24 ounces
Copper Sulfate - - - - - - - - - - - -	4 ounces
Citric Acid - - - - - - - - - - - - - -	5 ounces
Potassium Bromide - - - - - - - -	1/4 ounce

Mix thoroughly until all chemicals are dissolved.

Solution B

3% Solution Hydrogen Peroxide

For etching prepare a bath of equal parts A and B.[22]

Etching is continued until the silver image is bleached completely through and the black gelatin layer is dissolved. Room lights may be turned on after the etching is completed. The film is washed for fifteen to thirty seconds in running water at 65° to 75° F. To insure removal of all traces of

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[22] "Making Transparencies For Overhead Projection", Eastman Kodak Company Pamphlet No. S-7, (1968), p. 6.

gelatin the film may be swabbed gently with a wet cotton pad. No pressure is applied.

The lines of copy on the film are now a light cream color. To obtain sharp black lines, the film is re-developed for three minutes, rinsed in the stop bath for fifteen seconds and agitated in Fixer for five minutes.[23] The film is now washed in running water for five minutes and then hung up to dry. When drying is completed, approximately thirty minutes, the film may be mounted in a standard nine and one-half inch by seven and one-half inch projection frame.

The sample transparency on the following page is designed to facilitate the students' conception of the Multilith Offset Press Ink and Fountain Roller System. The original copy was selected from programed teaching materials furnished by the Addressograph Multigraph Corporation and reduced to 80 per cent of original size.

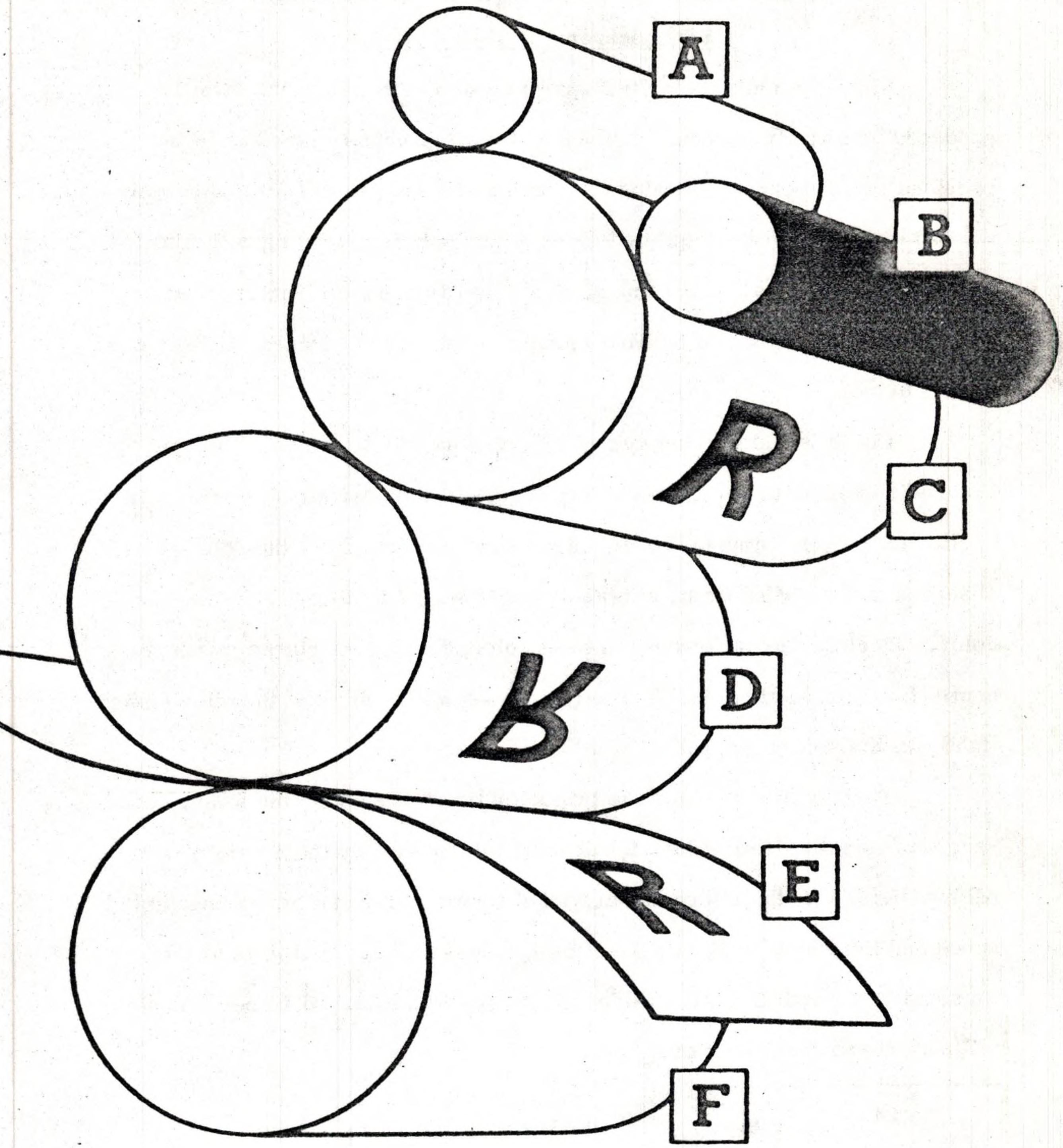
Cost Analysis

Kodalith Estar Base Film (.004 thick)	=	$ .30
Kodalith Film Processing Chemicals	=	.02
Transparency Mounting Frame	=	.10
Transparency Mounting Tape	=	.07
Total		$ .49

After selection of the copy, the total processing time, including mounting of the transparency, did not exceed fifteen minutes.

[23] Ibid.

Figure 1.--Ink and fountain roller system of the Multilith 1250 Offset Press.


A
B
C
D
E
F

Single or Multi-color Positive Transparencies On Orthochromatic Film Type-3

Single or multi-color transparencies on orthochromatic film are produced by slightly varying the black and white process described in the previous experiment. Following the etching process, the film is thoroughly washed in water and then agitated in the Fixer solution. Fixing will dissolve the image lines and all that remains is a relief image etched in the film base. The film is washed for five minutes to remove all traces of Fixer and then is dried.

Color is added by applying liquid food colors to the relief image. To acquire complete coverage, several drops of the desired color are applied to the relief image. After ample time is allowed for the color to be absorbed in the etched area, a swabbing pad is used to absorb the excess color. To clear the background area of color, the film is rinsed in a 2 per cent solution of acetic acid.[24] The film is allowed to dry and then is polished lightly with a soft cotton pad.

The original copy for the two color transparency on the following page was selected from industrial literature furnished by the Huntington Alloys Division of the International Nickel Company for use by the regularly scheduled Introductory Metals Technology Class in Industrial Arts at the University of North Dakota. The original copy was enlarged 20 per cent for utilization as a transparency.

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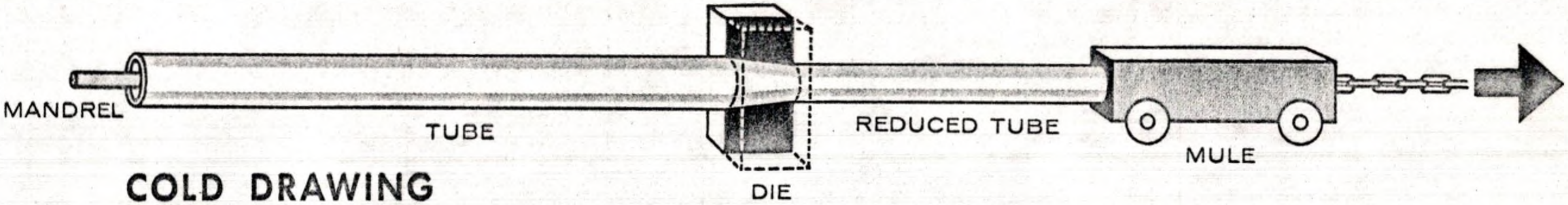
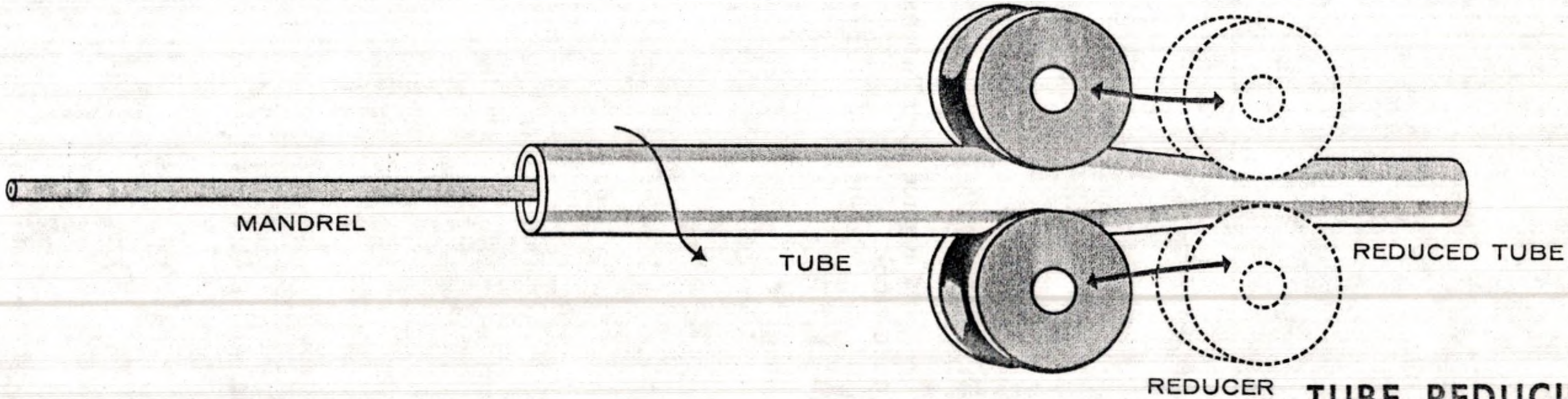
[24]*Ibid.*, p. 8.

Figure 2.--Two methods of reducing diameter of cold tube stock.

Two ways to reduce *Tube* Dimensions



COLD DRAWING



TUBE REDUCING

Cost Analysis

Kodalith Estar Base Film (.004 thick)	= $ .30
Kodalith Film Processing Chemicals	= .02
Food Coloring	= .03
Transparency Mounting Frame	= .10
Transparency Mounting Tape	= .07
Total	$ .52

Film processing, including mounting and color additives, did not exceed twenty-five minutes.

Black and White Positive Transparencies

On Autopositive Projection Film

Transparency production on autopositive projection film is fast and economical. However, due to critical development time and temperature, the resulting transparencies tend to retain a clouded background.

Preparation of the original copy and equipment is the same as in the two previous experiments. However, a special developer is required and it must be held to a constant temperature of 68° to 72° F. Exposure time is based on 1500 footcandles for twenty seconds with an F32 lens opening. Enlarging or reducing the original copy drastically affects these basic calibrations.

The following table may be consulted for any change in reproduction size:[25]

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[25]"Kodak Autopositive Materials," Eastman Kodak Company Pamphlet No. Q-23, (1968), p. 8.

Reproduction Size	25%	50%	100%	150%	200%	300%
Multiply Exposure Time by:	.4	.55	1.0	1.6	2.3	4.0

After exposure the film is developed for one and one-half to five minutes. The development time varies due to light intensity and any variance in reproduction size in relation to the original copy. Development time can only be established through trial and error.

During exposure and development, the film must be handled under red safe light. However, as soon as development is completed, room lights may be turned on.

To remove the top gelatin layer, the film is placed on an inclined surface and sprayed with running water at 60° to 90° F.[26] While spraying, the surface is swabbed gently with a soft cotton pad. It is then washed thoroughly and allowed to dry.

The transparency on page 27 was produced by enlarging the original copy 290 per cent and exposing the film for 120 seconds at F32. Development time was two minutes. The original copy was reproduced from instructional pamphlets supplied by the Ajax Electric Furnace Company.

Cost Analysis

Kodak Estar Base Autopositive Projection Film	=	$ .34
Kodalith Autopositive Developer	=	.04
Transparency Mounting Frame	=	.10
Transparency Mounting Tape	=	.07
Total		$ .55

Film processing and mounting time did not exceed ten minutes.

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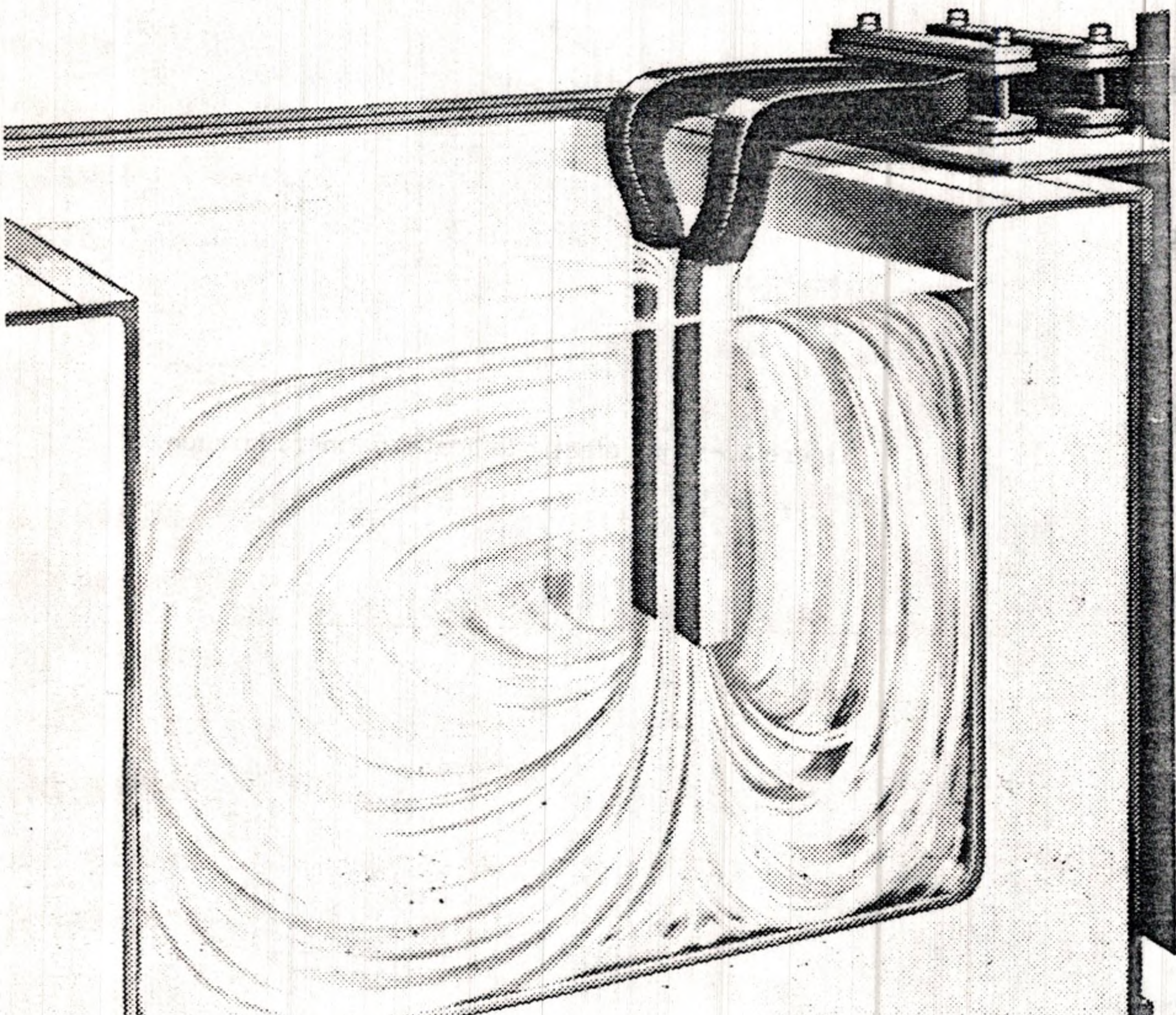
[26] Ibid., p. 8.

Figure 3.--Ajax electrode heat treatment furnace.



Multi-Color Positive Transparencies

Printed By Offset Lithography

Utilizing the afore mentioned processes, transparencies are produced on a one to one ratio. To facilitate rapid mass production of the same original copy, the offset printing process was selected.

The offset process for printing transparencies does not differ from standard procedures accepted in the printing industry. However, a compatability between the ink and the plastic printing surface must be maintained. Along with this compatability, the ink must be sufficiently transparent to allow light from the projector to pass through and transmit color on the screen.

As in the previous experiments, production commences with selection or production of original copy. If the original copy is produced in the laboratory, it is best to produce it oversize and reduce the image to printing size during the photographic process. This procedure will minimize drafting errors.

The only deviation from standard offset practices is during the plate burning procedures. Normally, the photographic negative and the sensitized offset printing plate are positioned together in such a way that the printing image will be "right reading." However, the transparency is printed in reverse by turning the photographic negative over during the plate burning operation. Plate de-sensitizing and development are carried out in the routine manner.

During press operation the plastic sheets have a tendency to stick together due to static electricity and thus produce feeding problems. This condition is corrected by placing tissue paper interleafs between each plastic sheet. However, this practice creates another problem, as the interleafs must also be fed through the press. The solution to these problems was solved by adhering the interleaf to the plastic sheet with double stick tape. Thus, the plastic and the interleaf are fed through the press at the same time, but only the plastic receives a printed image.

Ink control on the press is critical and only a very thin coating of ink is applied to the plastic. This thin coat prevents cracking and chipping of the ink after drying time and minimizes image backset in the press delivery and stacking system. The backset that does occur is not detrimental to the printed surface due to the presence of the attached interleaf.

Single color runs are quite elementary but multi-colors present registration difficulties. Although the A. B. Dick Offset Press used for this experiment had both horizontal and vertical adjustments for registration, some problems were encountered. Close register of the second color is very difficult when both horizontal and vertical placement of the second color is critical. This problem is illustrated by the red arrow and the red cam lob of the engine cut-away in Figure 5. However, when registration of the second color is only required in one plane, either horizontal or vertical, the operation is immensely simplified. This type of registration is illustrated in the sample transparency in Figure 7.

Press speeds are not critical and may be maintained approximately the same as when feeding twenty pound coated stock. However, the delivery and stacking system of the press will reach its capacity much sooner with five mil plastic than with twenty pound coated stock. Also, the printed plastic must be dried individually and not in stacks.

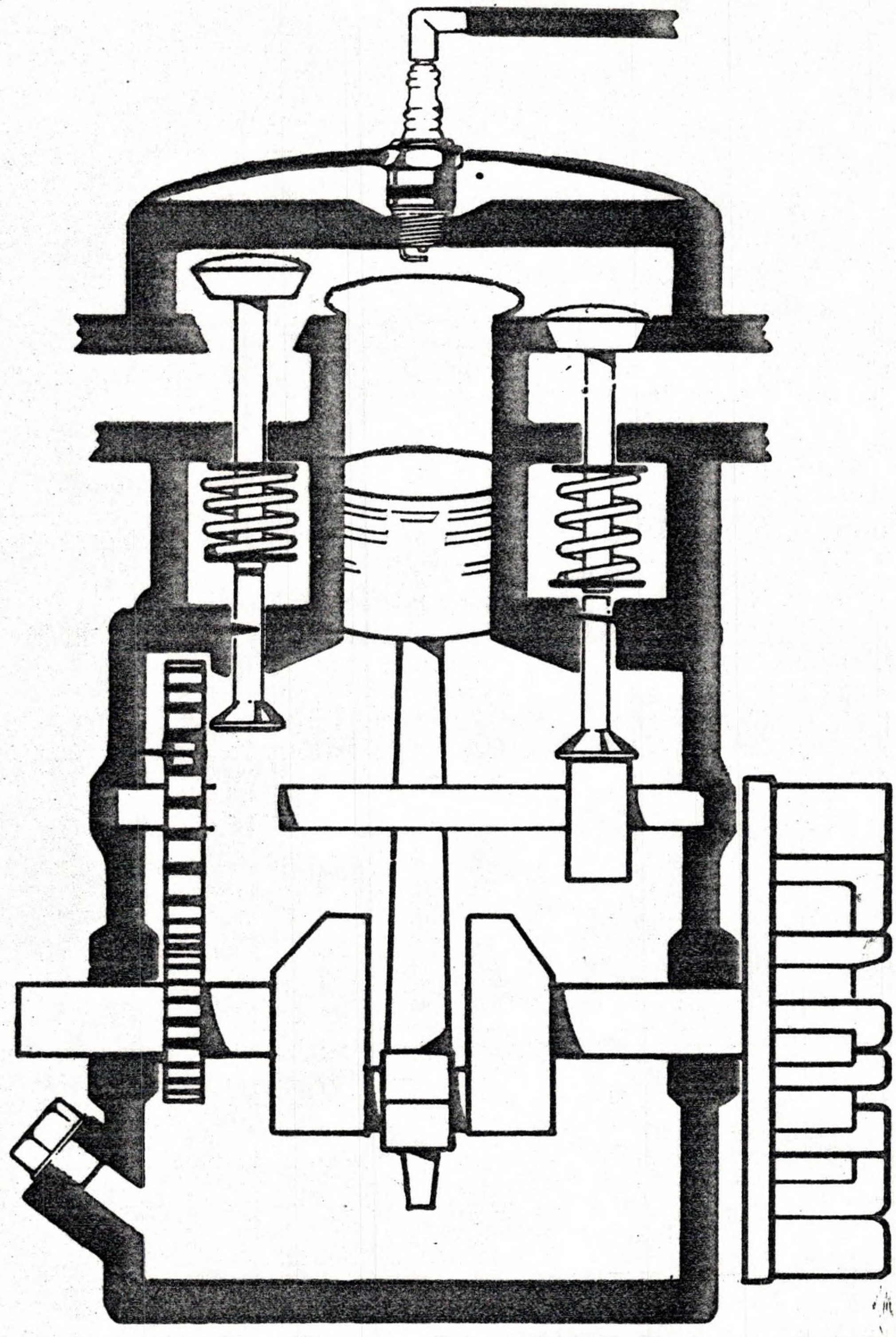
The sample transparencies (Figures 4 through 7) were printed on five mil, Kodacel TA401 Triacitate using balanced process transparent inks furnished by the Sun Chemical Corporation, Carlstadt, New Jersey.

Cost Analysis

Kodalith Estar Base Film (.004 thick) - -	$ .22
Kodalith Film Processing Chemicals - - -	.02
Mask -	.03
Offset Printing Plates - - - - - - - - - - - -	.48
Plate Development Chemicals - - - - - -	.05
Ink -	.05
Plastic -	.05
Transparency Mounting Frame - - - - - -	.10
Transparency Mounting Tape - - - - - - -	.07
Total	$1.07

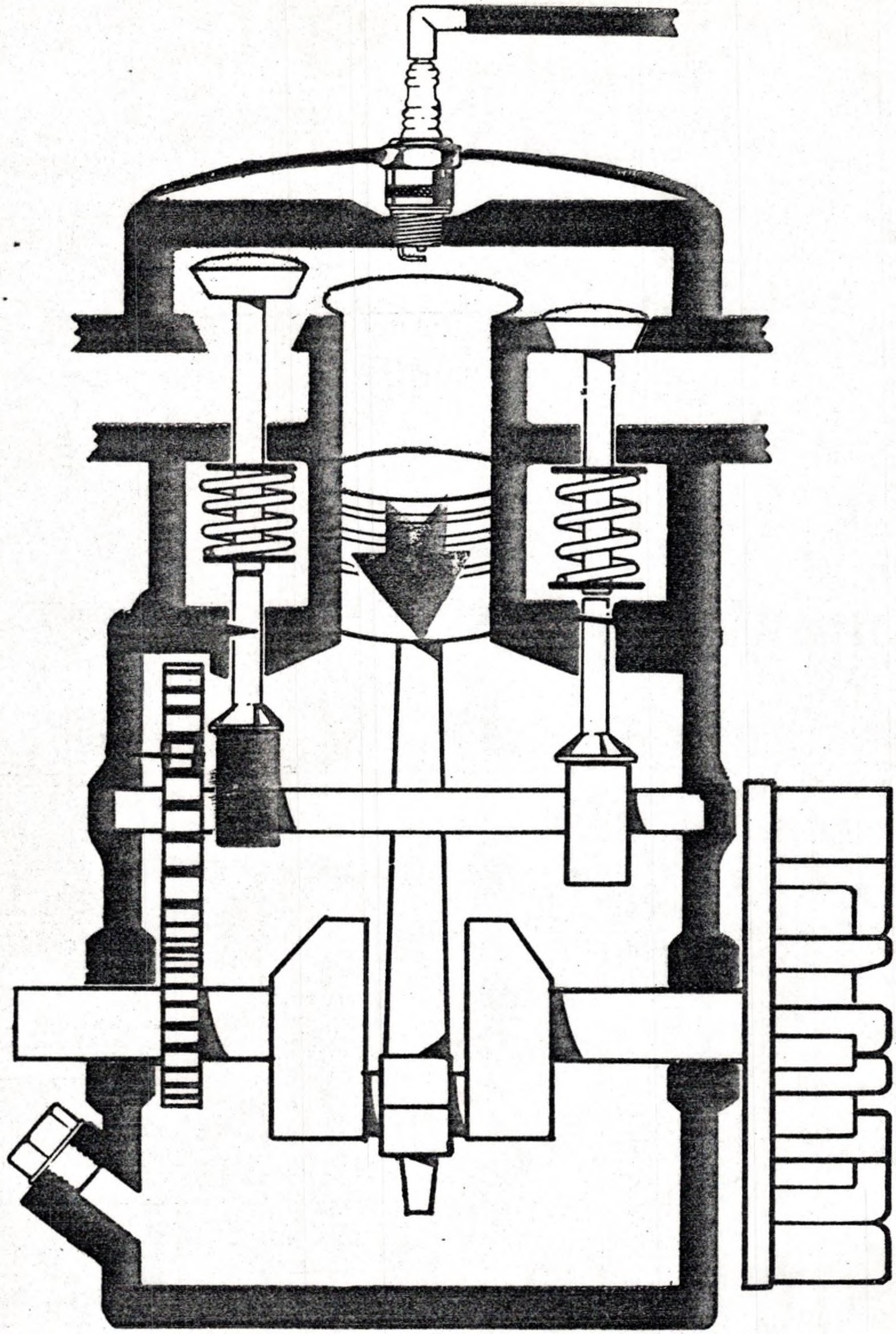
This cost analysis represents the first printed copy. Each succeeding printed copy would only require plastic, ink, mounting frame and tape. Therefore, each succeeding print would be obtained at a cost of twenty-seven cents. At least two hours were required for production of the first print.

Figure 4.--First press run. Intake stroke of a four stroke cycle engine.



NTAKE OR SUCTION STROKE

Figure 5.--Second press run. Intake stroke of the four stroke cycle engine.



NTAKE OR SUCTION STROKE

Figure 6.--First press run. Tailstock offset for machining tapers on a metal lathe.

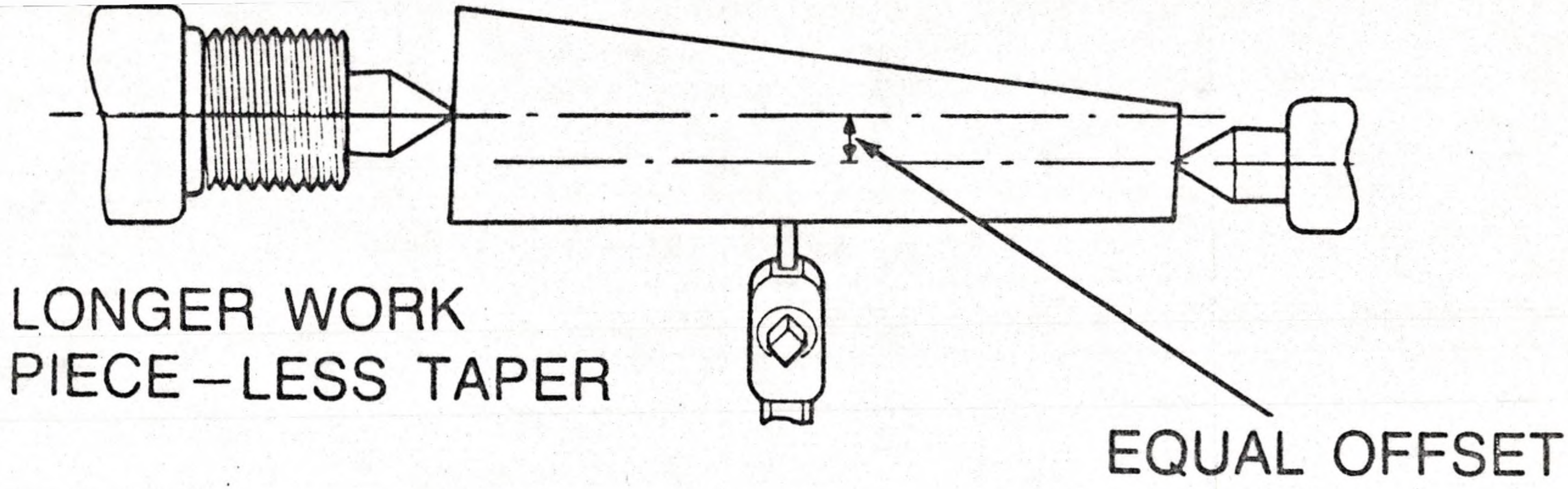
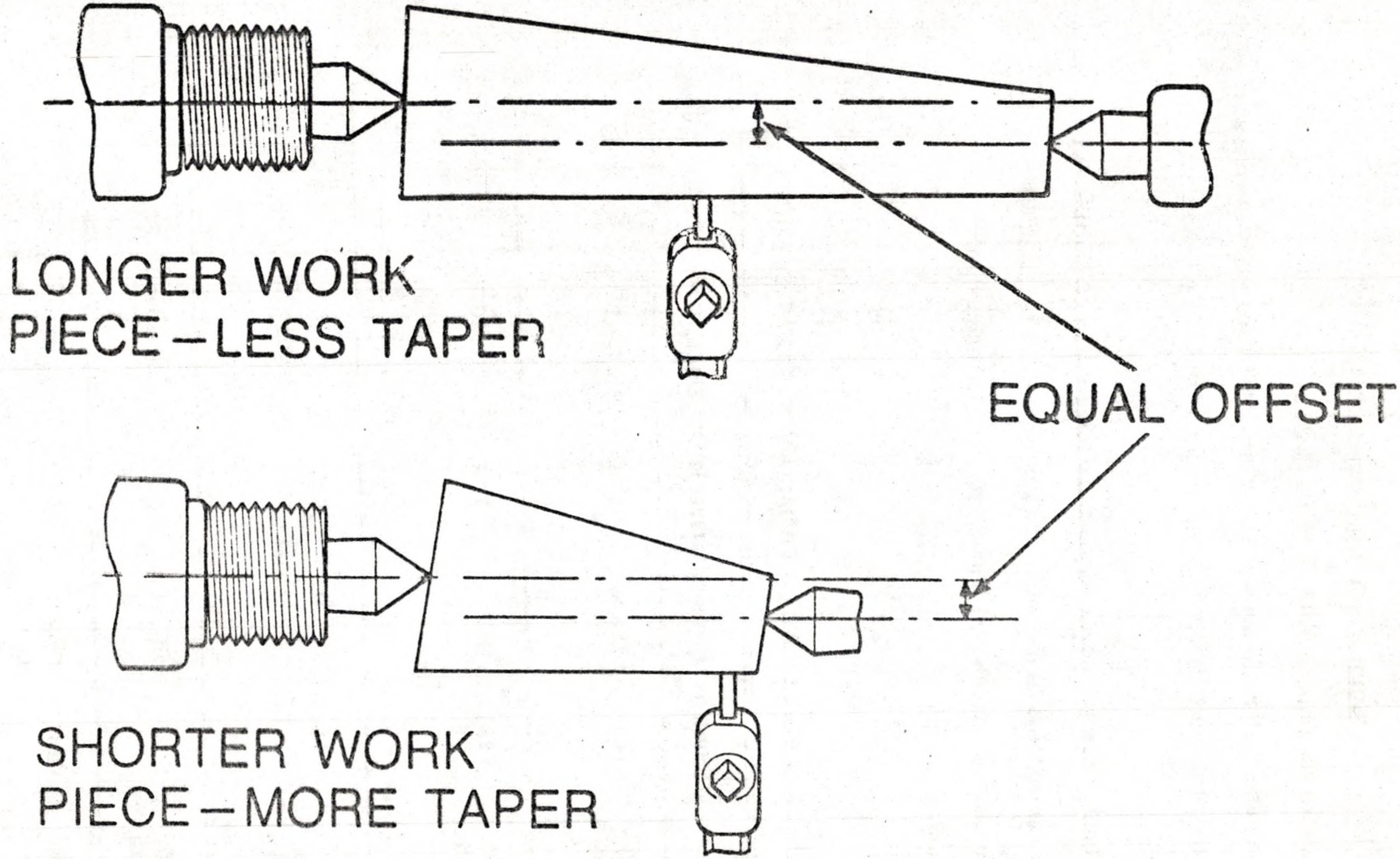

LONGER WORK
PIECE—LESS TAPER
EQUAL OFFSET

Figure 7.--Second press run. Tailstock offset for machining tapers on a metal lathe.



TAPER VARIES WITH LENGTH

Commercial Comparison

A review of the data in Table 1 reveals that:

1. The base materials used in the afore mentioned experiments are of the same quality as the base materials used by industrial firms.
2. Overlays are not necessary for the acquisition of multi-color transparencies in the laboratory prepared transparencies.
3. The cost for purchased transparencies far exceeds those produced in the laboratory.

TABLE 1

TRANSPARENCIES AVAILABLE FROM COMMERCIAL SOURCES

Company	Base	Mounted	Process	Overlays	Single Color	Multi Color
Keuffel & Esser	Diazo film .004	Yes	Diazo	Yes	$1.75-4.45	$2.65-11.25
United Trans-parencies Inc.	.005 Plastic	Yes	Offset	Yes	$1.50	$1.95-3.95 2 colors
Technifax Plastic Coating Corp.	.004 Diazo film	Yes	Diazo	Yes	$1.95	Not Available
Brodhead-Garrett	.005 Plastic	Yes	Offset	Yes	$3.65-10.60	$3.65-10.60
Minnesota Mining & Manuf. Co.	.005 Plastic	Yes	Offset Diazo	Yes	Available in Sets Single and Multi-Color $32.00-$700.00	

CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Media "software" has become an integral part of the educational process. Due to the vast quantity of new knowledge that is being discovered, the educational process on all levels must take immediate steps to condense and simplify this knowledge.

Although there is little proof supporting the hypothesis that media promotes retention, there is valid research to support the use of media in the classroom. This support stems from reports that conclude that media facilitates individualized instruction, speeds up the educational process and leaves the teacher more time to attend to individual student needs.

Durable, low cost transparencies can be produced in either black and white or color through the use of existing graphic arts photomechanical equipment and supplies. This process requires the addition of an etching bath, coloring solution, transparent ink and plastic sheets.

The process makes use of the following equipment and supplies:

1. Darkroom--a room equipped with running water, a sink and capable of being darkened from all light except red safe lights.

2. Process Camera--a camera capable of reducing, enlarging and copying graphic materials through the use of sheet film.

3. Orthochromatic Film--a light-sensitive polyester base material that produces a negative of full contrast: black and white with no intermediate tones.

4. Developer--a special solution used to bring out the latent image of exposed film.

5. Stop Bath--a citric acid solution used to stop development of the film at a predetermined time.

6. Etch Bath--a copper sulfate solution that chemically reacts with the film's silver base to change the negative to a positive.

7. Fixer--a commercially prepared bath used to harden the film surface.

8. Coloring Agents--any coloring agent that is water soluble. Food coloring, water paints and colored pencils are readily acceptable for the photo processes, and transparent inks are acceptable for the mechanical process.

9. Offset Press--any offset press equipped with vacuum feed and capable of receiving eight and one-half by eleven inch sheets.

10. Plastic Sheets--any clear plastic material compatible with the selected inks and at least five mils thick.

Of the materials utilized, only the etch bath, coloring agents and plastic sheets would constitute additions to existing programs offering Offset Lithography. These additions do not represent a large monetary investment.

Conclusions

Teacher prepared transparencies in Industrial Arts Education can greatly enhance the present course content. Instructors should take greater interest in the selection of transparencies with regard to local application and student needs.

Industrial literature will take on new meaning. Materials unsuitable for classroom use, because of limited size, can become brilliantly colored transparencies in a matter of minutes at a very low cost.

Upgrading of existing projectuals and expansion of course content can be incorporated at any interval; and, teachers will become more knowledgeable about the material presented when they are responsible for the preparation of accurate visuals.

Teachers will continue to select the course content and transparencies will continue in their role as supporting material for lectures and demonstrations. However, if transparencies are purchased, they tend to become the core of the course; thus, lectures and demonstrations will be serving as supporting material. In this way sources other than educational fields may be exercising too great an influence in the classroom.

Since these transparencies are less expensive, yet of equal quality with regard to materials and course content, more concepts could be introduced to the students in a meaningful form. Thus, teachers and students would benefit considerably through the implementation of these processes.

Recommendations

It is the author's recommendation that the orthochromatic and the autopositive processes for the production of overhead transparencies be incorporated in Industrial Arts Teacher Education Programs. The financial outlay for supplies is minimal when compared to the cost of commercially purchased transparencies.

It is further recommended that the graphic arts instructor should make provisions to inform all staff members of the existence of materials and supplies for the production of transparencies when they become available. Also, as soon as possible, these techniques should be introduced to the students during the regularly scheduled offset lithography courses.

The author does not recommend the production of transparencies by utilizing the Offset Lithography Process. Although the transparencies are of high quality, the process is much too technical and time consuming to justify the production of a single transparency. However, under special conditions that warrant the mass production of a single concept for overhead projection, this process is highly recommended.

BIBLIOGRAPHY

Books

Kemp, Jerrold E. Planning and Producing Audiovisual Materials. San Francisco: Chandler Publishing Company, 1963.

Journals

Bourisseau, Whitfield; Davis, O. L.; and Yamamoto, Kaoru. "Sense-Impression Responses of Negro and White Children to Verbal and Pictorial Stimuli." AV-Communication Review, XV (Fall, 1967), pp. 259-268.

Chan, Adrian; Travers, Robert M.; and Van Mondframs, Adrian P. "The Effect of Colored Embellishment of a Visual Array on a Simultaneously Presented Audio Array." AV-Communication Review, XIII (Summer, 1965), pp. 159-164.

Gropper, George L. "Programing Visual Presentations for Procedural Learning." AV-Communication Review, XVI (Spring, 1968), pp. 33-56.

Hopkins, Kenneth D. and Lefever, D. Welty. "Comparative Learning and Retention of Conventional and Instructional TV Methods." AV-Communication Review, XIII (Spring, 1965), pp. 28-37.

Lesmez, A. V. "Implementing Audiovisual Services By Phases." Visual Communications Instructor, III (December, 1968), pp. 11-19.

Lesser, Gerald S. and Schueler, Herbert. "New Media Research in Teacher Education." AV-Communication Review, XIV (Fall, 1966), pp. 318-362.

Levonian, Edward. "Auditory and Visual Retention in Relation to Arousal." AV-Communication Review, XVI (Spring, 1968), pp. 57-62.

Neidt, C. O. and Sjogen, D. D. "Changes in Student Attitudes During a Course in Relation to Instructional Media." AV-Communication Review, XVI (Fall, 1968), pp. 250-286.

Stranger, Norman R. "Multi-Sensory Presentations." Visual Communication Instructor, III (October, 1968), pp. 15-24.

Yeager, Lowery Dayle. "About Projectuals." The Journal of Industrial Arts, XXVII (September-October, 1968), pp. 32-33.

Articles

Floyd, Howard A. "How to Pre-Plan Your Visual Aids." Reproductions Review, November, 1968, pp. 13-45.

Floyd, Howard A. "Make Visuals In-House and Save." Reproductions Review, April, 1969, pp. 23-43.

Schwartz, Gilbert and Goodall, Harrison. "Teaching the Design Concept with the Use of Visuals." Industrial Arts and Vocational Education, January, 1967, pp. 41-44.

Pamphlets

"Kodak Autopositive Materials." Eastman Kodak Company Pamphlet No. Q-23, (1968), pp. 1-8.

"Making Transparencies for Overhead Projection." Eastman Kodak Company Pamphlet No. S-7, (1968), pp. 1-8.

Letters

Harris, William G. General Manager of United Transparencies Incorporated, Binghamton, New York, January 2, 1969.