ENGINEERING DESIGN GRAPHICS JOURNAL

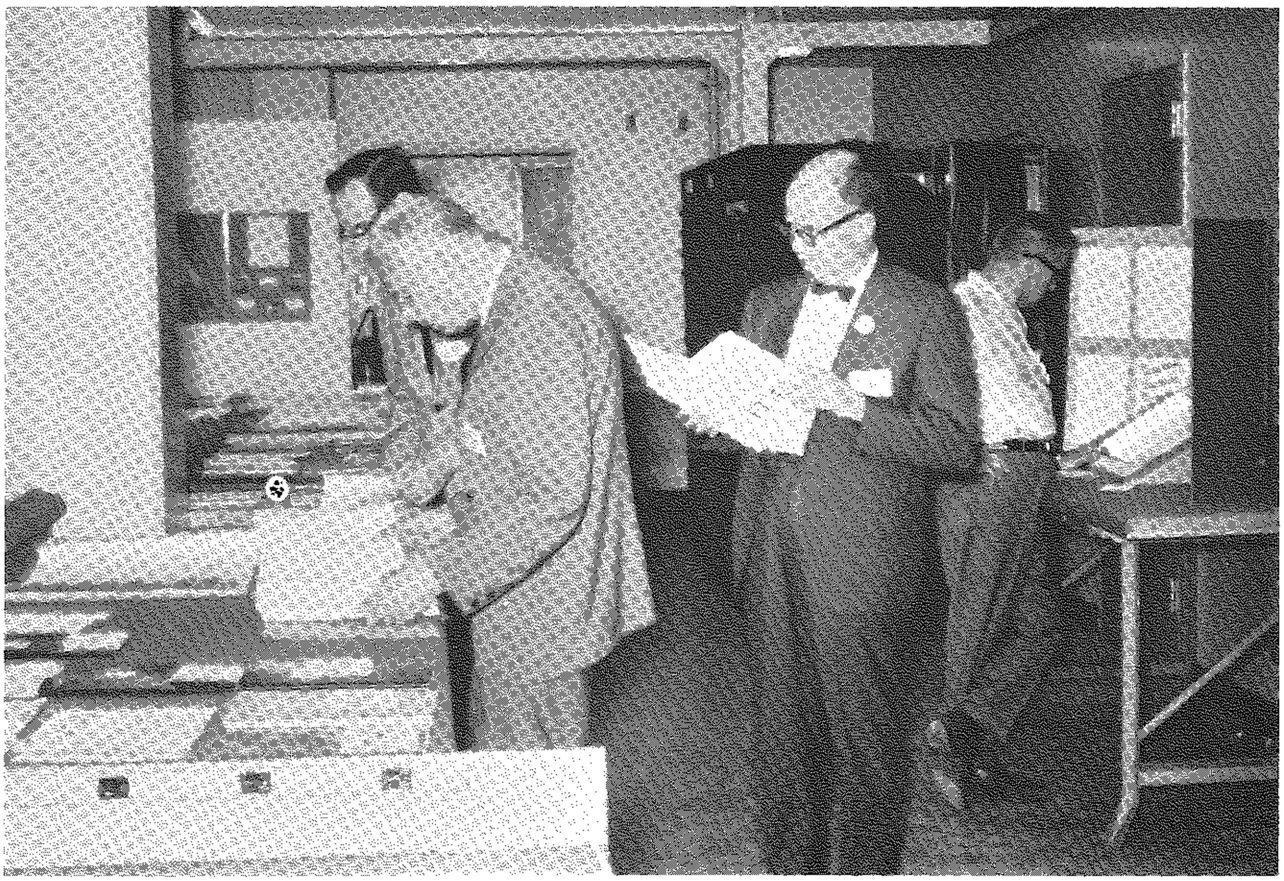
Winter 1970 Volume 34 Number 1 Series 101

R. WALLACE REYNOLDS
Host, Mid-Year Meeting
January, 1970

Published by the Engineering Design Graphics Division, American Society for Engineering Education

ANNUAL MEETING

OHIO STATE UNIVERSITY



Columbus, Ohio

June 22 to June 26, 1970

Engineering Design Graphics Journal

Winter 1970 Volume 34 Number 1 Series 101

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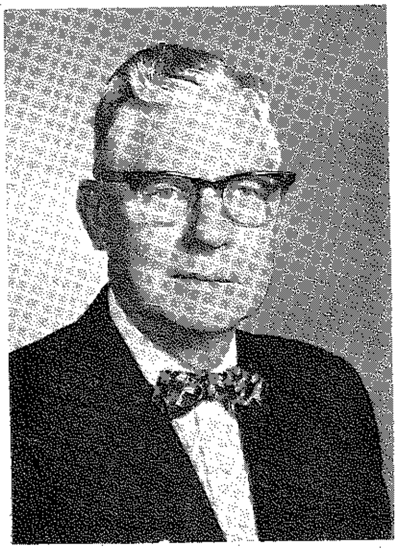


JOURNAL OF ENGINEERING GRAPHICS

by
EARL D. BLACK
Editor; 1964-1967

The following article was written by Professor Earl D. Black when he was the editor of the JOURNAL OF ENGINEERING GRAPHICS, and appeared in the Spring 1965 issue as an editorial. The present editorial staff felt that although much has been done, since the article first appeared, the words are as appropriate now as they were then, and is therefore being reprinted with the kind permission of its author.

The JOURNAL OF ENGINEERING GRAPHICS was begun in 1937, sponsored by the American Society for Engineering Education, Division of Engineering Drawing, now known as the Division of Engineering Graphics. Since the inception of the Division, the work in the field of engineering graphics has expanded and changed. If one reviews the early writings of the contributors to the Journal, one finds emphasis placed upon skills, line weight, inking, testing, better use of teching time, the "direct method" vs the "classical method", lettering, simple dimensioning, selection and design of equipment, and many fringe subjects. Today emphasis is on fundamentals, and many of the items then classified as fundamental are now fleeting by-products. The new emphasis is on elements of design and integration of knowledge from the various engineering sciences. The Division Of Engineering Graphics has looked to the Journal for articles on new developments, new methods of teaching, suggested course material, and research in many areas of specialization. Ideas suggested for future development in engineering graphics have been rejected after intensive experimentation. On the other hand, many ideas, first rejected on proposal, have come to be a standard procedure in many engineering schools. Throughout this long period of development, the JOURNAL OF ENGINEERING GRAPHICS (nee DRAWING) has served as the primary communications agency for its subscribers. It exists primarily as a service agency to members of the Division of Engineering Graphics and record selected articles on many subjects normally included in the broader field of study in graphical science.

Historically, the Journal records a gradual and continuous transition from one set of objectives and course coverage to the proposal and actual consummation of others. The arguments, pro and con, have been faithfully recorded, and the needs of engineering graphics in professional engineering applications have been discussed.

The full review of the published material over the years in the JOURNAL OF ENGINEERING DRAWING and GRAPHICS would indeed furnish a liberal education in this subject area.

IN THE DIVISION

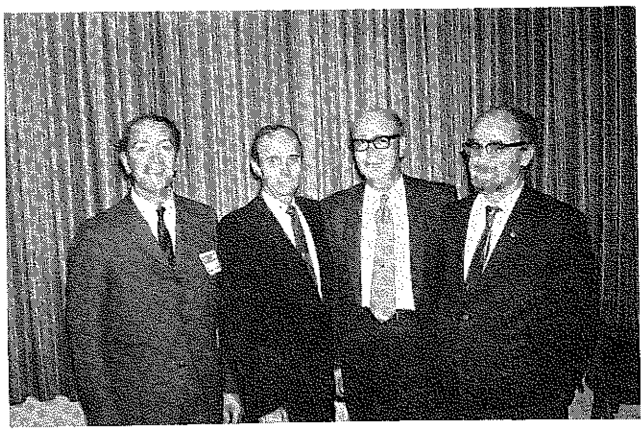
MID - YEAR MEETING

engineering graphics division - asee

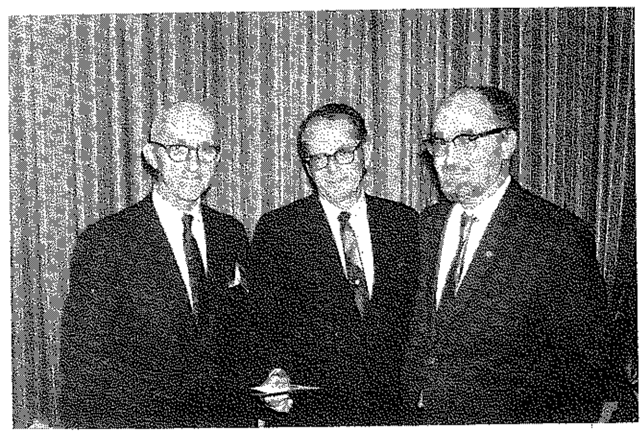
SAN LUIS OBISPO, CALIFORNIA

CAL STATE POLY

January 21-24, 1970

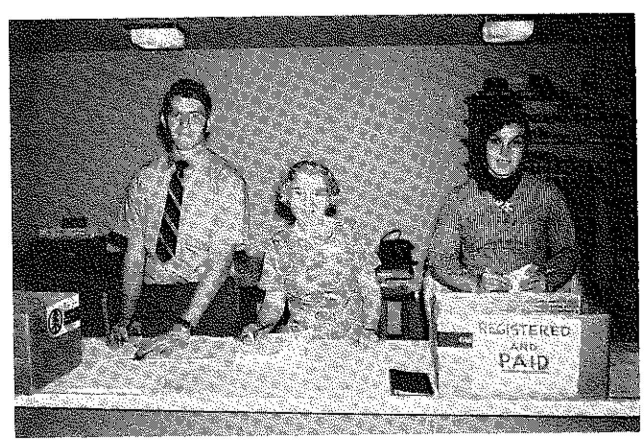


Program Chairman Reynolds and Staff

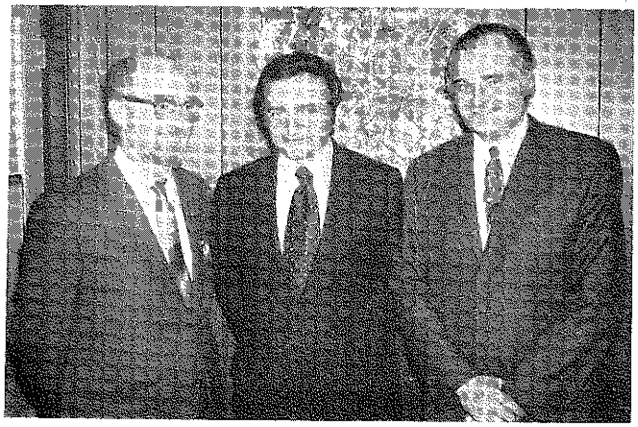


Dean Higdon, President Kennedy and Program Chairman Reynolds

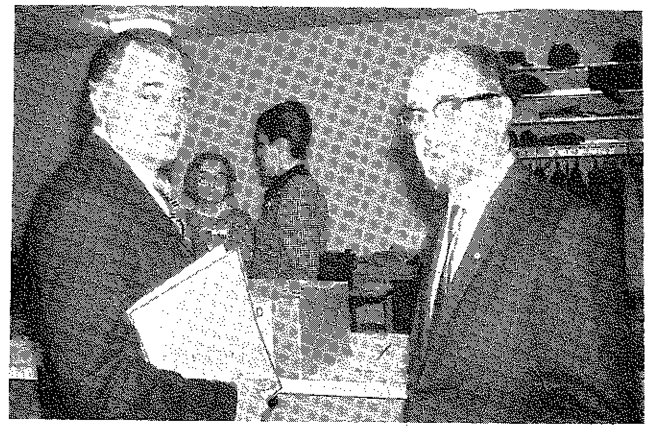
A Most Outstanding Technical Crew



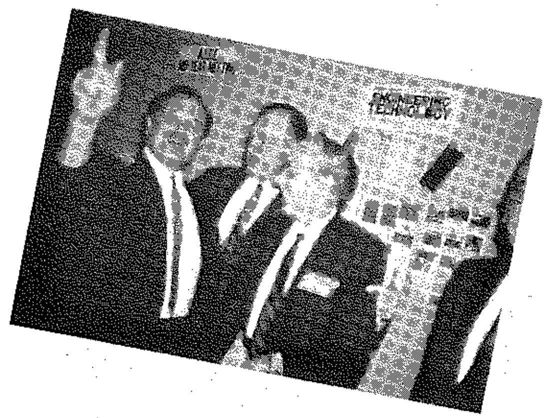
At the Registration Desk

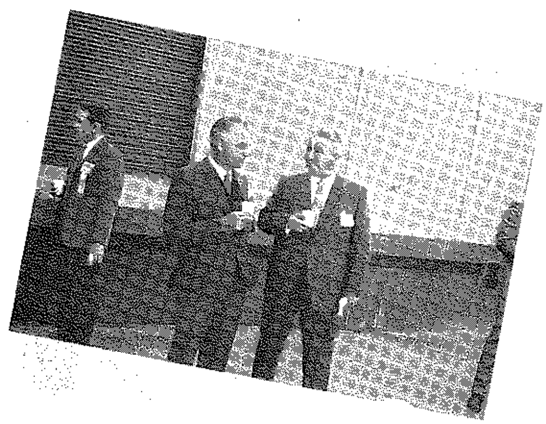


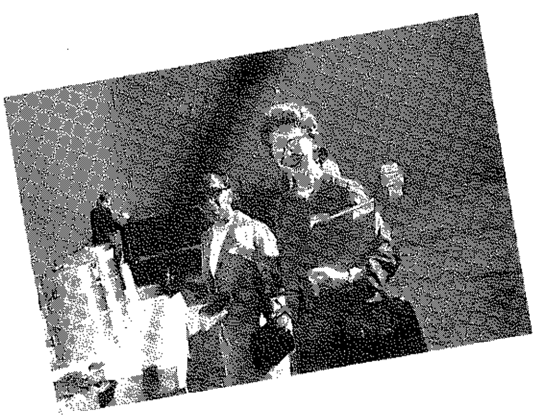
Wally Reynolds, Host; Jack Ryan, Dinner Speaker; Steve Slaby, Division Chairman

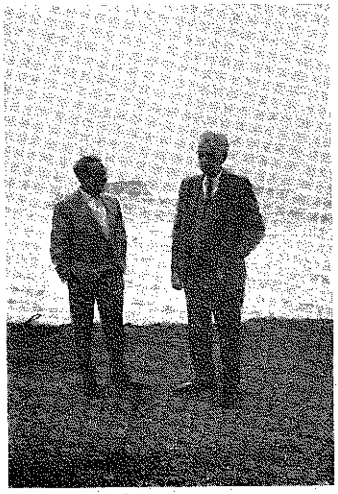


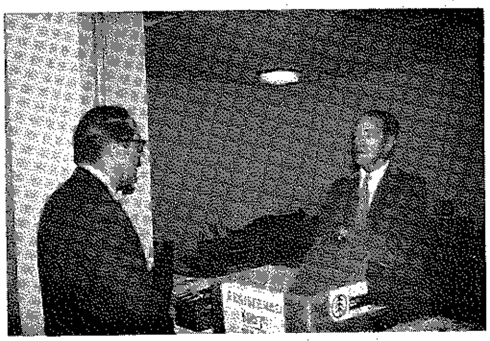
Division Chairman Slaby and Host Reynolds

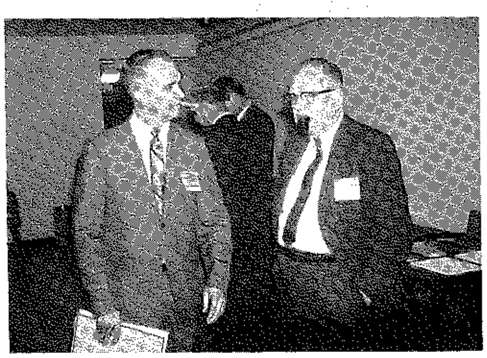


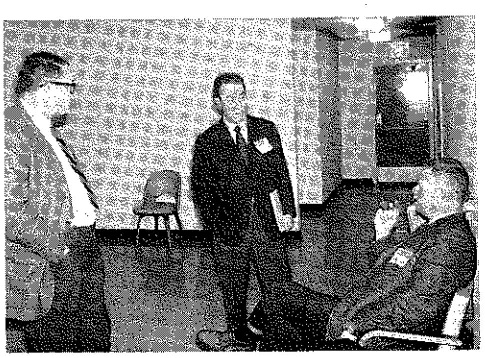












DEAN HARVEY HERBERT JORDAN

1885-1969

Professor Harvey Herbert Jordan, Associate Dean Emeritus of the College of Engineering of the University of Illinois at the Urbana-Champaign Campus, died on Saturday, June 28, 1969, at the age of 84. He is survived by his wife Sarah who is a patient in the Americana Nursing Home in Urbana, one daughter -- Mrs. Stuart (Donna) Maner of Urbana, and three grandsons.

Dean Harvey Jordan was one of the founders of the Division of Engineering Drawing, which is the oldest division of the American Society for Engineering Education.

As a scholar he was the senior author of two standard texts on Engineering Drawing and Descriptive Geometry. He was a member of Phi Kappa Phi an Intercollege Engineering Honorary Society, Tau Beta Pi and Sigma Tau which are National Engineering Honorary Societies, Phi Eta Sigma, Chi Epsilon and Triangle fraternities. He was a member of the American Society of Civil Engineers, the Illinois Society of Professional Engineers and the American Society for Engineering Education.

Dean Jordan was born on March 7, 1885 at Waltham, Maine, the son of Ronald and Carey Blake Jordan. He married the former Sarah Slater on October 9, 1919. He was a 1910 graduate of the University of Maine as a Civil Engineer and obtained his master's degree in Theoretical and Applied Mechanics from the University of Illinois.

In 1911, he was appointed an instructor of Engineering Drawing at the University of Illinois and rose to the rank of Professor in 1921. He was appointed head of the Department of General Engineering Drawing in 1922 and served in that capacity until 1949. From 1917 to 1934 he served as Assistant Dean of the College of Engineering and was appointed Associate Dean in 1934, serving in that capacity until his reirement in 1953.

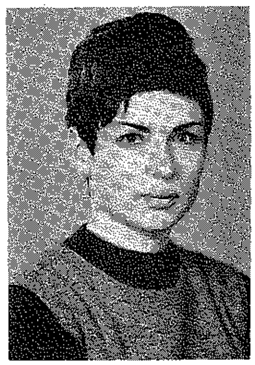
Dean Jordan is remembered for his devotion to the students in the College of Engineering to whom he was always available. He personally shook hands with every graduating engineering student during his term as Assistant and Associate Dean of the College of Engineering. Before the days of government sponsored student loans, there were countless numbers of students who received personal loans from the Dean to enable them to finish their education. As testimony to their affection for the Dean, the "Harvey H. Jordan Award" was established in 1953, upon his retirement, to annually recognize an outstanding senior in the College of Engineering based on high scholastic standing and character.

During the depression years of the 1930's, he organized the Placement Office of the College of Engineering. Today, this center is recognized as having one of the outstanding placement programs in the country.

Active in community affairs, Dean Jordan participated in a number of civic and fraternal activities including that of Alderman of the City of Urbana from 1921 to 1927. He was chairman of the Urbana City Planning Commission, Chairman of the Urbana Transportation Commission, President of the University Club, President of the Kiwanis Club, President of the Champaign County Family Services, and a member of the Urbana Masonic Lodge 157 A. F. & M.

For his 42 years of dedicated service to the University and Community, Dean Jordan will be remembered affectionately and respectfully by his students, townspeople, and colleagues as a warm, gentle person who befriended many and who set high standards, not only for himself, but also for the conduct of the Dean's office. Paraphrasing the late President Kennedy, Dean Harvey Jordan did not ask what the University could do for him but what he could do for the University.

THE KREIDLER AWARD



The Kreidler Award is intended to encourage research in the field of Graphics and/or the use of Graphics in research in other fields. The award consists of $100 together with an appropriate certificate. The following guide-lines have been established for this award;

1. Any article, paper, report or thesis concerning Graphics research may compete.
2. Subject matter may include, but is not limited to, new application of graphical methods, new or unusual graphical problem solutions and studies of trends or needs of Graphics in education or industry.
3. The research must have been completed during the twelve months ending July 31 of each year.
4. The research must be brought to the attention of the Awards Committee. The committee will search diligently for all contributions to the literature but is not responsible for finding all of them.
5. The majority of the committee votes received will determine the winner.
6. The winner will be announced and the award made at the Engineering Graphics Division Mid-Year Meeting dinner following the year covered by the competition.

The Kreidler Award, announced at the 1970 Mid-Year Meeting in San Luis Obispo, California, was given to RUTH SHAPIRA and UZI ZAMONSKY of the Technion Institute in Israel, for their article "A New Solution Method For Cylinders -and Cone Problems" which appeared in the Fall 1968 issue of the JOURNAL OF ENGINEERING GRAPHICS.

THE OPPENHEIMER AWARD

To encourage better presentation of papers on the program, at meetings of the Engineering Graphics Division, A. S. E. E., the Frank Oppenheimer Award has been established. The award will be offered twice yearly --- once at the Mid-Year Meeting and once at the Annual Meeting of the Division ---- and shall be based on the following;

1. Purpose

To encourage and reward excellence

in the presentation of papers.

2. The Award
   The award shall consist of $100 accompanied by an appropriate certificate.

3. Judging
   The Awards Committee shall appoint three judges from among those members of the Division present at the meeting. The judges may recommend

3. Eligibility
   Persons presenting papers listed on the official program of the meeting shall be eligible. Persons moderating or presiding at a session will, normally, not be eligible.

4. Judging
   The Awards Committee shall appoint three judges from among those members of the Division present at the meeting. The judges may recommend that the award be shared, or that it not be given at a particular meeting.

5. Requirements
   The following items shall be considered in judging the presentations;
   a) Familiarity with Content
      The speaker should give the impression that he speaks freely and without notes.
   b) Timing
      The speaker shall stay within the time allotted.
   c) Delivery
      The speaker should enunciate clearly, speak loud enough to be heard in the last row, use

the microphone effectively when available.
   d) Enthusiasm
      Enthusiasm should be maitained throughout the presentation, and the voice should not sag.

6. Presentation
   The award shall be presentaed at the Banquet or Dinner Meeting of the Division, unless such meeting precedes a portion of the program, in which case it shall be presented at the last session on the program.

The Oppenheimer Award for the 1970 Mid-Year Meeting at California Polytechnic College was made to Dean James S. Blackman of the University of Nebraska for his paper "Creativity - Its Care And Cultivation Among Engineering Students".

DISTINGUISHED SERVICE AWARD COMMITTEE

The Distinguished Service Award Committee is now considering candidates for this high honor. Any member of the Engineering Graphics Division of A. S. E. E. may recomend a worthy colleague for this award and should write to

Dean E. W. Jacunski
College of Engineering
University of Florida
Gainesville, Florida 32601

In order to receive the award, a person must have made clearly recognizable contributions to Engineering Graphics in several of the following ways, of which item (e) shall not be omitted;

(a) Success as a teacher, both as to competence in subject matter and the ability to inspire his students to high achievement.

(b) Improvement of the tools of and conditions for teaching.

(c) Improvements in teaching, including development of teachers, development of testing and guidance programs, and coordination of fields of subject matter.

(d) Scholarly contributions of literature, honors, etc.

(e) Service to the Division as shown:
   (1) by regular attendance at its meetings
   (2) by service on its committees or as an officer with a record of achievement
   (3) by contributions to its publications or summer school programs

(continued on page 13)

INDUSTRIAL RELATIONS COMMITTEE

The objectives of the Industrial Relations Committee were formulated in 1967 when Richard Springer was its chairman. During my tenure of the past six or eight years on this committee, I have heard no suggestions about changing any, nor adding new objectives.

However, little has been done to implement these objectives, and perhaps little can be done. Copies of my letter of May 23, 1969 and the Annual Report of June 1969, indicate that there has been very little group activity on the part of our committee. Only three members of the committee, besides myself, were present at the Penn State meeting. We held two meetings but only three attended at any one time. Our discussion was given almost entirely to how we could commence the implementation of our propsal to see what influence can be exerted on the Engineering Society representatives on the ECPD committee with the aim of enlisting their aid in restoring graphics courses to ECPD accredited curricula. You will recall that this proposal was approved by the Graphics Division at the 1969 annual meeting at Penn State.

It is my strong feeling that our committee should concentrate on this one objective and expend the energy available on this , at the present time.

Any serious efforts at implementation of this propsal raises some important considerations:

a. The efforts could generate considerable political rumble, both in educational administration and professional engineering circles, thus demanding diplomatic procedure.

b. We would need the support and prestige of all segments and officers of the Graphics Division.

c. It seems fruitless to approach ECPD representatives except through the avenue of some considerable pressure on the part of their constituents.

d. If we propose a restoration of the graphics course we will have to have some kind of specific parameters regarding content, units, etc.

It seems to me that the first step should be an extensive national survey, using a well designed questionnaire to determine:

a. The magnitude of the demand for more graphics capability in engineering graduates.

b. The nature of this capability.

If the results of this survey indicate a sufficient demand on the part of industry people, we can then proceed with the efforts needed to secure the required influence on the ECPD representatoves.

This project will not be done in a few weeks.

I intend to send a proposed copy of the questionnaire to each member of the Industrial Relations Committee by December 1, with the hope that I will have sufficient feedback from committee members to allow some action on it during a committee meeting at Cal Poly in January 1970.

In the meantime I will be exceedingly pleased to have any suugestions on this project from any member of the Industrial Relations Committee.

Respectfully submitted

R. Wallace Reynolds, chairman
Industrial Relations Committee

COMPUTER GRAPHICS COMMITTEE

PURPOSE

As members of the engineering profession, we should be aware of new areas of development in our immediate field of educational interest. Technology is rapidly changing; therefore, instruction should reflect this new technology. Computer Graphics is an area of potential development and growth which graphics-design oriented courses should explore and utilize.

It is the intent of the Computer Graphics Committee to provide instructional information which may be incorporated into current freshman and sophomore courses. The committee will also be responsible for informing the Division of the "state of the art" in such related areas as: Computer-Aided Design, Digital Data Plotting, Numerical Control, and Computer-Aided Manufacturing Methods.

It is recognized that practical instruction in Computer Graphics is limited to computer and plotting equipment as well as instructional capability. However, reference material and film are easily obtainable and lectures could be presented as an informational unit of instruction in existing programs.

GOALS for 1969-70

1. To alert the Division to the significance of Computer Graphics in freshman and sophomore design courses.

2. To provide instructional material which may be incorporated into existing course structure.

3. To organize a Seminar-Workshop for engineering faculty who are interested in teaching computer graphics.

4. To present an informational technical session at the Annual ASEE Meeting at Ohio State University in June 1970.

Respectfully submitted

Paul M. Reinhard, Chairman
Computer Graphics Committee

MEMBERSHIP COMMITTEE

PURPOSES

The Membership Committee is charged with the responsibility of soliciting new members for the Engineering Graphics Division, and secondarily, for the ASEE regardless of division affiliation. Additional members are desired to provide a more diversified point of view and a broader base of membership to the Division.

The Membership Committee has agreed that the best means of recruiting new members is through subscription to the JOURNAL OF ENGINEERING GRAPHICS. A subscriber to the Journal is believed to be a much better prospect for membership to ASEE than one who is unfamiliar with the goals and aspirations of the Division of Engineering Graphics.

This close relationship between the Membership Committee and the Journal prompted a proposal at the Executive Meeting during the Annual Convention at UCLA in 1968 that the editor and circulation manager be members of the Membership Committee. It was further proposed that Journal funds be made available to support membership solicitations conducted by mail. The proposals were accepted as being in the best interest of the Division, by the Executive Committee.

An ever-increasing membership which reflects an active engineering graphics field would give renewed strength to the future of the Division of Engineering Graphics.

PLANS for 1969-70

The membership committee would like to continue its solicitation of new members by gaining new subscriptions to the JOURNAL OF ENGINEERING GRAPHICS. The following is an outline of activities that are expected to accomplish the general goals of the committee:

1. Mail complimentary copies of the Journal to prospective members. Mailing labels and explanatory letters will be prepared for attachment to current Journal issues and mailed with the regular mailing from Brown Publishing Company.

2. A letter and membership information will be sent to each Graphics Division member requesting that they recruit new members for the Division.

This will be a continuation of the program begun in 1965 which increased our subscriptions to the Journal from 653 to 922 in 1968. The implementation of this program will be dependent upon the avalability of funds from the Journal of Engineering Graphics.

Respectfully submitted

James H. Earle, Chairman
Membership Committee

ENGINEERING DESIGN EDUCATION COMMITTEE

MEMBERSHIP

East Coastal Area
Percy H. Hill, Chairman (North)
Tufts University
E. W. Jacunski (South)
University of Florida

Wilfred P. Rule (North)
Northeastern University

Central Area
Jerry S. Dobrovolny (North)
University of Illinois
James H. Earle (South)
Texas A & M University

West Coastal Area
William S. Chalk (North)
University of Washington
Peter Z. Bulkeley (South)
Stanford University

PURPOSE

Membership to the committee is to be drawn from as wide a geographical spread as possible so that its members may consult with schools in their area to advise on curricula, course content, and methods and techniques of teaching engineering graphics as a vehicle for creative design. The committee's primary purpose is to encourage instruction, at the introductory level (among all technical schools), in engineering design and creative engineering. This encouragement involves communicating the meaning of the "Design Process", providing a mechanism for the exchange of design projects and case histories among institutions, and conducting seminars in design education at ASEE regional areas.

The work of the committee may be summarized as follows:

1. To present engineering graphics as a vehicle for instruction in engineering design.

2. To broaden the outlook of engineering graphics educators in the area of design education.

3. To make available recognized authorities in design education to educators for assistance in curriculum planning, writing of case studies, writing of design projects, and to explain the role of graphics in design education.

GOALS for 1969-1970

Present:

The committee continues to advise institutions on curriculum planning and course content to achieve a design oriented course of instruction. Recent visits and materials made available to institutions involve one in the northeast, one in the south, and another in the southwest region.

The committee will conduct a seminar on Graphics and Design education at a combined meeting of ASEE Sections involving members from New England and Upper New York - Ontario and Quebec at West Point in April of 1970.

Future

The committee plans to actively collect design problems, projects, and cases and to make them available on request and publish them in a special issue of the Journal when their numbers warrent such publication.

The committee plans to award a "certificate of merit" to outstanding teachers and to pioneering efforts in the design-graphics area. Such award will carry a cash prize. Details of the award are now being worked out.

The committee is considering the feasibility of offering the second summer school on engineering design education

Respectfully submitted

Percy H. Hill, chairman
Engineering Design Education
Committee

Dist. Serv. Award (cont'd from page 10)

The committee would appreciate having all recommendations before March 10, 1970.

Past recipients of the Distinguished Service Award were

1950 - Frederick G. Higbee
1951 - Frederick E. Giesecke
1952 - George J. Hood
1953 - Carl L. Svensen
1954 - Rudolph P. Hoelscher
1955 - Justus Rising
1956 - Ralph S. Paffenberger
1957 - Frank A. Heacock
1958 - Henry C. Spencer
1959 - Charles E. Rowe
1960 - Clifford H. Springer
1961 - William E. Street
1962 - Jasper Gerardi
1963 - Theodore T. Aakhus
1964 - Warren J. Luzadder
1965 - Ralph T. Northrup
1966 - James S. Rising
1967 - Ivan L. Hill
1968 - B. Leighton Wellman
1969 - Edward M. Griswold

ANNUAL MEETING
TENTATIVE PROGRAM

Monday, June 22, 1970

8:00 A. M.
Annual Creative Engineering Design Display
(Repeat Tuesday, Wednesday and Thursday)

8:00 P. M.
Executive Committee Meeting

Tuesday, June 23, 1970

1:45 P. M. - 3:30 P. M.
Conference - Panel Discussion
Theme
COMPUTER GRAPHICS INFORMATION PROCESS AT THE UNDERGRADUATE LEVEL
Presiding
PAUL REINHARD
University of Detroit
Speakers
WILLIAM SAAS
IBM Corporation
"Computer Graphics Media"

CARL W. BECHTOLD
University of Colorado
"The Freshman and Computer Graphics"

EDWARD V. MOCHEL
University of Virginia
"An Elective Course in Computer Graphics"

3;40 P. M. - 5:30 P. M.
Computer Graphics Seminar
Demonstration in the Ohio State University Computer Center
Presiding
Robert LaRue
Ohio State University

Wednesday, June 24, 1970

10:00 A. M. - 11:45 A. M.
Conference - Panel Discussion
Theme
THE ROLE OF GEOMETRY AND GRAPHICS IN THE INFORMATION PROCESS OF MODERN TECHNOLOGY
Presiding
JAMES H. EARLE
Texas A & M University
Speakers
S. T. HALASZ
City College of the University of N. Y.
"The State of the Art"

M. GUERARD
Texas A & M University
"Research and Applications"

C. E. S. LINDGREN
Harvard University
"Relations with Other Disciplines"

V. P. BORECKY
University of Toronto
"Looking Ahead"

LOUISA BONFIGLIOLI
Technion, Israel
"Looking Ahead"

12:00 Noon
Annual Business Meeting and Luncheon

6:30 P. M.
Annual Banquet
Presiding
STEVE M. SLABY
Princeton University
Speaker
D. C. WATSON
Staff Engineer, Operations Division
Fairchild Hiller
Republic Aviation Division
Farmingdale, New York
"Educating the Minority Engineer"

Thursday, June 25, 1970

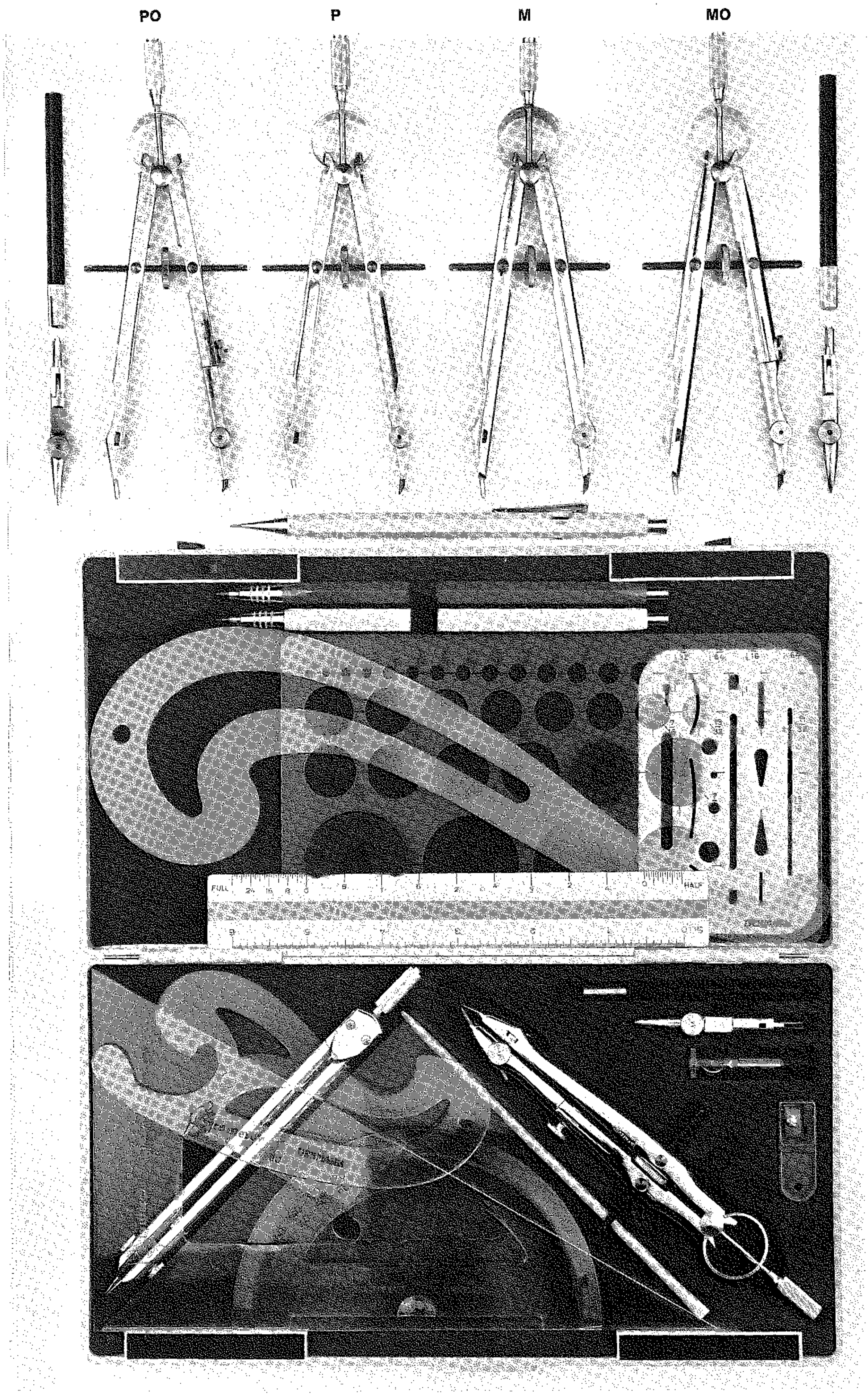
10:00 A. M. - 11:45 A. M.
Conference - Panel Discussion
Theme
ENGINEERING GRAPHICS INFORMATION PROCESSES IN RESEARCH AND DESIGN
Presiding
PERCY H. HILL
Tufts University
Speakers
DUANE G. HARRER
Unimation, Inc.
"The Unimate"

JAMES C. OTIS
Case-Western Reserve University
"Application of Computer Aided Design to Electrocardiography"

WILLIAM C. CROCHETIERE
Tufts University
"Engineering Design in Physical Medicine"

1:45 P. M. - 3:30 P. M.
"Cracker Barrel" Session
Panel Discussion with Audience Participation including Student Presentations.
Presiding
Steve M. Slaby
Princeton University

(continued on page 37)



SHOWN KIT #M440

A NEW CONCEPT IN DRAFTING EQUIPMENT

The Compact Kit

CONTENTS:

- *Acrylic Triangle with Fingerlifts 45°6″*
- *Acrylic Triangle with Fingerlifts 60°8″*
- *Protractor 180°5″, Curve #80, Curve #82*
- *Metal Erasing Shield, Circle Template #1117*
- *2 Mechanical Pencils, 1 Extra Lead*
- *Leadpointer, 6″ 4 Bevel Special Scale – Engine Divided*
- *6″ Divider M8*

KIT #M440 – *6″ Giant Bow MO with Pen and Pencil Part, Sliphandle*

KIT #P440 – *Same However 6″ Giant Bow PO*

KIT #M441 – *6″ Giant Bow Pencil M Plastic Eraser (Not Shown)*

KIT #P441 – *Same However 6″ Giant Bow Pencil P*

All kits available with ad- ditional lettering guide #1007 (Not Shown);
Also Dunilon Triangles instead of acrylic;
Also with 6″ adjustable triangle instead of 2 tri- angles and protractor;
Also with Gramo Fine- liner 0.5 millimeter lead instead of 2 mechanical pencils.

The Fall issue of the JOURNAL OF ENGINEERING GRAPHICS printed the list of award winners at the Annual Creative Design Display at Pennsylvania State University during the 1969 A.S.E.E. Convention. However, names of designers receiving Honorable Mention were not known. Since then, these names were made available and are as follows:

HOME EXERCISER
Designers: Thomas L. Palmore
Michael D. Olsen
Steven H. Olsen
William D. Pennington
Clyde R. Pifer
Jewell F. Plangman
Instructor: Professor James H. Earle
School: Texas A & M University

HOME EXERCISER
Designers: Franklyn B. Jeffs
Michael W. Goss
Larry T. Lamb
Michael R. Landolt
Dennis W. Lang
Instructor: Professor Ronald D. McCage
School: Texas A & M University

INVESTIGATION OF ADAQUACY OF HOUSING FOR MARRIED STUDENTS AT TEXAS A & M UNIVERSITY
Designers: R. E. Rubenstein
S. D. Snyder
Instructor: Professor North B. Bardell
School: Texas A & M University

MODIFICATION OF A SERVICE STATION
Designers: Derwood Freitag
M. Roberto Garza
Scotty Griffin
Mack Hudson
Ronny Jones
Instructor: Dr. Richard F. Vogel
School: Texas A & M University

AN ECONOMICAL CEMENT MIXER
Designers: David Huntington
John Hobson
Raymond Kopecky
Thomas Huefner
Bob Lissner
Robert Johnston
Instructor: Professor Jimmy Hatley
School: Texas A & M University

AUTOMOBILE LUGGAGE STORAGE DEVICE
Designer: L. Rene French
Instructor: Professor E. D. Groves
School" Texas A & M University

PLANNING FOR THE FUTURE - TRAILER FACILITY
Designers: Aubrey G. Cherry
Billy Wayne Coss
Charles Allen Crews
Walter E. Debord
Harry Frank Elrod
Instructor: Professor Samuel M. Cleland
School: Texas A & M University

OUTLET SAFETY
Designers: Robert S. McCarthy
Dale A. Williams
Lawrence Duda
R. A. Froelich
R. Frankel
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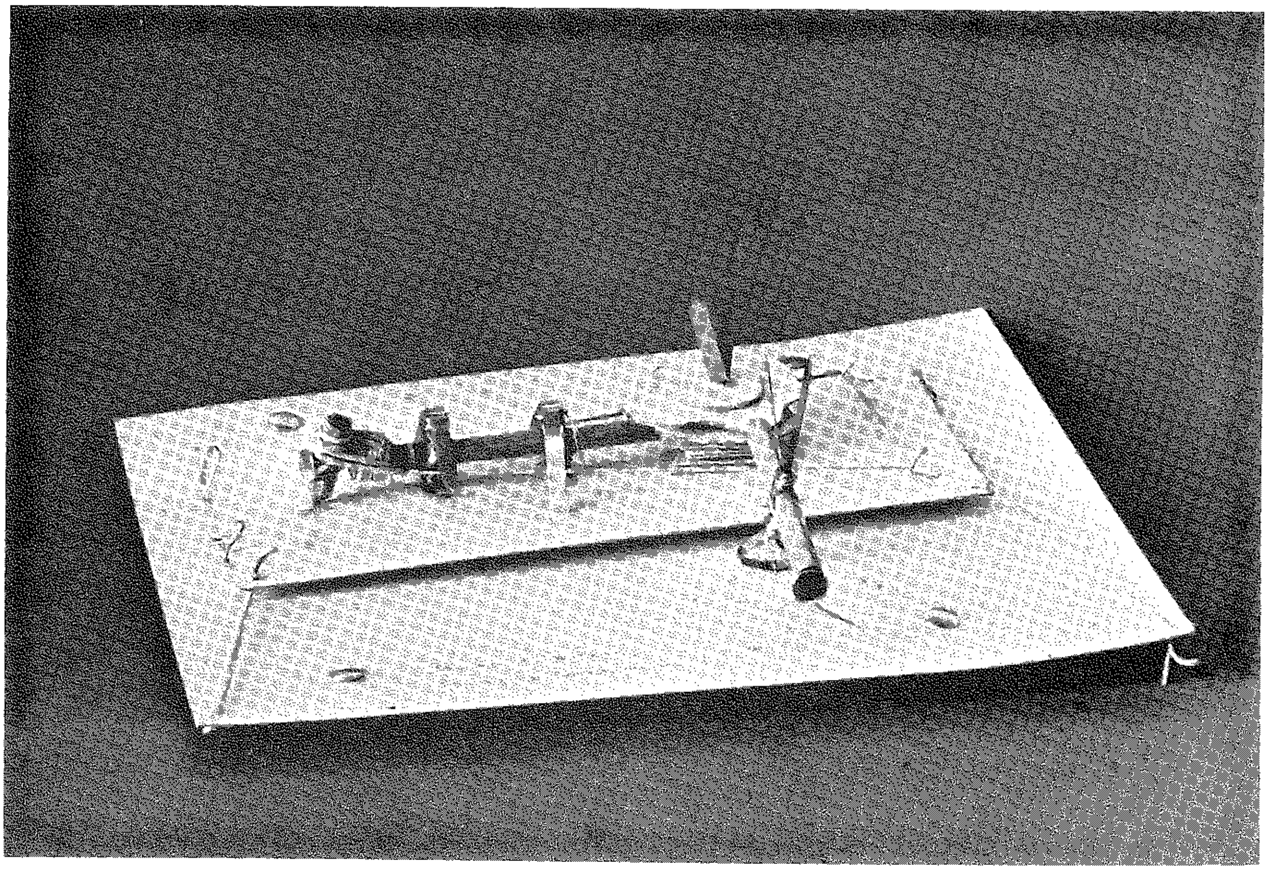
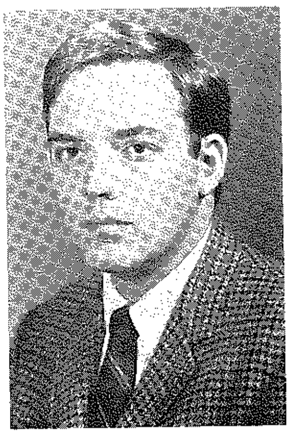


OHIO STATE UNIVERSITY

JUNE 22 – JUNE 26
1970

ANIMATED FILM TEACHING VERSUS LECTURE-DEMONSTRATION METHOD



by
Dr. EVERETT R. GLAZENER
Chairman, Engineering Technology Department
Texas A & M University

and

Dr. DENNIS C. NYSTROM
Assistant Professor
Technical & Industrial Education
Southern Illinois University

In the past twenty years many innovations have been introduced to engineering graphics and drafting curricula for the purpose of improving instruction. Examples of such methods are programmed instruction, team teaching, and closed circuit television. These media have been directed toward helping the student develop skill, knowledge, and an appreciation for the graphic sciences and their place in our modern industrial society.

Need for Better Techniques

More material is being presented to college and technical school students than ever before. To complicate matters, Howe[1] states that there has been a reduction in the time allotted for teaching engineering graphics. Consequently, instructors must find more efficient teaching methods.

With the rise of television in the last twenty years, advertisers have been using animation extensively[2]. Animated motion pictures gave life to inanimate objects. The objects can be tilted, divided, and moved at will without the disadvantage of human hands blocking the vision of the class. the liveliness of the objects enables the student to visualize concepts that cannot usually be seen when using chalkboard presentations of the same material.

Technical research techniques were used to determine the effectiveness of animated films in teaching specific concepts in engineering graphics. This research was designed to test the following hypotheses:

1. There was no significant difference in the initial learning between students receiving the 16 mm sound animated film method of instruction and those receiving the conventional lecture demonstration method.

2. There was no significant difference in the retention of the experimental group, exposed to animated film, and the control group, exposed to the conventional method of instruction.

3. There was no apparent difference in the interest shown by the students viewing the animated films and those subjected to the conventional method of instruction.

Research Materials

Various educational materials were used in conducting the research. A qualified jury and two preliminary pilot studies were utilized to determine the quality and applicability of the research materials.

The study was based on the content of an introductory course offered to all college freshmen in the various engineering curricula at Texas A & M University. Four units of instruction were selected. These four units were;

1. multiview orthographic projection
2. auxiliary projection
3. sectioning
4. basic dimensioning

The 16 mm animated films were developed to teach the basic concepts of the units involved. The completed films ranged from six to eight minutes in length.

Three forms of each unit test were developed. The tests consisted of five mutiple-choice questions and two drawing problems.

All materials were submitted to the recognized jury; and after revisions were made, a preliminary pilot study was conducted. The best seating arrangement, projector and speaker placement, and lighting was determined. All tests were administered, and an item analysis was performed. Results of this pilot study were also used in the development of the final animated films.

A second pilot study was conducted to determine the unit test reliabilities. Figure 1 illustrates the test reliabilities as determined by an analysis of variance technique[3].

A questionnaire was developed to assess the opinion of the students in regard to the two methods employed in teaching the selected units. The questionnaire also provided space for general comments regarding all facets of the course and the teaching methods employed.

Conducting the Research

The study involved 400 beginning engineering students in the Engineering Graphics Department at Texas A & M University during the fall semester of 1968-69. Five instructors, each teaching two sections, were involved. The rotational method of treatment assignment was applied and resulted in 1600 observations for the 400 students. Figure 2 illustrates the treatment assignments.

The unit pretest was administered directly preceding the introduction of each unit. It was assumed that this procedure would account for any transfer of learning taking place between unit of instruction. The posttest was administered immediately after the introductory material was presented. The test of retention was given four weeks after the posttest.

Test	Number of Items	Reliability Coefficient
Multiview Orthographic Projection	7	.72
Primary Auxiliary Projection	7	.82
Basic Sectioning	7	.67
Dimensioning	7	.70

Figure 1.--Unit Test Reliabilities

Teacher	Section	Unit I	Unit II	Unit III	Unit IV
A	1	Exp.	Con.	Exp.	Con.
	2	Con.	Exp.	Con.	Exp.
B	3	Con.	Con.	Exp.	Exp.
	4	Exp.	Exp.	Con.	Con.
C	5	Exp.	Con.	Con.	Exp.
	6	Con.	Exp.	Exp.	Con.
D	7	Exp.	Exp.	Con.	Con.
	8	Con.	Con.	Exp.	Exp.
E	9	Con.	Con.	Exp.	Exp.
	10	Exp.	Exp.	Con.	Con.

TREATMENTS: Exp.--Animated film method
Con.--Lecture-demonstration method

UNITS: I -- Multiview Orthographic Projection
II -- Primary Auxiliary Projection
III -- Sectional Views
IV -- Basic Dimensioning

Figure 2.--Treatment Assignments

Analysis od Data

The data collected from the reasearch was analyzed by two different techniques. A graphical procedure provided a visual analysis of the data. Figure 3 illustrates a graphical comparison of the mean gain scores achieved by the experimental and control groups on each unit of instruction. Figure 4

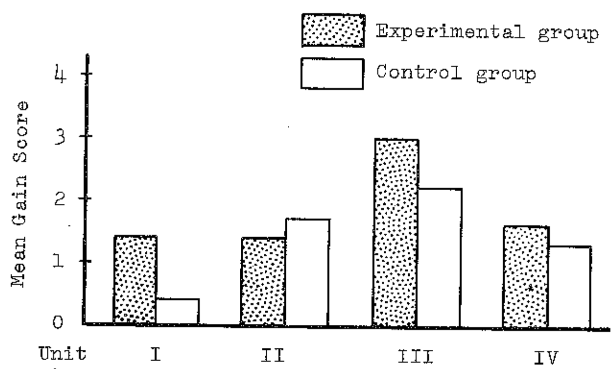


Figure 3.--Mean Gain Score Comparison

illustrates a comparison of the test of retention scores on each unit of instruction.

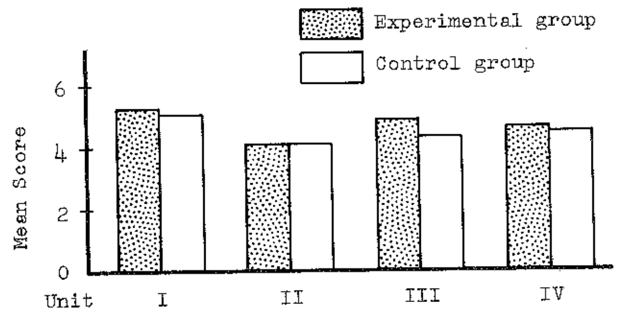


Figure 4.--Test of Retention Score Comparison

The analysis of variance technique revealed **a** significantly higher gain from the pretest to the posttest of the experimental group. This gain was significant at the .01 level of confidence. A significantly higher test of retention score was also revealed. The experimental group scored significantly higher than the control group at the .05 level of confidence.

On the student questionnaire, 85.2 % of the students stated that they felt the animated film method of instruction assisted them in understanding the basic concepts of the units involved. However, only 40.7 % of the students preferred the animated film method of instruction when compared with the conventional lecture-demonstration method. General comments revealed that the students felt a method of immediate feedback during the films was necessary.

Conclusions and Recommendations

The following hypotheses were rejected on the basis of significant differences at the .01 and .05 levels of confidence as determined by the analysis of variance technique.

1. There was no significant difference in the initial learning between students receiving the 16 mm sound animated film method of instruction and those receiving the conventional lecture-demonstration method

2. There was no significant difference in the retention of the experimental group, exposed to animated films, and the control group, exposed to the conventional method of instruction.

Since 59.3 % of the students stated that they would rather be taught by the conventional lecture-demonstration method of instruction, the third hypothesis was rejected.

3. There was no apparent difference in the interest shown by the students viewing the animated films and those subjected to the conventional method of instruction.

The students' major criticism of the animated film method of instruction was that the films provided no opportunity for questions. This prevented immediate feedback, and impaired reinforcement. To provide this feedback, more research should be conducted to develop a method whereby concepts can be reinforced during the viewing of the films

Other Recommendations

1. Further research should be conducted to determine the effectiveness of sound animated films in other areas of engineering graphics and industrial education.

2. This research should be repeated involving a broader sample of colleges and universities throughout the United States.

3. Additional research should be conducted to determine the effectiveness of the animated film method of instruction presented via educational television.

REFERENCES

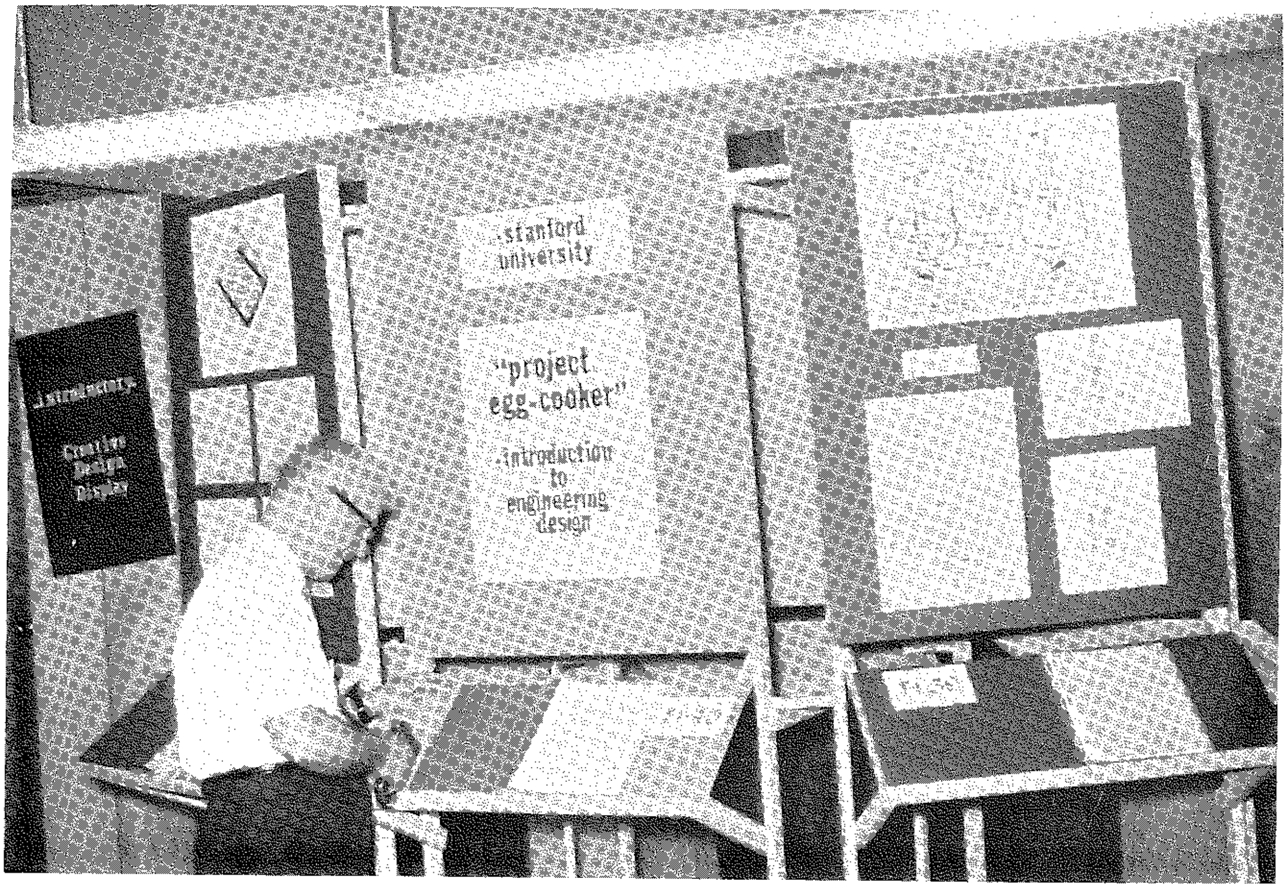
[1] Howe, H. B., "Research for Improving the Teaching of Graphics", The Journal of Engineering Graphics, XVI (May, 1952), 22-25.

[2] Basic Titling and Animation, Rochester: Eastman Kodak Company, 1965.

[3] Micheels, William J., and Karnes, M. Ray. Measuring Educational Achievement, New York: McGraw-Hill Book Company, 1950.

I'm against the merger. Have you seen their steno pool?

CREATIVE DESIGN DISPLAY



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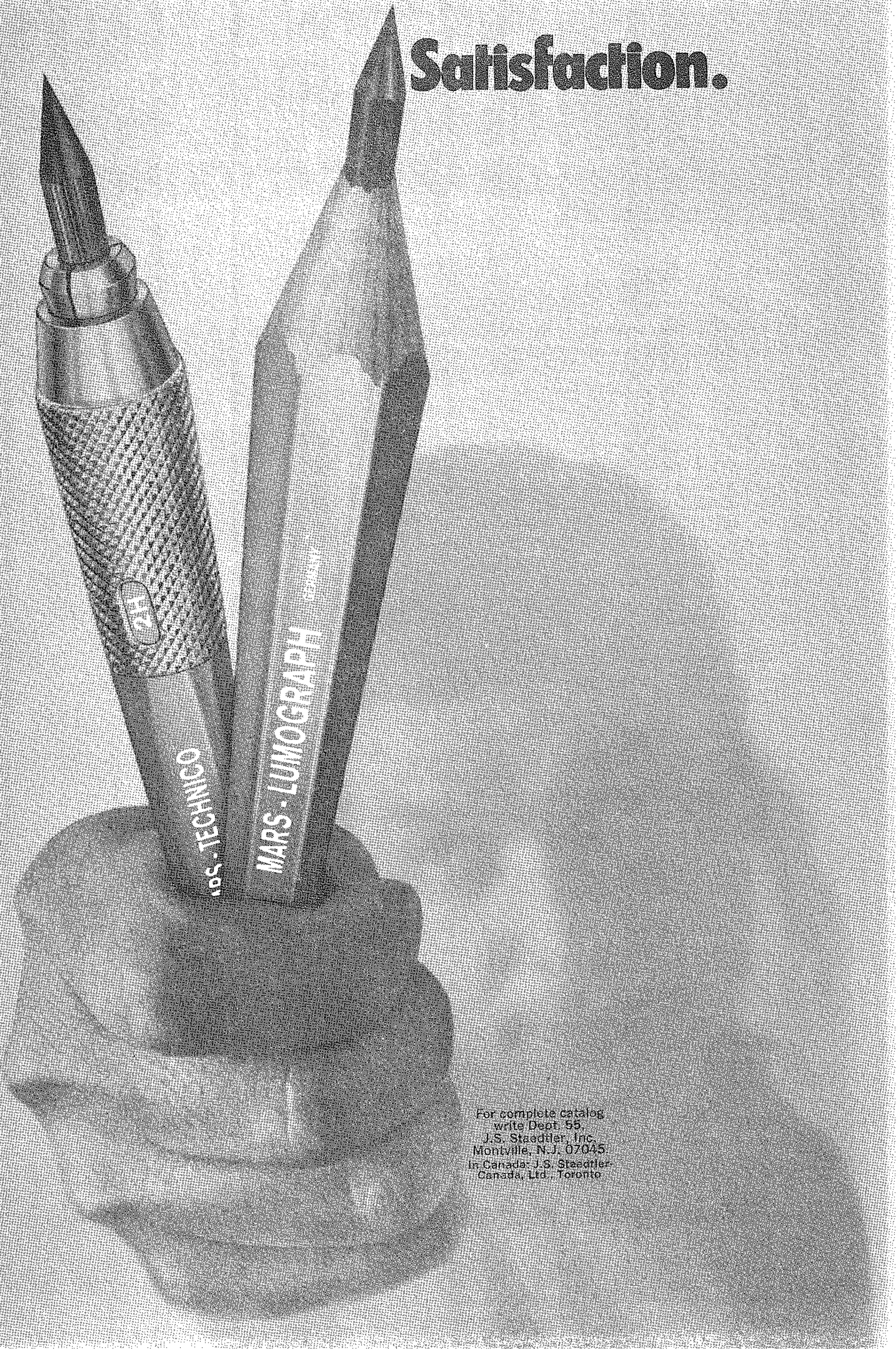
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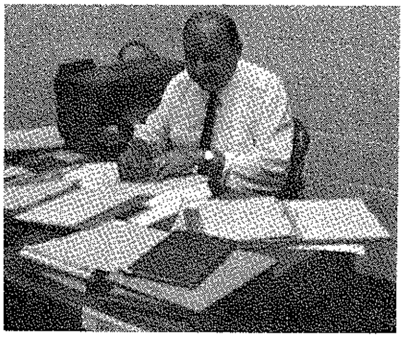

FUNCTIONAL SCALES ON A PLOTTER USING GRAPHICAL CONCEPTS

FRANKLYN K. BROWN
Northeastern University

Functional scales are recognized as useful devices for graphical computetion purposes such as conversion scales, nomographs, etc.; as well as measuring bases such as dials, gauges, meters, etc., along which an indicator or pointer moves. The graduation of these scales often requires precise information which a student can sometimes generate, but often destroys by a simple error so common to iterative computation performed by any of us. In addition, effectiveness of these scales is largely susceptible to the many levels of quality of manual technique and skill required to produce the scale on the appropriate media (pencil or ink on paper, scribes on film, scribes on metal, etc.)

Whereas technique development is now receiving little or no emphasis in many Engineering Graphics curricula, the Functional Scales made by most students tend to lose their effectiveness due to errors and inaccuracy inherent in current manual graphical methods employed. The computation of graduation distances, even if done correctly, may be inaccurate. The line-work required to create the graduations precisely is a rare commodity.

Fortunately, however, the digital computer can be used to perform, both tirelessly and accurately, the calculations required to locate the graduations. A digital increment plotter which receives its positional instructions directly from a computer can be made to produce the scale on paper (known as hard-copy). In addition, such data generated by the computer can be recorded on paper or tape for the purpose of specifications to an appropriate engraving machine to "divide" or graduate scales of plastic, metal, wood, etc. These can be in the form of numbers to be transmitted to a machine operator or N/C tapes for direct control of the machine. The plotter output may be used as is, or may merely be a "proof" of the required scale to be produced in quantity.

The simple conversion scale shown in

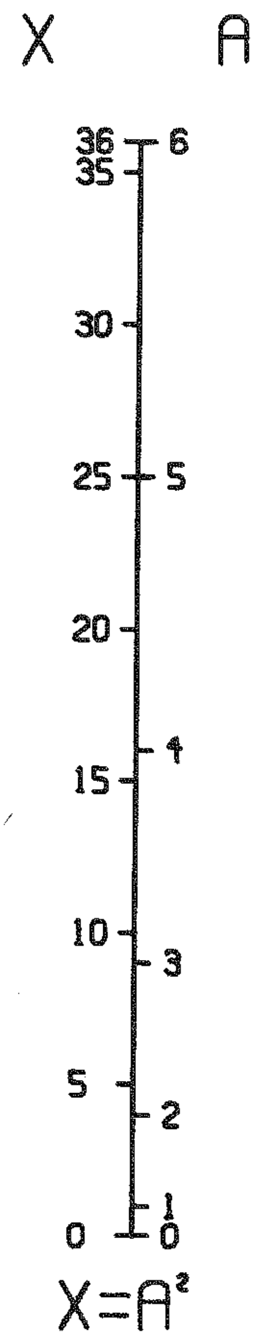

Figure 1

Figure 1 uses only three of the basic sub-routines available to most plotter programmers, namely PLØT, NUMBER, and ANNØT. Sub-routine PLØT is the real workhorse, with sub-routine NUMBER used to calibrate the graduations, and sub-routine ANNØT to identify the scales.

The instructions to the computer will be the same as the steps that one would take to draw the scales manually, for that is really all that any program consists of, namely the detailed step-by-step procedure to solve a given program. Several methods exist for drawing functional scales, but assume that we will use that which is most graphical and involves the least mathematics. The proportional sub-division method fill the bill here.

We shall begin by making a linear scale, as it is the easier type to begin with. Let's say that we are to draw a scale 7" long to represent values of the function of a simple variable (say "X") as the variable ranges from 0 to 6 as shown in the sketch of Figure 2. The f(X) is X, thus the scale will be uniformly divided. Letting X increment by 1 is logical for this range and this demonstration. The distance between tic marks will be proportional to the differences of the value of f(X) for corresponding increments of X. We can use the computer to determine these values and to convert them to appropriate pen addresses. This relationship between the value of the function and the scale distance can be expressed as the ratio:

$$\frac{SD}{SL} = \frac{FX}{FXF} \qquad (1)$$

where

SD = Scale Distance for a given value of the variable, measured from the minimum end of the variable X scale.
SL = The total scale length
FX = The value of the Function for the same given value of the variable, measured from the minimum of the F(X) scale.
FXF = The value of the Function for the Final value of the variable.

This ratio may be illustrated by the sketch in Figure 3 in which the vertical scale represents the scale to be plotted but whose inter-tic distance (7/6") is awkward, and the sloping construction scale is the true functional scale but whose intervals can easily be arranged to convenient values by varying its slope and length. Notice that the two scales are proportional to each other. Whereas SL and FXF are constant, SD must vary as FX

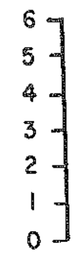

Figure 2

varies. If we were making the scale in Figure 2 by hand, we would draw it vertically 7" long, and draw the sloping construction scale at some convenient length and angle and lay off appropriate lengths along it. These would be transferred to the main stem, which would be calibrated in terms of the variable X, but the inter-tic distance would be proportional to the inter-function increment as determined on the sloping construction scale. This technique is also shown in Figure 3.

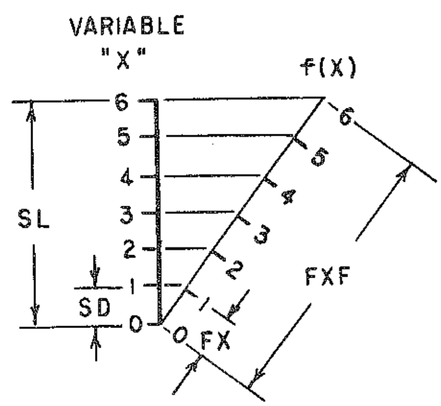

Figure 3

We can now write this ratio into a program which will repeatedly increment X, evaluate the function, and then determine the corresponding proportional scale distances. Figure 4 is a program which will plot the required scale and calibrate it with tic marks .1" long at increments of X = 1 along the scale, as shown in Figure 2. A more sophisticated scale would, of course, contain sub-divisions, but we kept this scale simple for demonstration purposes. Such refinements can easily be included by the programmer as required. This program will produce the vertical scale only, with the tic marks and calibrations.

If the variable in the function has a power or exponent other than +1, the scale gradua-

```
C  INITIALIZE
       SL=7.
       XMAX=6.
       FXF=XMAX
C  MØVE TØ START
       CALL PLØT (2.,1.,-3)
C  CALCULATE SD AND PLØT
       DØ 5 I=1,7
       X=I-1
       FX=X
       SD=SL*FX/FXF
       CALL PLØT (0.,SD,2)
C  PLØT TIC MARK
       CALL PLØT (-.1,SD,2)
C  ANNØTATE TIC MARK
       CALL NUMBER (-.3,SD-.1,.2,X,0.,-1)
C  RETURN TO SCALE
     5 CALL PLØT (0.,SD,3)
```

Figure 4

tions will, of course, be non-uniform, reflecting the non-linearity of the function. The general reasoning will be the same as in the foregoing example, as the relationships between the scale distances and the values of the function remain unchanged. This can easily be demonstrated by discussing a scale to represent a simple non-linear function. The basic idea will hold true regardless of the specifics of the function. It is merely a matter of carefully handling the expression of the function itself.

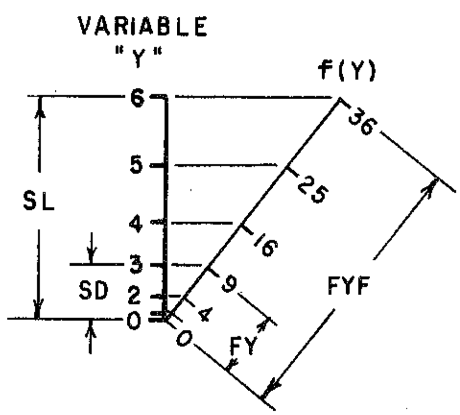

Figure 5

As an example, let's say we are again to draw a scale 7" long, but to represent the values of a non-linear function (say Y^2) as the variable Y ranges from 0 to 6, as shown by the vertical scale in Figure 5. The f(Y) is Y^2, therefore, the scale will be non-uniformly divided. Again, letting Y increment by 1 is logical for this range and this demonstration. Figure 5 shows a sketch of both scales required to relate to the ratios developed for equation (1). Note that the distance between tic marks is still proportional to the differences between the values of f(Y) for corresponding increments of the variable Y. Figure 6 consists of a program to plot only the vertical scale shown in Figure 5.

An application of the use of functional scales is the plotting of two scales on one stem, thus providing a two-variable conversion scale representing an equation involving two variables. as an example, if we have the simple equation

$$X = A^2 \qquad (2)$$

where A varies from 0 to 6, we can make such a scale as shown in Figure 7. In this case, f(A) is A^2, producing a non-linear scale, Similarly, f(X) is X, and a linear scale is produced. The limits of X are dependent upon the limits of A, and logical increments have been preselected for both scales by the programmer. Minor sub-divisions have again been omitted for simplicity of demonstration.

```
C  INITIALIZE
       SL=7.
       YMAX=6.
       FYF=YMAX  2
C  MØVE TØ START
       CALL PLØT (2.,1.,-3)
C  CALCULATE SD AND PLØT
       DØ 5 I=1,7
       Y=I-1
       FY=Y**2
       SD=SL*FY/FYF
       CALL PLØT (0.,SD,2)
C  PLØT TIC MARK
       CALL PLØT (-.1,SD,2)
C  ANNØTATE TIC MARK
       CALL NUMBER (-.3,SD-.1,.2,Y,0.,-1)
C  RETURN TØ SCALE
     5 CALL PLØT (0.,SD,3)
```

Figure 6

It should be obvious that the program to produce a plot such as in Figure 7 is little more than repeating the plot for a single scale, but paying attention to the appropriate function, and making the tic marks on the proper side of the stem. If the programmer were involved in making many such plots, he could easily create his own sub-routines as required.

Figure 8 contains a program to produce the two variable conversion scale shown in Figure 7. Can you determine how the programmer achieved the small (but real) increment at the top of the X scale ? Any two-variable conversion scale can be similarly plotted. The programmer must pay careful attention to the functional relationships when initializing, and select logical increments with which to control his independent DØ loops required for each scale.

In this fashion, any functional scale may be plotted, either seperately or inconjunction with any other functional scale. The programs may be made quite general by reading the initializing values such as SL, AMIN, and AMAX from data cards, but any initializing Arithmetic Assignment statements which involve the function must, of course, be unique to those functions. This does not cause undue difficulty as they are grouped and easily identifyable at the beginning of the program.

Functional scales plotted along circular arcs may be produced just as easily by converting from linearly determined scale distances to angularly determined scale distances and reconverting the angular displacement of the pen into appropriate X and Y plotting coordinates. Similarly, functional scales may be plotted along any curve which can be defined mathematically. This is difficult to do each time it is executed manually, but once "debugged", a program will create any plot with no effort on the part of the programmer beyond providing proper initializing data and initializing Arithmetic Assignment statements involving the functions of the variables and of the curve along which the scales are to be plotted.

Students quickly realize that time invested in producing a good program will return excellent dividends in the form of quickly and easily produced plots and/or N/C tapes or tables of data for a wide variety of scales.

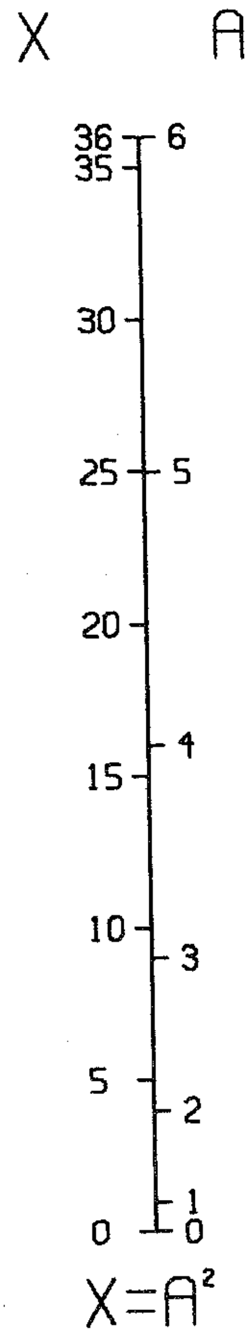

Figure 7

```
C  INITIALIZE
      SL=7.
      AMIN=0.
      AMAX=6.
      FAF=AMAX**2
      XMIN=AMIN**2
      XMAX=AMAX**2
      FXF=XMAX
C  MØVE TØ START
      CALL PLØT (2.,1.,-3)
C  CALCULATE SD (X SCALE) AND PLØT
      J=XMIN
      K=XMAX
      DØ 5 I=J,K,5
      X=I
      FX=I
      SD=SL*FX/FXF
      CALL PLØT (0.,SD,2)
      CALL PLØT (-.1,SD,2)
      CALL NUMBER (-.4,SD-.075,.15,X,0.,-1)
    5 CALL PLØT (0.,SD,3)
      CALL PLØT (0.,SL,2)
      CALL PLØT (-.1,SL,2)
      CALL NUMBER (-.4,SL.075,.15,FXF,0.,-1)
C  RETURN TØ START
      CALL PLØT (0.,0.,3)
C  CALCULATE SD (A SCALE) AND PLØT
      J=AMIN
      K=AMAX
      DØ 6 I=J,K
      A=I
      FA=I**2
      SD=SL*FA/FAF
      CALL PLØT (0.,SD,2)
      CALL PLØT (.1,SD,2)
      CALL NUMBER (.2,SD.075,.15,A,0.,-1)
    6 CALL PLØT (0.,SD,3)
C  ANNØTATE X SCALE
      CALL ANNØT (-.75,7.5,.3,0.)
C  ANNØTATE A SCALE
      CALL ANNØT (.5,7.5,.3,0.)
C  ANNØTATE EQUATIØN
      CALL ANNØT (-.45,-.6,.3,0.)
      CALL ANNØT (.3,-.35,.1,0.)

                Data Deck

X
A
X=A
2
```

Figure 8

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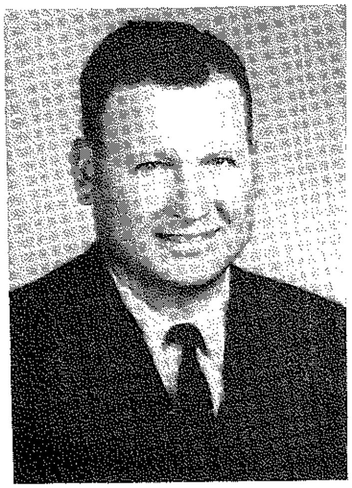


STATUS OF DESCRIPTIVE GEOMETRY IN THE UNITED STATES

ROY G. TRAPP
Instructor of Industrial Arts
North Texas State University

A survey, conducted in the spring of 1967, of the high schools with an enrollment of 975 pupils or greater, in the state of Texas, indicated that there will be an increased demand for descriptive geometry teachers in the secondary schools as technology expands and is extended down from college to high school levels[1]. If this trend can be projected nationwide, then industri al teacher education institutions must anticipate the need for preparation in this area. Present research reveals that a sizeable minority group of schools is not meeting this need; however, more than one-fourth of the colleges and universities questioned, indicated that there was no descriptive geometry available to students in the industrial teacher education program. To send a graduate of this discipline into the teaching profession or industry without, at least, an introductory course in this basic subject is an injustice to the student.

During the fall of 1967, an inquiry was directed to appropriate institutions of higher learning in the United States as listed in the INDUSTRIAL TEACHER EDUCATION DIRECTORY, 1966-67 edition, concerning aspects of the teaching of descriptive geometry in the particular college or university. Of the 208 schools contacted, 158 (76 %) responded with 110 (70 %) indicating that descriptive geometry was taught by some department in the university. Four schools noted that the subject was to be initiated in September of 1968.

A significant rvelation of the survey is that 42 schools (27 %) of those engaged in technical teacher preparation did not make descriptive geometry available to their students in any department of the college or university. In this group were included a number of state universities as well as state colleges.

Among the institutions offering descrip-

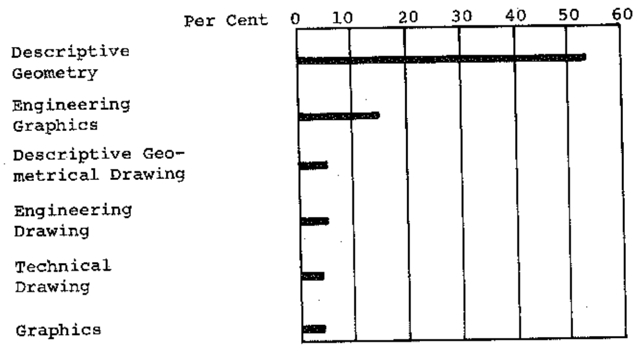


Figure 1

Titles under which descriptive geometry is taught.

tive geometry, the subject was taught as a seperate course by 95%, while only 5% indicated that material from descriptive geometry was integrated into other courses such as graphics, mechanical drawing, drafting, and engineering drawing.

Figure 1 illustrates the most commonly used titles under which the course was taught, while Table I lists the least used titles. The title "Descriptive Geometry" was most popular, being used by over 50% of the responding schools. Engineering Graphics was second, being used by 15% of the respondents.

The textbooks most often used was Parė, Loving, and Hill DESCRIPTIVE GEOMETRY. Texts used by 2% or more of the universities are referred to in Figure 2. Instructor developed materials ranked second in use, and ENGINEERING DESCRIPTIVE GEOMETRY by Rowe and McFarland ranked

---

1 Roy G. Trapp, "Status Of Descriptive Geometry in Texas," TIAA Bulletin, Vol. XII, No. 4 (April, 1968), 17-18.

Title	%
Advanced Graphics	1
Basic Drafting and Design	1
Descriptive Drafting	1
Developmental Descriptive Geometry	1
Drafting III	1
Drawing and Design	1
Engineering Drafting	1
Engineering Geometry	1
Graphic Analysis	1
Graphic Science	1
Industrial Drawing	1
Mechanical Drawing	1
Orthographic Representation	1
Pattern Development	1

Table I

Titles under which descriptive geometry is taught. (least used)

third. Table II lists books that are used by 1% of the schools responding to the survey.

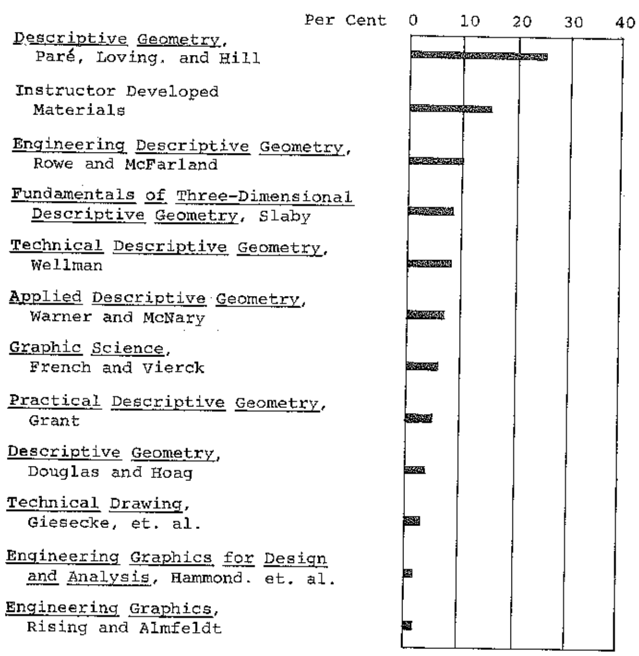


Figure 2

Textbooks used in descriptive geometry.

The method of solution employed by 85% of the schools was the "direct method", while 38% used "revolution" and 10% used the "Mongean Method".

Title and Author	%
Applied Descriptive Geometry Problems Book, Warner and Douglass	1
Basic Graphics, Luzadder	1
Descriptive Geometry, Etter	1
Descriptive Geometry, Schaum's College Outline Series, Hawk	1
Descriptive Geometry, Nellis and Wickham	1
Descriptive Geometry, Watts and Rule	1
Engineering Drawing and Geometry, Hoelscher and Springer	1
Engineering Graphics, Svensen and Street	1
Fundamentals of Modern Math, May and Grahom	1
Geometry of Engineering Drawing, Hill and Palmerlee	1
Geometry of Engineering Graphics, Byers and Turner	1
Graphics with an Introduction to Conceptual Design, Levens	1
Problems for Dimensional Descriptive Geometry, Seid	1

Table II

Textbooks used in descriptive geometry (least used)

The depth and scope of study are graphically shown in Figure 3. Other topics that are mentioned by at least one school include motion analysis, velocities, accelerations, displacement, design, graphical math of nomography and statics, shades and shadows, package design, obliques and isometrics, architectural design, tool project, mechanics, surveying, creative and conceptual design.

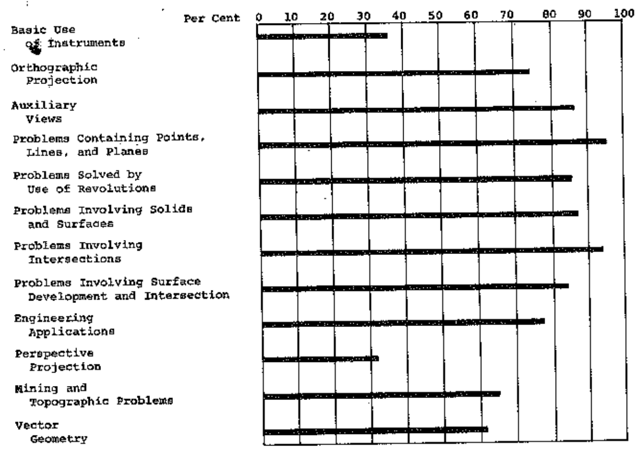


Figure 3

Topics included in the depth and scope of study.

Approximately 80% of the institutions required some form of introductory drawing as a prerequisite to taking descriptive geometry. Such requirements are engineering drawing, engineering graphics, technical drawing, or basic drafting.

Class enrollment ranged as follows:

1 - 10	5% of the schools
11 - 20	33% of the schools
21 - 30	53% of the schools
31 - up	8% of the schools

Six instructors of the indtitutions of higher learning cantacted, felt very strongly that descriptive geometry was a most thought-provoking course and that it should be one with a high priority in a curriculum of industrial or industrial arts education, and especially that with a drawing concentration.

The researcher is especially concerned about the high percent of schools (27%) which do not offer descriptive geometry, and it is aspiration that this article will have some influence in reducing this percentage to alleviate the critical situation.

SUMMARY OF QUESTIONNAIRE

STATUS OF DESCRIPTIVE GEOMETRY

	No. of Schools	Per cent of 208	Per cent of 156	Per cent of 110
Colleges and universities to which questionnaires were sent as listed in Industrial Teacher Education Directory, 1966-67.	208			
Questionnaires returned	158	76		
Usable questionnaires	156	75		
Schools offering descriptive geometry	110	53	70	
Subject as separate course	104	50	67	95
Subject as part of an integrated course	6	3	4	5
Schools offering descriptive geometry but only for engineering or math majors (included in the 110 figure above)	7	3	5	6
Schools scheduled to begin the course in September, 1968 (not included in the 110 figure above)	4	2	3	4

	No. of Schools	Per cent of 208	156	110
Schools offering industrial teacher education which do not teach descriptive geometry	42	20	27	
Departments teaching descriptive geometry:				
Industrial Arts				45
Engineering Graphics				22
Industrial Education				13
General Engineering				6
Industrial Technology				5
Mathematics				3
Mechanical Engineering				3
Industrial Design				2
Industrial and Technical Education				2
Technology				2
Architectural Engineering				1
Engineering and Technology				1
Engineering Technology				1
Graphic Science				1
Industrial Drafting and Design Technology				1
Industrial Engineering				1
Machine and Tool Design Technology				1
Technical				1
Technics				1
Titles under which descriptive geometry is taught:				
Descriptive Geometry				53
Engineering Graphics				15
Descriptive Geometrical Drawing				5
Engineering Drawing				5
Technical Drawing				4
Graphics				4
Advanced Graphics				1
Basic Drafting and Design				1
Descriptive Drafting				1
Developmental Descriptive Geometry				1
Drafting III				1
Drawing and Design				1
Engineering Drafting				1
Engineering Geometry				1
Graphic Analysis				1
Graphic Science				1
Industrial Drawing				1
Mechanical Drawing				1
Orthographic Representation				1
Pattern Development				1
Textbooks used in descriptive geometry:				
Descriptive Geometry, Paré, Loving, and Hill				25
Instructor Developed Materials				15

	No. of Schools	Per cent of 208	156	110
Engineering Descriptive Geometry, Rowe and McFarland				10
Fundamentals of Three-Dimensional Descriptive Geometry, Slaby				8
Technical Descriptive Geometry, Wellman				8
Applied Descriptive Geometry, Warner and McNary				7
Graphic Science, French and Vierck				6
Practical Descriptive Geometry, Grant				5
Descriptive Geometry, Douglas and Hoag				4
Technical Drawing, Geisecke, et. al.				3
Engineering Graphics for Design and Analysis, Hammond, et. al.				2
Engineering Graphics, Rising and Almfeldt				2
Applied Descriptive Geometry Problems Book, Warner and Douglass				1
Basic Graphics, Luzadder				1
Descriptive Geometry, Etter				1
Descriptive Geometry, Schaum's College Outline Series, Hawk				1
Descriptive Geometry, Nellis and Wickham				1
Descriptive Geometry, Watts and Rule				1
Engineering Drawing and Geometry, Hoelscher and Springer				1
Engineering Graphics, Svensen and Street				1

	No. of Schools	Per cent of 208	156	110
Fundamentals of Modern Math, May and Grahom				1
Geometry of Engineering Drawing, Hill and Palmerlee				1
Geometry of Engineering Graphics, Byers and Turner				1
Graphics with an Introduction to Conceptual Design, Levens				1
Problems for Dimensional Descriptive Geometry, Seid				1
Methods by which descriptive geometry is taught:				
Direct				85
Revolution				38
Mongean				10
Topics included in the depth and scope of study:				
Basic use of instruments				36
Orthographic projection				74
Auxiliary views				86
Problems containing points, lines, and planes				95
Problems solved by use of revolutions				85
Problems involving solids and surfaces				87
Problems involving intersections				94
Problems involving surface development and intersection				83
Engineering applications				77
Perspective projection				32
Mining and topographic problems				65
Vector geometry				62
Other topics mentioned include motion analysis, velocities, accelerations, displacement, design, graphical math of nomography and statics, shades and shadows, package				

	No. of Schools	Per cent of 208	156	110
design, obliques and isometrics, architectural design, tool project, mechanics, surveying, creative and conceptual design.				
Approximately 80% of the institutions offering descriptive geometry required some form of introductory drawing as a prerequisite, such as:				
Engineering drawing				29
Engineering graphics				17
Technical drawing				20
Basic drafting				9
Class size:				
1-10				5
11-20				33
21-30				53
31-up				8

From the Comment Section:

Six instructors felt very strongly that descriptive geometry was a most thought-provoking course and that it should be a course with high priority in the curriculum of the industrial arts teacher and especially one with a drawing concentration.

Annual Meeting (continued from page 14)

Faculty

Engineering Design
- PERCY H. HILL
  Tufts University
- JAMES H. EARLE
  Texas A&M University

Computer Graphics
- PAUL M. REINHARD
  University of Detroit

Theoretical Graphics
- PATRICK BORECKY
  University of Toronto

Engineering Education
- PHILIP L. BRACH
  Washington Technical Institute

Industry

"Engineering Education vs Reality"
MARIO D'ANTONIO
President
Trenton Textile and Engineering Manufacturing
Trenton, New Jersey

Research

"Engineering and Research"
ARTHUR BROKAW
Principal Investigator
Water Infiltration Research Project
American Public Works Assoc.

Panel

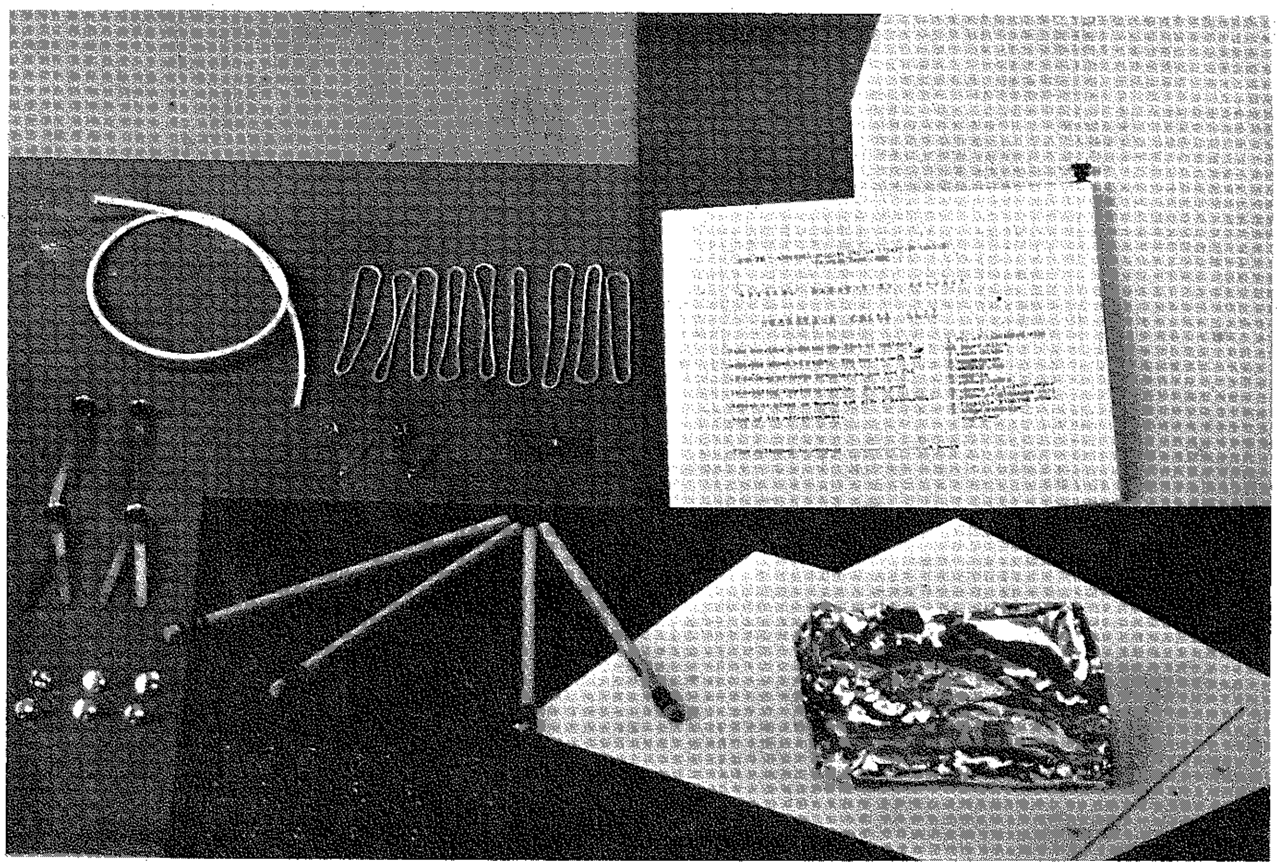
Students

Engineering Design
- J. C. OTIS
  Ph.D Candidate
  Case-Western Reserve Univ.

Computer Graphics
- TIMOTHY GREGOIRE
  Class of 1971
  School of Engineering & Applied Science
  Princeton University

Theoretical Graphics
- (students to be announced)

CREATIVE DESIGN DISPLAY



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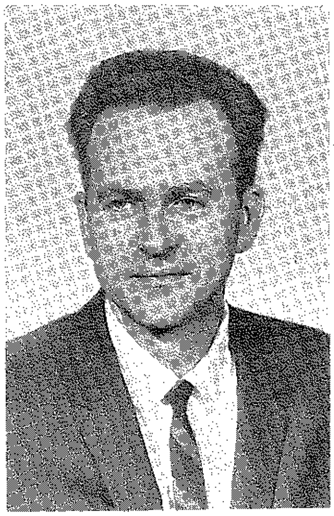

SOLUTION TO A CLASS OF PROBLEM INVOLVING DIHEDRAL ANGLES

THOMAS THORSEN
El Camino College

Abstract

In this note we demonstrate a revolution technique that can be used in orthographic projection to pass a plane through a line of arbitrary orientation when the plane's dihedral angle with a reference plane is given. The technique is demonstrated in two examples: when the reference planes are the horizontal projection plane and a plane of arbitrary orientation, respectively.

Method of Construction: Example I

Consider a line AB given in its orthographic projections on the H and F projection planes[1] in Figure 1. Through this line, we wish to pass a plane which has a dip of 30°SE, i.e., a plane which has a dihedral angle of 30° with the horizontal projection plane and which is tilting downward in a southwesterly direction[2]. The difficulty inherent in a problem of this type is, of course, that we do not know the position of the necessary auxiliary projection plane to H relative to the line AB. We begin the solution by drawing an auxiliary projection plane X to H in an arbitrary position. In this auxiliary projection plane we locate the image of a point on the line AB, say B. We know that projection plane X has been properly located when the view of the line AB in this plane coincides with the edgeview (EV) of the given plane. Hence, we draw the EV of this plane through the image of B, introduce the elevation of A, and hence find the location of A on this EV. Except for point B, however, the images in this preliminary auxiliary plane do not have the proper relationship to the image of the line AB in H. However, we know that if we could find the proper orientation of the auxiliary plane, then the images in that plane would be as shown in Figure 1. We must seek the proper line of sight, then, in order for the two views to be reconciled.

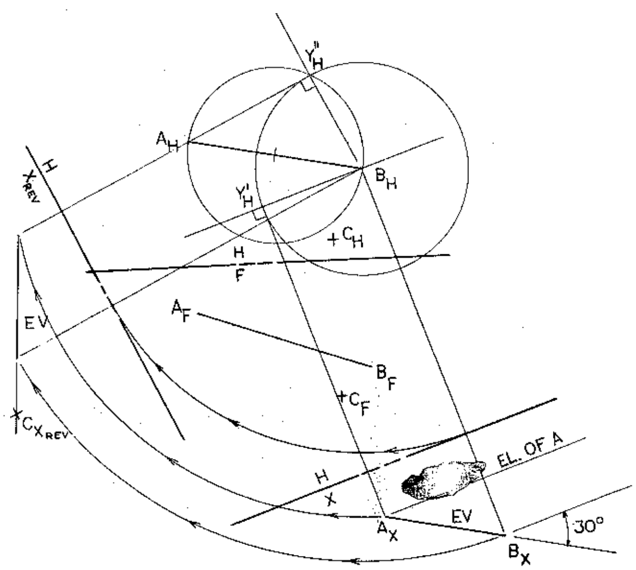

Figure 1
Solution, Example 1

The necessary reconciliation is obtained in the following manner: Through B_H draw a line parallel to the folding line H-X. The projection line through A_X must be perpendicular to these two lines and intersects the line through B_H at Y'_H. Construct a circle with $B_HY'_H$ as a radius and construct the tangent from A_H to this circle. The point of tangency is designated as Y''_H. It will become obvious, in a moment, that the second tangency point will not give the desired solution. The two views, H and X, have been rotated about a vertical axis through B_H until the two images, Y'_H and Y''_H coincide. The arcs described by the principal points during the revolution are indicated in Figure 1. When the revolution is completed, $A_H A_X Y_H$ is then a straight line which is perpendicular to the folding line H-X, thus satisfying the requirement of orthographic projection. It now remains to pick an arbitrary point C on the EV of the plane in X_{rev} and a consistant image in H. The plane defined by the images of the points A, B, and C in projection planes H and F now define the plane which passes through the line AB and which has a dip of 30° SE.

We note that if the plane's dihedral angle with H had been given, rather than its dip, then two solutions would have been possible. The second solution would make use of the second point of tangency in the H plane in Figure 1. The plane of the second solution would have a dip of 30° NE.

The construction shown in Figure 1 is only possible as long as the dihedral angle of the plane with H is equal to, or greater than, the slope of the line. If the dihedral angle were smaller, this would manifest itself in that A_H would then be inside the circle $B_H Y_H$ as a radius, i.e., it would be impossible to construct a tangent from A_H to the circle. If the dihedral angle were equal to the slope of the line, A_H would lie on the circle and only one solution would exist. Only if the dihedral angle of the plane with H exceeds the slope of the line will two solutions exist (if not restricted by dip designations) as we have shown in this example.

The solution to the above problem is also shown in Figure 2. The preliminary auxiliary projection plane has now been located in a different position than in Figure 1. The vertical axis of revolution is now passed through A_H. As before, the auxiliary plane with its images is rotated about this axis until it is in its proper position. In this instance, tangents to the circle with $A_H Y'_H$ as a radius are drawn from B_H. Again, the solutions are obtained when Y'_H coincides with the points of tangency Y''_H.

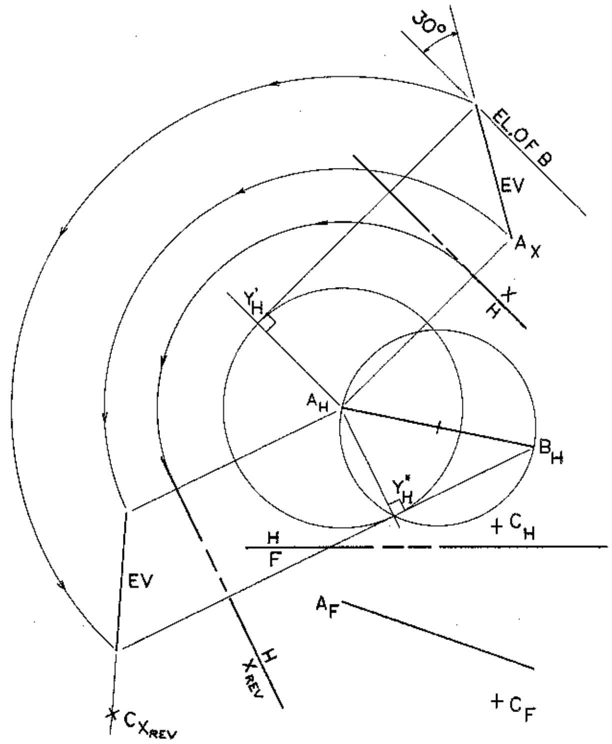

Figure 2
Alternate Solution Construction, Example I

Example II

In Figures 3, 4, and 5 we demonstrate the method when the reference plane is not one of the given projection planes. Consider this problem: Given the plane and the line AB whose images are as shown in projection planes 1 and 2 in Figure 3. It is desired to pass a plane with a 40° dihedral angle with the given plane through the line AB. In order to present the solution with as much clarity as possible, we have divided it into three figures. In Figure 3, we establish the EV of the plane and then find the image of the line in an auxiliary projection plane 4 which is parallel to the plane.

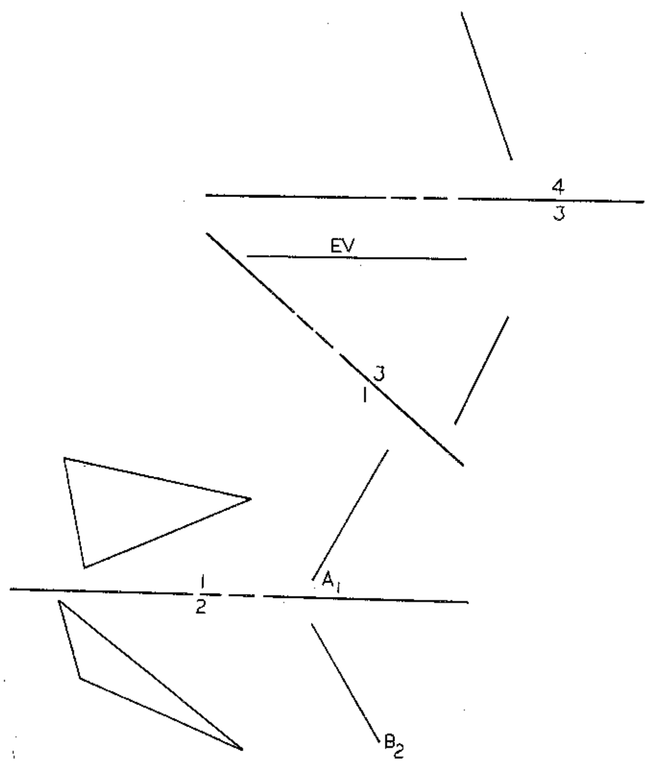

Figure 3
Problem Statement, Example II

Consequently, the problem is solved using projection planes 3 and 4 as shown in Figure 4, i.e., the problem now is to pass through the line AB a plane which has a dihedral angle with the plane 4 of 40°. The constructions necessary to obtain the solutions are shown in Figure 4. One solution is the plane defined by the points A, B, and C, the other by points A, B, and D. In Figure 5, we have stated the solutions by transferring the images of C and D to projection planes 1 and 2,

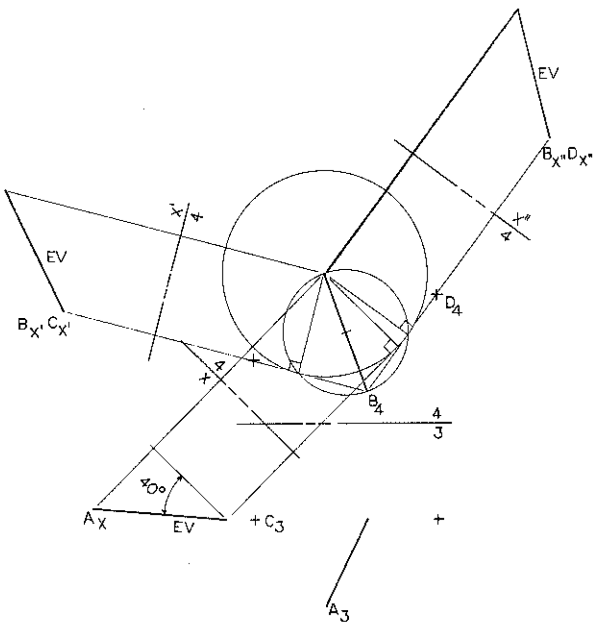

Figure 4
Solutions, Example II

Conclusion

The method which has been described is applicable to any problem where operations must be performed in a plane having a given dihedral angle with a reference plane under the further restriction that the plane must pass through a specified line. One might think, for example, of an elastic string secured between two points and then stretched in a specified plane in a certain manner. The method can be used in, what in descriptive geometry terminology, are called revolution problems. Suppose, for example, that two planes are given and that one plane is to be revolved about a line in the plane until the dihedral angle between the two planes is a given value. The method set forth here can be used to yield solutions to such problems as hinted at and which would be impossible to solve with conventional descriptive geometry methods.

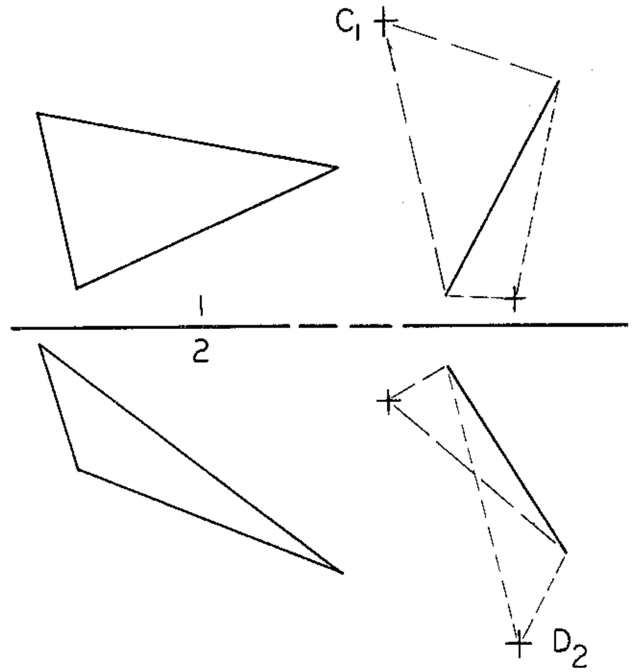

Figure 5
Solution Statement, Example II

References and Notes

1. The nomenclature and symbols of descriptive geometry is used, e.g., H and F denote horizontal and frontal projection planes, respectively.

2. See, for example, B. L. Wellman, "Technical Descriptive Geometry", McGraw-Hill, New York, 1957 (2nd Ed.), or S. M. Slaby, "Fundamentals of Three-Dimensional Descriptive Geometry", Harcourt, Brace and World, New York, 1966.

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4-DIMENSIONAL DESCRIPTIVE GEOMETRY SOLUTION OF LINEAR SYSTEMS

by
Dr. ROBERT K. NARCHI
Faculty of Engineering
University of Alexandria
U.A.R.

INTRODUCTION

This paper is in two parts. Part I gives a graphical method for solving linear equations with three variables, using the known 3-dimensional descriptive geometry of Gaspard Monge. Part II deals with an analogous method for solving linear equations with four variables using 4-dimensional descriptive geometry. This method may also be extended for the solution of linear equations with n-variables using n-dimensional descriptive geometry, but it is to be noted that any further extension of this method leads to many lines and complicated constructions, and consequently to a non-practical method of solution.

PART I

SOLUTION OF A LINEAR SYSTEM WITH THREE VARIABLES

1.1 Let the equations of the system be

$$a_1x + b_1y + c_1z = k_1 \qquad (1)$$

$$a_2x + b_2y + c_2z = k_2 \qquad (2)$$

$$a_3x + b_3y + c_3z = k_3 \qquad (3)$$

where x, y and z are the three variables and a_n, b_n, c_n and k_n (n = 1; 2; 3) are known coefficients.

1.2 Since a plane is represented analytically by a linear equation in x, y, and z, the above equations may be regarded as three planes ϕ_1, ϕ_2, and ϕ_3. These planes intersect in a point S which is a common point to the three planes and consequently satisfy the three given equations.

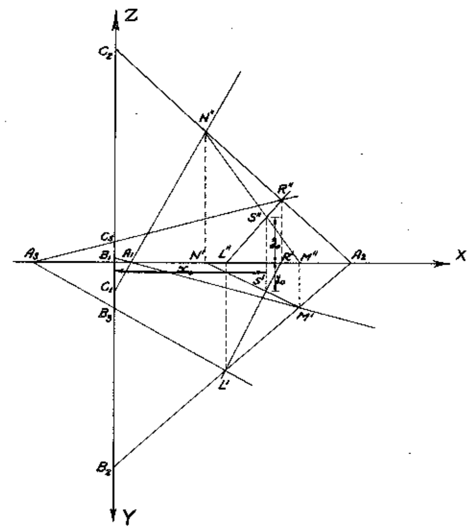


FIG « 1 »

1.3 The representation of the above three planes and the determination of the required point S by the descriptive geometry of Gaspard Monge may be performed as shown in Figure 1.

1.3.1 The three planes ϕ_1, ϕ_2, and ϕ_3 cut the X, Y, and Z axes in points whose coordinates are

$$A_n\left(\frac{K_n}{a_n}, 0, 0\right)$$

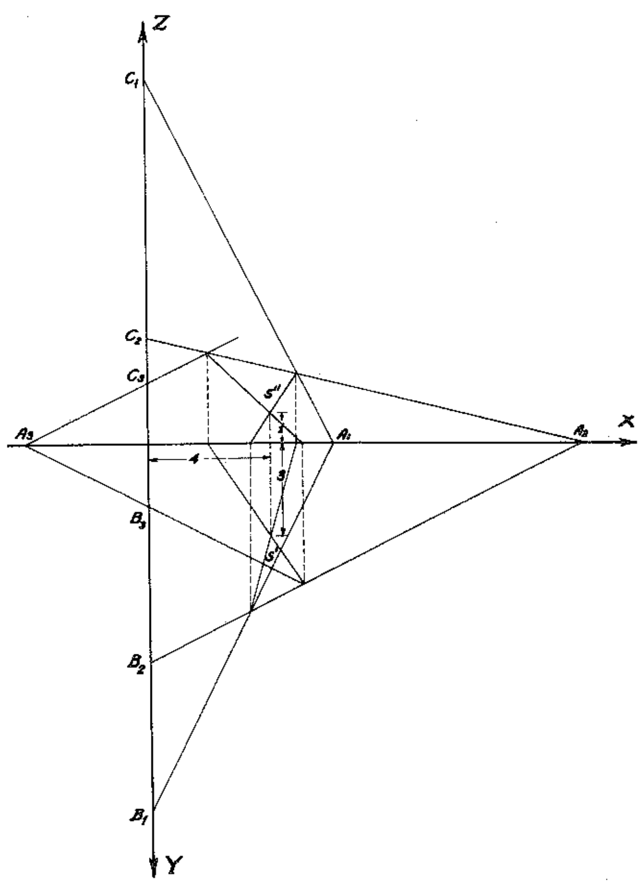
$$B_n\left(0, \frac{k_n}{a_n}, 0\right)$$

$$C_n\left(0, 0, \frac{k_n}{c_n}\right)$$

1.3.2 Plot the points A_1, B_1, and C_1 of equation (1) and join A_1B_1 and A_1C_1, which gives the vertical and horizontal traces of the plane ϕ_1. In the same way, the vertical and horizontal traces of the planes ϕ_2 and ϕ_3 may be determined.

1.3.3 As A_1B_1 and A_2B_2 belong to the same vertical plane of projection they intersect in a point M which lies in ϕ_1 and ϕ_2. In the same way we obtain N the point of intersection of A_1C_1 and A_2C_2. Joining M and N we obtain the line of intersection of the two planes ϕ_1 and ϕ_2. The coordinates of any point on MN will satisfy the equations (1) and (2).

In the same way we obtain LR the line of intersection ϕ_2 and ϕ_3. The coordinates of any point on LR will satisfy the equations (2) and (3). MN and LR belong to the plane ϕ_2, and therefore intersect in a point S, which is the point of intersection of the three planes ϕ_1, ϕ_2 and ϕ_3. The coordinates of S satisfy the three equations (1), (2), and (3) and hence represent the required solutions.



1.4 Example

Solve the following equations:

$$2x + y + z = 12$$
$$x + 2y + 4z = 14$$
$$-x + 2y + 2z = 4$$

Solution: (Figure 2)

1. Represent the three equations as previously explained in 1.3
2. Determine the point of intersection, S, of the three represented planes
3. Measure the three coordinates of point S.

Result:

$x = 4$

$y = 3$

$z = 1$

PART II

4-DIMENSIONAL DESCRIPTIVE GEOMETRY SOLUTION OF A LINEAR SYSTEM WITH FOUR VARIABLES

In the 4-dimensional descriptive geometry introduced by Lindgren(1) and Abdel Messih (2) a point P is represented by its orthogonal normal projections P_1, P_2 and P_3 on the three spaces of projection having a ground line in common and which intersect two by two in three planes (Figure 3). The distances from P_1, P_2 and P_3 to the ground line determine the distances from P to the three spaces of projection. This system of reference does not involve any coordinate axes.

This work deals with the solution of linear equations whose numerical coefficients will be represented graphically by the coordinates of some points with reference to four mutually perpendicular axes of reference. We devote, therefore, the following article (II. 1) to introduce suitable coordinate axes of reference and to show how these axes are represented.

II. 1 Coordinate System of Reference

II. 1. 1 From a definite point O taken as the origin we suppose 4 axes OX, OY, OZ and OT perpendicular to each other and determining the hyperspace (Figure 4).

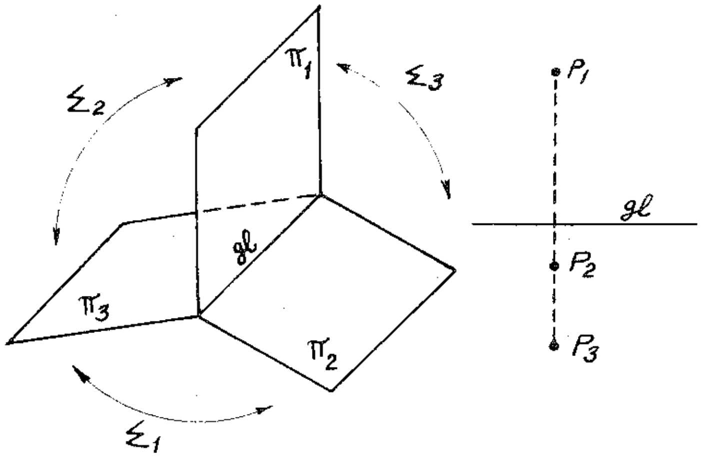


FIG « 3 »

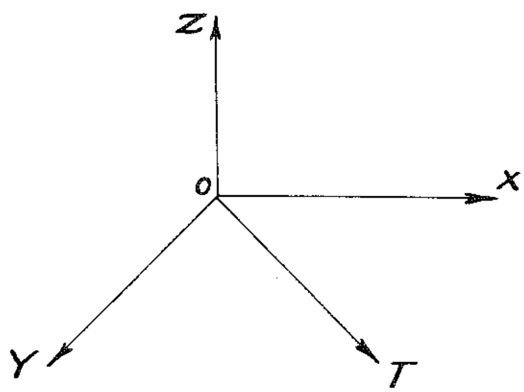


FIG « 4 »

II.1.2 Each 3 of the above axes determine a space of projection which we denote thus:

The space of OX, OY and OT by Σ_1

The space of OX, OZ and OT by Σ_2

The space of OX, OY and OZ by Σ_3

The space of OY, OZ and OT by Σ_4

II.1.3 Each of these axes being perpendicular with each other is then perpendicular to the space determined by them:

OX is perpendicular to Σ_4

OY is perpendicular to Σ_2

OZ is perpendicular to Σ_1

OT is perpendicular to Σ_3

Accordingly, the coordinate of a point parallel to any axis, represents the distance from this point to the space of projection to which this axis is perpendicular.

II.1.4 The spaces of projections intersect two by two in planes which we shall denote as follows:

Σ_1 and Σ_2 intersect in the plane π_3

Σ_2 and Σ_3 intersect in the plane π_1

Σ_1 and Σ_3 intersect in the plane π_2

Σ_1 and Σ_4 intersect in the plane π_4

Σ_2 and Σ_4 intersect in the plane π_5

Σ_3 and Σ_4 intersect in the plane π_6

II.1.5 <u>Representation of the reference system</u> (Figure 5)

The representation of the spatial system chosen above on one plane is performed as follows

II.1.5.1 Consider the plane π_1 to be the plane on which the whole system will be represented and take OX horizontal and OZ vertical. Rotate the plane π_2 about OX until it coincides with π_1. OY, being perpendicular to OX, will be vertical after rotation and coincide with OZ. Rotate the plane π_3 about OX until it

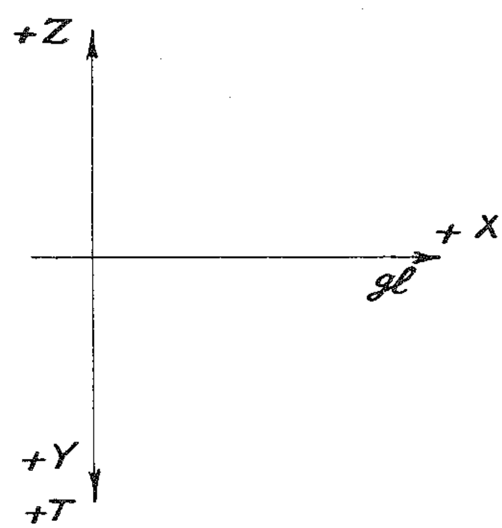


FIG « 5 »

coincides with τ_1. OT, being perpendicular to OX, will, after rotation, also be vertical and coincide with OZ and OY. In this manner the four axes are represented. The positive direction of these axes are chosen as is shown in Figure 5. OX is also considered the ground line and will sometimes be denoted as gl.

II. 1. 5. 2 The three projections of any point on the spaces Σ_1, Σ_2, Σ_3 involve the four coordinates determining the point, they are, therefore, sufficient to represent that point. The following constructions will, therefore, be restricted to the three spaces Σ_1, Σ_2 and Σ_3 and their planes of intersection two by two π_1, π_2 and π_3. The spaces and mode of projection, in that way, are thus analogeous to those considered by (1) and (2).

II. 1. 6 The representation of a point M (x_1, y_1, z_1, t_1) may be easily performed as shown in Figure 6.

Example (Figure 6)
Represent the following points:

P (2, 3, 6, 4)
R (5, -2, 5, 3)
S (7, 4, 3, 1)

whose given coordinates are x, y, z and t respectively.

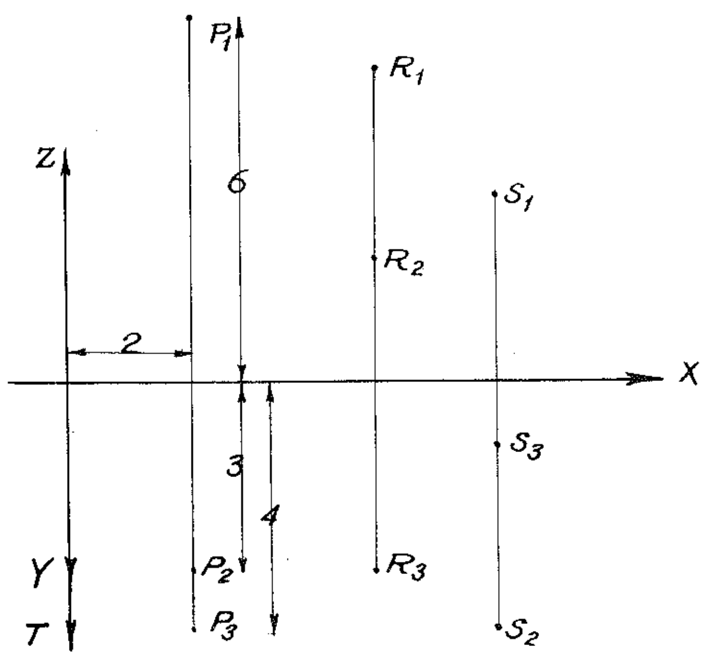


FIG « 6 »

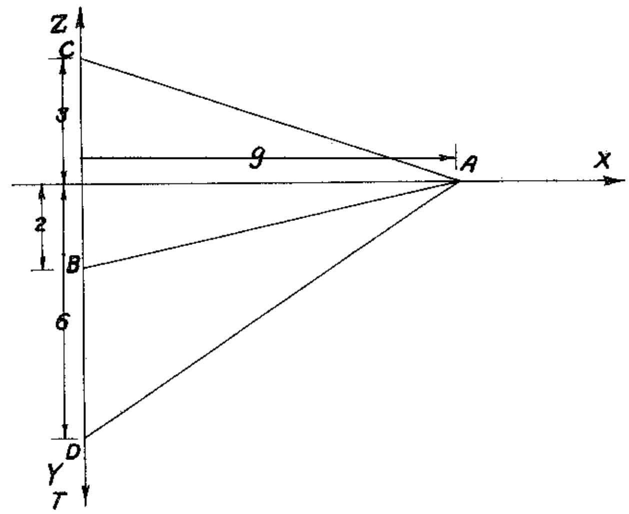


FIG « 7 »

II. 1. 7 Since any linear equation with four variables may be considered as a hyperplane, the representation of the hyperplane whose equation is

$$a_1x + b_1y + c_1z + d_1t = k$$

may be performed as follows:

The hyperplane will cut the X, Y, Z and T axes in points whose coordinates are

A_1; $(\frac{k_1}{a_1}, 0, 0, 0)$

B_1; $(0, \frac{k_1}{b_1}, 0, 0)$

C_1; $(0, 0, \frac{k_1}{c_1}, 0)$

D_1; $(0, 0, 0, \frac{k_1}{d_1})$

respectively.

Example (Figure 7)
Represent the hyperplane given by the equation:

$$2z + 9y + 6z + 3t = 18$$

The hyperplane will cut the X, Y, Z and T axes in points whose coordinates are

A (9, 0, 0, 0)

B (0, 2, 0, 0)

C (0, 0, 3, 0)

D (0, 0, 0, 6)

Plot these points and join AB, AC, and AD to obtain the traces of the hyperplane π_1, π_2 and π_3.

II. 2 Solution of a linear system with four variables

II. 2. 1 Let the equations of the system be:

$$a_1x + b_1y + c_1z + d_1t = k_1 \quad (1)$$

$$a_2x + b_2y + c_2z + d_2t = k_2 \quad (2)$$

$$a_3x + b_3y + c_3z + d_3t = k_3 \quad (3)$$

$$a_4x + b_4y + c_4z + d_4t = k_4 \quad (4)$$

where x, y, z and t are the four variables and a_n, b_n, c_n, d_n and k are known coefficients.

II. 2. 2 Since a hyperplane is reprented, analytically, by a linear equation in x, y, z and t, the given equations (II. 2. 1) may be regarded as four hyperplanes Γ_1, Γ_2, Γ_3, and Γ_4. These hyperplanes intersect in a point S which is common to the four hyperplanes, and, consequently, satisfies the four equations.

II. 2. 3 The representation of these four hyperplanes and the determination of the required point S by the 4-dimensional descriptive geometry method may be performed as follows: (Figure 8)

II. 2. 3. 1 Each of the four hyperplanes is represented as in II. 1. 7 by the traces A_1B_1, A_1C_1 and A_1D_1 of Γ_1 on π_1, π_2, and π_3 respectively and A_2B_2, A_2C_2, and A_2D_2 of Γ_2 and A_3B_3, A_3C_3, and A_3D_3 of Γ_3 and A_4B_4, A_4C_4, and A_4D_4 of Γ_4.

II. 2. 3. 2 A_1B_1 and A_2B_2 belong to the same plane π_1, they intersect, therefore in a point U_{12} which lies in 1 and Γ_2. A_1C_1 and A_2C_2 belong to the plane π_2, they, therefore, intersect in a point V_{12} which lies in Γ_1 and Γ_2. A_1D_1 and A_2D_2 belong to the plane π_3 and therefore intersect in a point W_{12} which lies in Γ_1 and Γ_2. The three points U_{12}, V_{12} and

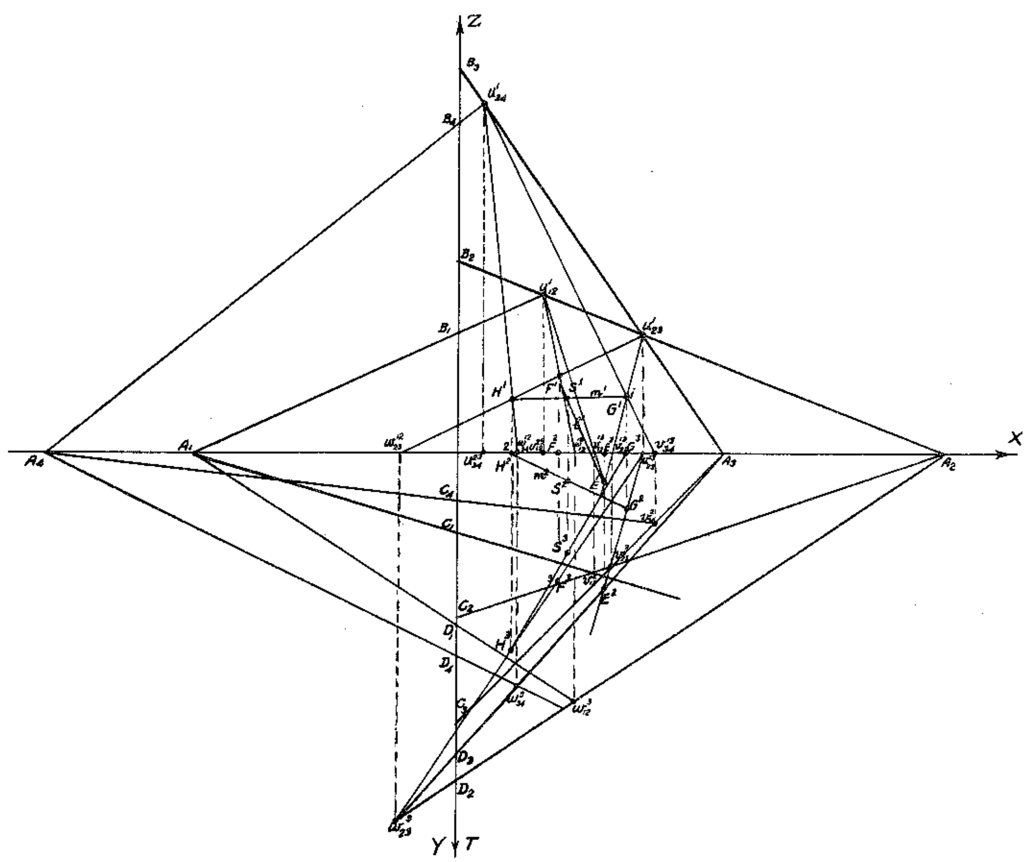


FIG "8"

W_{12} determine the plane of intersection α_{12} of the two hyperplanes Γ_1 and Γ_2. Similarly we determine the plane α_{23}, the intersection of the hyperplanes Γ_2 and Γ_3 by the points U_{23}, V_{23} and W_{23} as well as the plane α_{34}, the intersection of the hyperplanes Γ_3 and Γ_4 by the points U_{34}, V_{34} and W_{34}.

II.2.3.3 Since the two planes α_{12} and α_{23} belong to the same hyperplane Γ_2 they intersect in a straight line l, which can be determined as follows: (see (2))

α_{12} intersects the space of projection Σ_3 in the straight line $U_{12}V_{12}$.

α_{23} intersects the space of projection Σ_3 in the straight line $U_{23}V_{23}$.

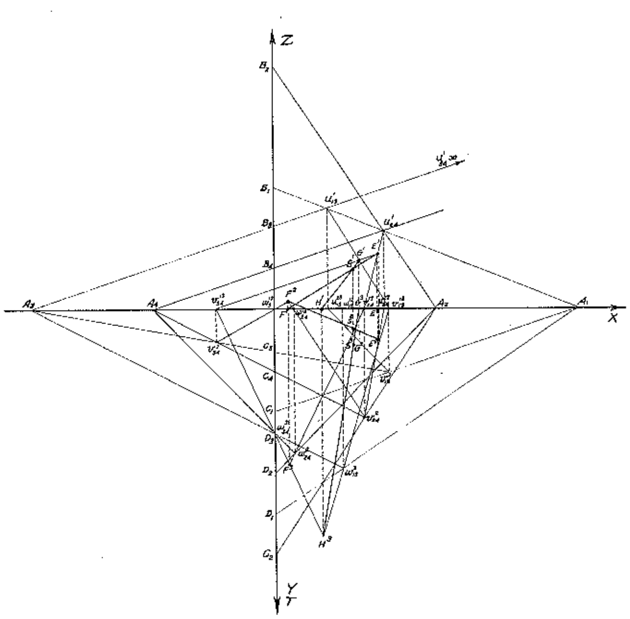
$U_{12}V_{12}$ and $U_{23}V_{23}$ belonging to the plane of intersection of Γ_2 with Σ_3 intersect in a point E.

Similarly;

α_{12} intersects the space of projection Σ_2 in a straight line $U_{12}W_{12}$.

α_{23} intersects the space of projection Σ_2 in a straight line $U_{23}W_{23}$.

$U_{12}W_{12}$ and $U_{23}W_{23}$ belonging to the plane of intersection of Γ_2 with Σ_2 intersect in a point F.



EF is the straight line l of the intersection of α_{12} and α_{23}.

Similarly the two planes α_{23} and α_{34} belong to the same hyperplane Γ_3 and intersect in the straight line m. In Figure 8, m is the line joining the two points G and H.

II.2.3.4 The straight lines l and m belong to the plane α_{23} and therefore intersect in a point S which belongs to the four hyperplanes and consequently satifies the four equations. The coordinates of S are the required solution of the given four equations.

II.2.4 Example: Solve the following equa-

$$2x + 6y + 5z + 3t = 30$$

$$3x + 2y + 2z + 3t = 24$$

$$-x + 6y + 3z + 2t = 12$$

$$-x + 2y + 3z + t = 6$$

Solution: (Figure 9)

1 - Represent the four equations as previously explained in II.2.3

2 - Determine the point of intersection S of the four hyperplanes

3 - Measure the four coordinatesof S.

Result: $x = 4$

$y = 1$

$z = 2$

$t = 2$

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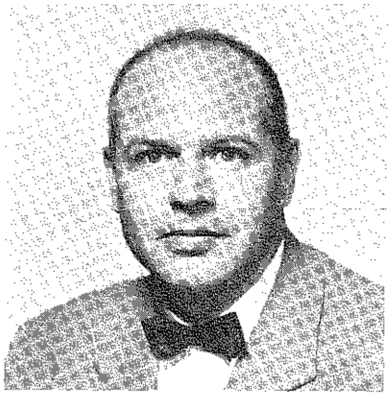

A GRAPHICAL ANALYSIS OF SHADING

by
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Texas A & M University

It is said that an artist is born, not made. We usually think this applicable to draw or paint. But it goes a step farther. Just as some people are color-blind, others are blind to shades of gray. The purpose of this analysis is to help the shade-blind see what happens when light is reflected from flat surfaces and learn a few mechanical methods of reproducing this illusion.

Physics teaches that light intensity varies inverse to the square of the distance from the light source to the reflecting surface. The flash photographer knows this and quadruples his exposure when the distance from the light to the subject is doubled. The light strength, itself, does not decrease appreciably. Otherwise we could not see the stars or bounce a laser beam off the moon. The reduction of reflected light results from the greater spread of the light beam as it moves away from the source. In Figure 1 we place a flat surface 1 ft. from a light that will illuminate exactly 1 square foot of that surface. We can measure the light reflected from the surface and use this for a reference. If the surface is moved 2 feet away from the light the reflected measurement will be only one fourth of the reference measurement because the same light is covering four times the area. When the light is 3 feet from the surface it must cover nine square feet and the reflected light value is one-ninth the original measurement. This is like using the same amount of white paint on each of four black surfaces which are one, four, nine and sixteen square feet. If the paint would cover one square foot adaquately, it would have to be spread very thin to cover sixteen square feet.

In natural situations we seldom see a light shining straight down on a stack of horizontal surfaces. Usually the direction of light is oblique to the surface. In Figure 2 we tilt a surface so one corner rests on a plane four units below the light. By math-

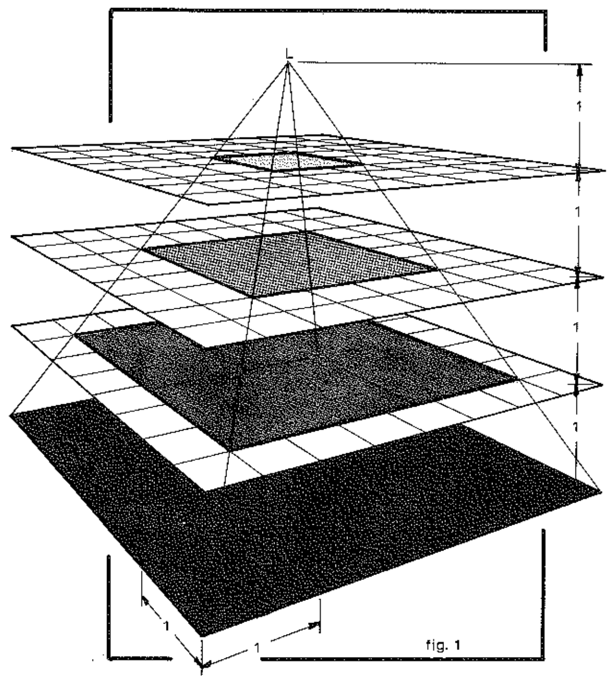


fig. 1

ematics and graphics we can lay off areas on this slanted surface proportional to the square of the distance from the light; Z_1, Z_2, Z_3, ... Z_5. If we shade these areas by a standard gray scale we might use a 10% screen (10% black to 90% white) for the area bounded by Z_1, and graduate the steps down to a 90% screen for the area bounded by Z_5. Although the gray scales are stepped rather than continuous, the surface would begin to assume the effect of graduated shading.

Another way to visualize the procedure would be to place a light (L) above one corner of a cube, Figure 3-b. The distances from the light to each circle would be equal increments, i.e., one unit, two units, three units, ... n units. The areas of each circle would be proportional to the square of the distance from the light. . The first circle, one unit from the light, would contain one square illumination unit. The second circle, two units from the light, would be four times the first illumination unit. The areas of the remaining circles would continue to increase, proportional to the square of the distance from the light.

Now, if these concentric circles are cut by a series of radians, a pattern of approximate quadrilateral figures are formed. The areas of these quadrilaterals are proportional to each other as the areas of their respective circles.

Again, the mechanically constructed figure begins to take on an effect of shading. This phenomenon is more apparent if Figure 3-a is viewed at a distance of eight or ten feet where the eye begins to see the quadrilaterals more than the lines.

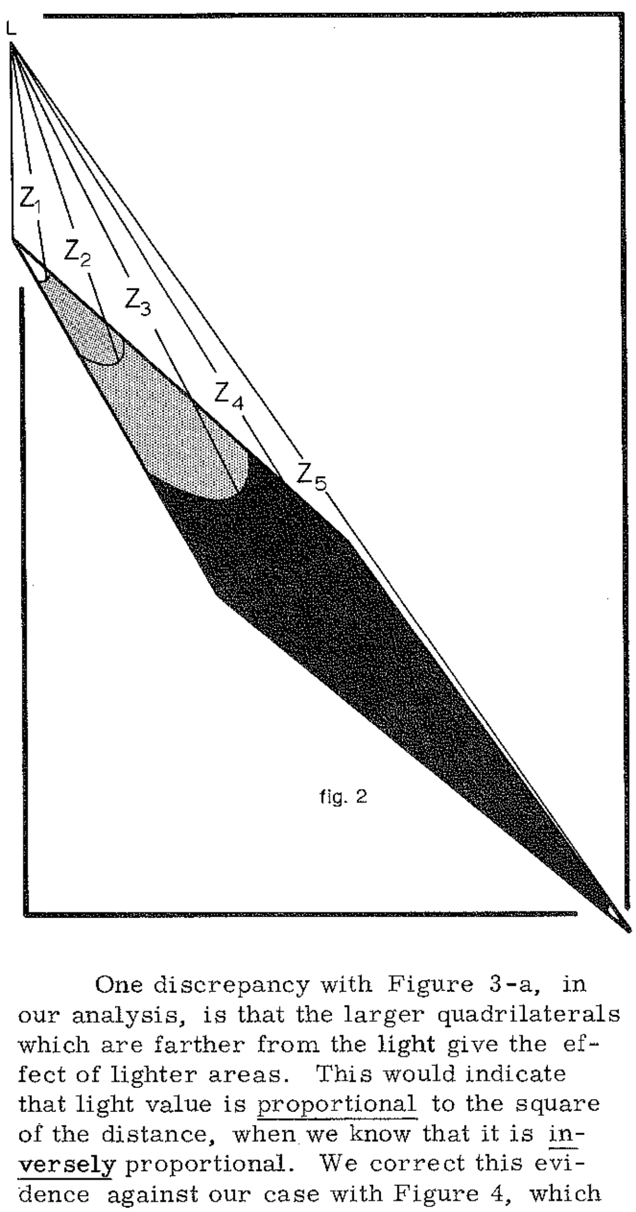


fig. 2

One discrepancy with Figure 3-a, in our analysis, is that the larger quadrilaterals which are farther from the light give the effect of lighter areas. This would indicate that light value is proportional to the square of the distance, when we know that it is inversely proportional. We correct this evidence against our case with Figure 4, which is a negative of Figure 3. Here, the lines are white and the quadrilaterals are black which, at a distance, approaches a gray scale effect.

This same principle is used in the printing art to give the effect of different shades of gray with only black ink and white paper. Photographic film is capable of reproducing continuous graduations of gray, but this cannot be done in printing a newspaper. However, the illusion of tone is made by the use of the half tone screen which converts the continuous graduation of grays in a photograph to proportional areas of white and black. Figure 5-a shows a newspaper half tone cut, greatly enlarged. Shades of gray are represented by different sizes of white dots placed on uniform centerlines called the screen. Very dark areas are reproduced by small white dots surrounded by large areas of black. As the gray tones graduate toward the lighter end of the scale, the white dots grow larger, decreasing the surrounding areas of black.

An interesting phenomenon, which can be seen here, is that the round white dots suddenly seem to become black squares. This can be explained by examining the enlarged area, Figure 5-b. The white dots become so large that they overlap. leaving the black, almost-square dots in the lighter areas of the illustration.

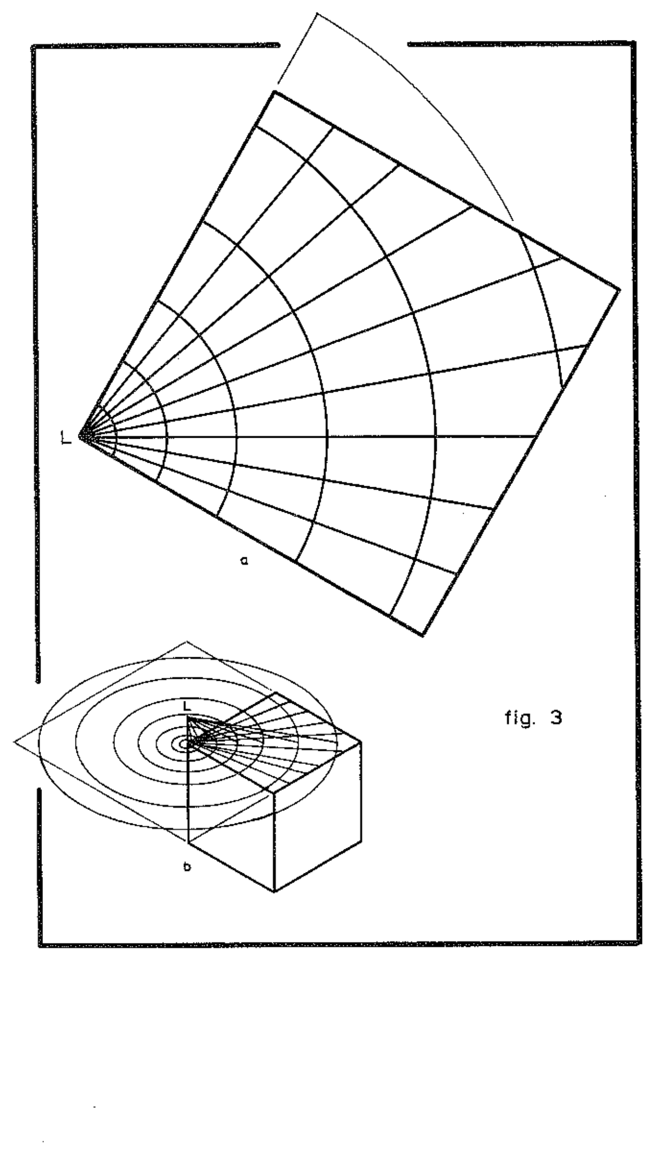


fig. 3

The other cubes in Figure 7 assume a single light source. All are made by using different patterns formed by grids connecting the logarithm divisions. The larger areas of white are made on the part of the cube closer to the assumed source of light.

Figure 7-c shows the modeling effect possible when more lines are drawn on one surface. Here, twice as many lines have been drawn on the right side as have been drawn on the top surface.

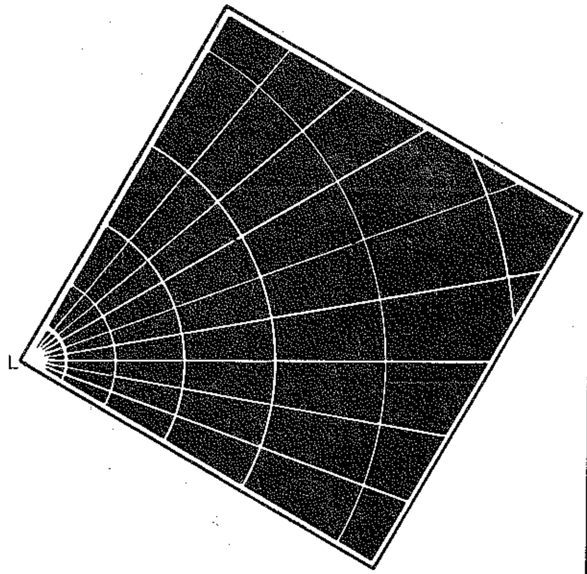


fig. 4

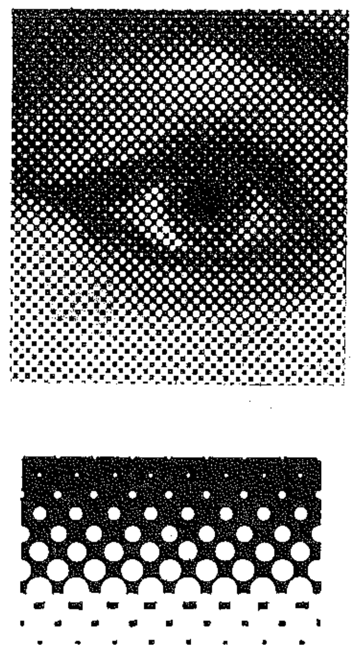


fig. 5

The purpose of this approach is not to teach artistic, or even realistic, shading techniques. However, by practicing the graphics lay-out method, the student should improve his ability to visualize and duplicate shading effects. There are several ways of dividing a major area into sub-areas that are inversely proportional in area to the assumed distance from the light source. One way is to divide the sides of the surface into linear distances equal to the squares of consecutive numbers, Figure 6-a.

In Figure 6-b we have used the logarithm values of numbers ten through one hundred. Logarithm grid paper may be used as a proportional scale to lay off these divisions. When viewed at a distance this makes a pleasing graduated gray scale effect.

In Figure 7 we have used the logarithm division method for a series of mechanical shading doodles. The first, Figure 7-a, represents three equal light sources, placed at the front, back, and bottom of the cube. As in photography, this represents a confused lighting which is not pleasing.

By using equal spacing of lines across an entire surface the effect of an area in shade can be made. This is shown on the front side of the cube in Figures 7-g, 7-h, and 7-i. The irregularities of the line spacing gives a textured effect.

In Figure 7-i we depart from the line shading and use our technique for a graduated gray effect. The grid lines are drawn with a soft pencil and smudged, starting with the darker area and working toward the light. The lines which are closer together place more graphite in the area which is to be dark.

Mechanical shading is so unlimited in possible variations that it offers the skilled illustrator another technique for creating the illusion of three dimensions on two dimensional paper. But of more importance, it provides the shade-blind student with a method of shading that he can use to improve the effects of his drawings.

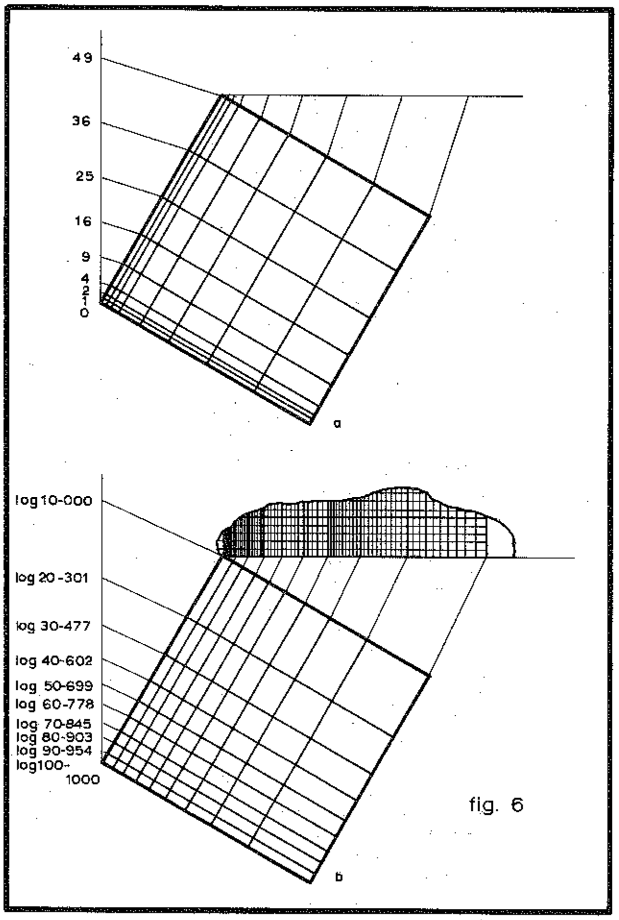


fig. 6

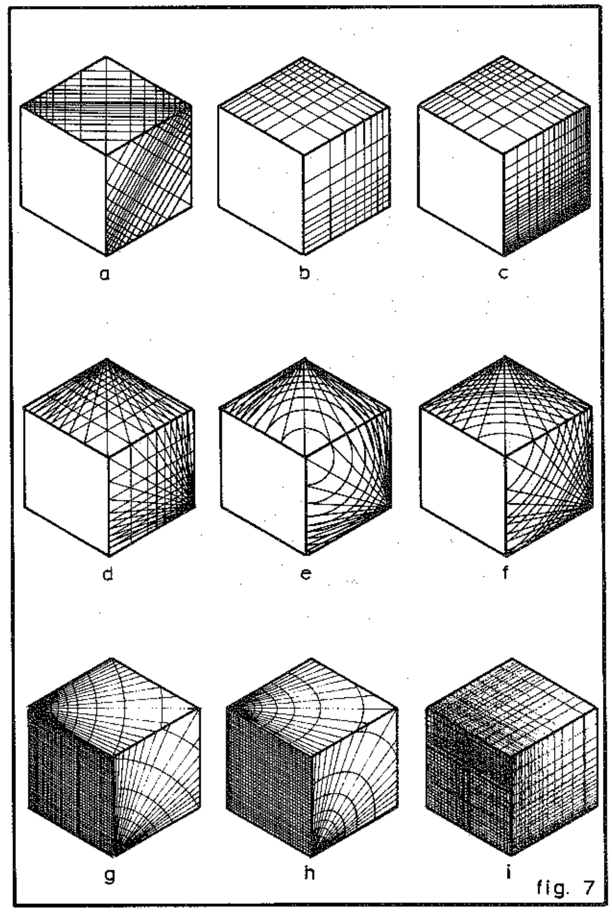
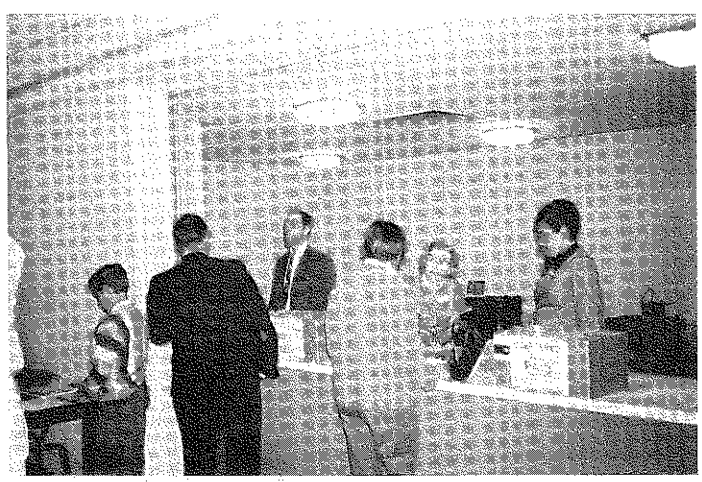
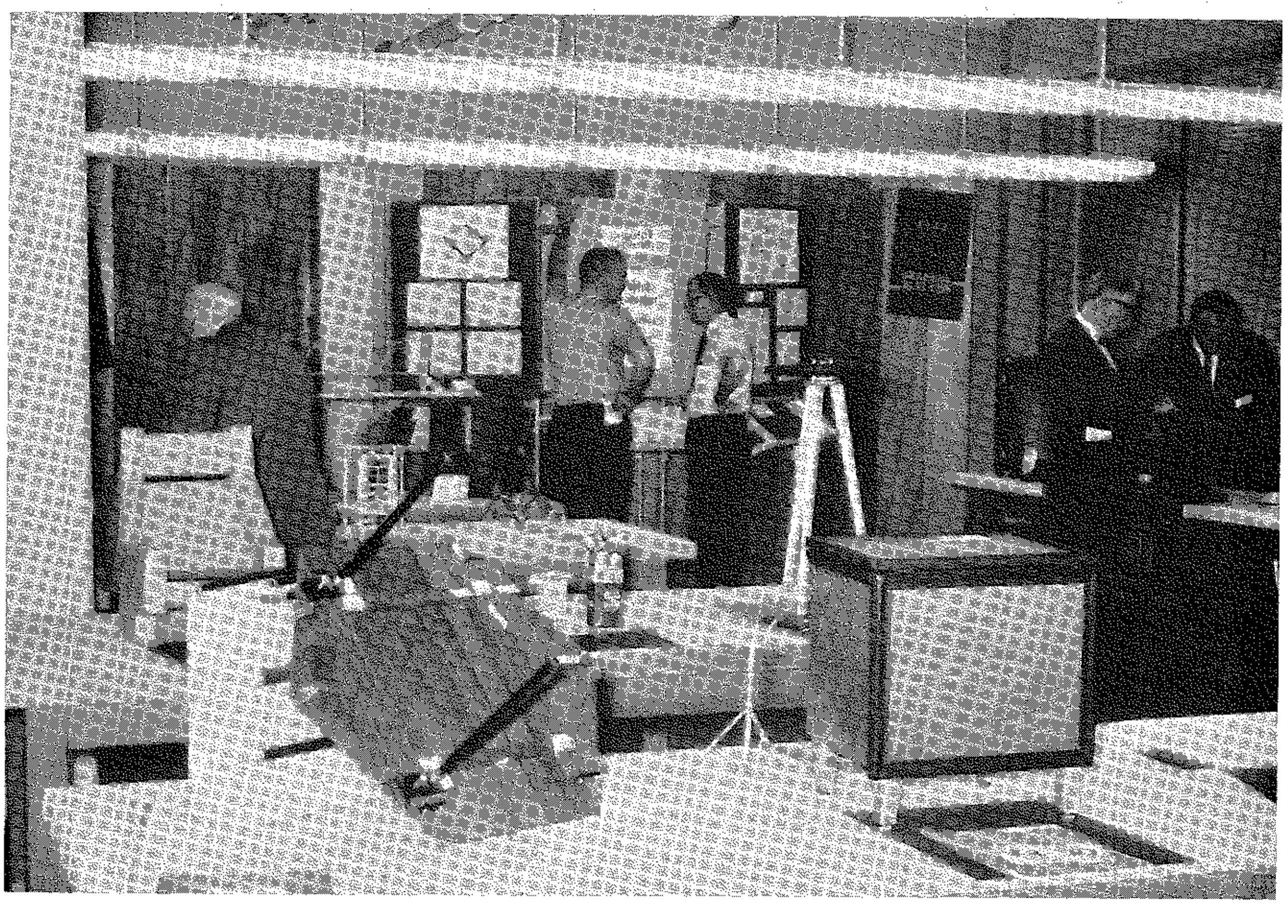


fig. 7



CREATIVE DESIGN DISPLAY



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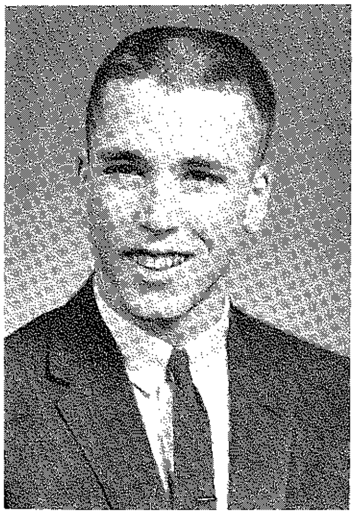


NEW BOOKS

ALLAN CLEMOW
Tufts University

ENGINEERING AS A CAREER, Ralph J. Smith, McGraw-Hill, 3rd Ed., 1969, 418 pages (Paperback)

Although this book is a third edition and might have found its way, in some form, to many desks, this reviewer feels that it should be remembered to the Journal readers. As the title suggests, the career aspects of engineering are brought out for, virtually, every phase of this huge profession. It is intended for freshman, or more specifically, for anyone interested in engineering. What makes it particularly useful are the design case studies in five different areas; construction, systems, hydraulics, electronics, and mechanical engineering.

The sequence of subjects is such that engineering is first defined in a variety of terms, then historical notes are used to show the progress of technology in various basic areas. Next, the areas of instruction in engineering are listed and subsequently explained in some detail. Following this, the functions of engineering, which transcend subject area, are dealt with (research, development, design, sales, teaching, etc.). Other parts of the book attempt to answer questions about the actual study of engineering.

There is a chapter on graphics, stressing the need for formal communication techniques. Coupled with this are chapters on the various methods of problem solving and some of the theoretical tools used by the engineer. The book concludes with a sixteen page compilation of useful equations and engineering data.

COMPREHENSIVE STANDARD FORTRAN PROGRAMMING, James N. Haag, Hayden Book Co., 1969, 312 pages.

This book, as Professor Haag states, is not one which tries to show a particular subset of Fortran for use by a specific machine, but is a presentation of the version of Fortran IV which, in 1966, was standardized by the USA Standards Institute. It is, as the name implies, a comprehensive book of Fortran and covers all aspects of the basic language. Certain pitfalls which commonly appear are eliminated and discussed so as to reduce confusion. As an example of this; the difference between the two types of key-punches. A small problem, perhaps, but this author takes time to delineate the differences.

The format of this book presents the precepts of language construction in a series of rules. These rules are succinct general statements which are followed by detailed explanations and examples. The advantage to this form of presentation is that the rules can be listed concisely in some form to provide a quick reference as a work guide after the basic material has been covered. Indeed, this book has a series of Appendices covering material such as comprehensive lists of Fortran statements, specific rules of language, usage of these Fortran statements, operating instructions for some equipment, error detection methods, and several excellent listings of reference material.

A typical chapter has fifty exercises at the end, including a special programming laboratory problem to challenge the student. In topic coverage the text material starts with a very complete and interesting history of the advent of computers and then proceeds through the introductory subjects surrounding programming. The material in the basic text does not cover all of the Fortran statements. Those that are not specifically reported are chronicled in the Appendices for reference. The author, for instance, does not cover DO statements in the text, but devotes eleven pages in Appendix K. There is an instructor's manual which may be obtained from the publisher.

A GUIDE TO PL/1, S. V. Pollack and T. D. Sterling; Holt, Rinehart and Winston; 1969, 556 pages.

PL/1 is a relatively new programming language which was developed, hopefully, to establish a common denominator between the myriad of specialized languages that exist, and therefore function more efficiently. Presently with Fortran, Cobol, Algol, Basic, etc. different compilers are required and each language represents specific objectives. PL/1 has been forwarded as an answer to this problem. The authors take an approach of deleting the normal introductory chapters of a computer text and begin immediately with a discussion of PL/1. They explain that this material on operating principles and hardware is available in a number of references and does not warrant repeating. The material is presented in a more or less conventional manner as far as topic coverage is concerned.

There are fifteen chapters which start with normal descriptive procedures in language development such as Basic Instructions, Program Formats, Arithmetic Data Forms, etc. However, this book goes deeper than most into the function of the compiler due to the interactive nature of the language. There are exercises at the end of most chapters, for the student to work with.

COMPUTER SCIENCE, A FIRST COURSE, A. I. Forsyth, T. A. Organick and W. Stenburg; John Wiley and Sons; 1969; 553 pages.

Computer Science, as the authors see it, is the development of the logical processes that end in the realization of an algorithm and the associated flow chart. The book is a result of a study group for 12th grade mathematics students. However, the authors point out that the methodology involved is applicable for the first year of college. The text develops all of the necessary tools for solving problems by digital computetion but does not concern itself with any of the programming languages. Instead, it leaves the solution of a problem in the graphical form of its algorithm, the flow chart. The authors, in defining their task, decided that this approach was preferable to the programming techniques. However, to supplement the text, they have provided several programming language booklets which are designed to mesh with the parent text. This makes the book, discussed here, more utilitarian as it can be adapted to more than one language. The programming language supplements are available in Fortran, Basic, and PL/1.

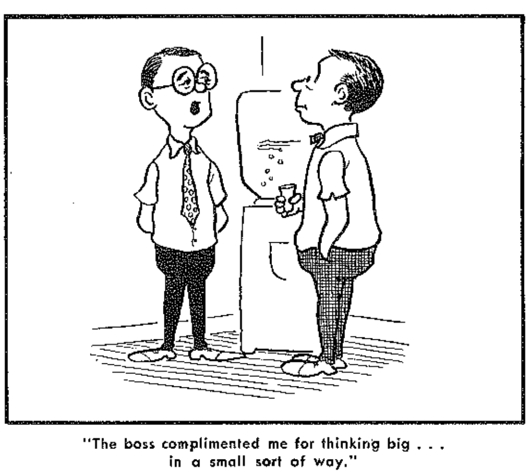
The book is divided into three parts: Basic Concepts, dealing with the concepts of an algorithm, a flow chart, and many examples of allied principles; Numerical Applications, which deals with some techniques of numerical methods; Nonnumerical Applications, explaining topics such as tree structures, searches, and string notation and operation. Exercises are included at the end of most sections of a chapter.

Additions to the Bibliography

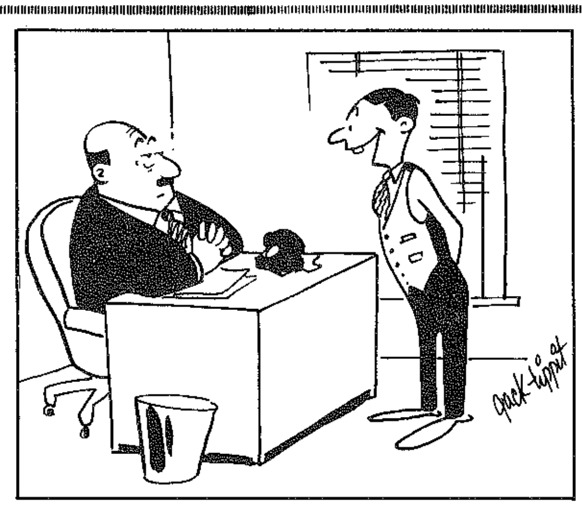
FUNDAMENTALS OF THREE-DIMENSIONAL DESCRIPTIVE GEOMETRY; Steve M. Slaby; Harcourt, Brace, and World, Inc.; 1966; 383 pages.

WORKBOOK FOR FUNDAMENTALS OF THREE-DIMENSIONAL DESCRIPTIVE GEOMETRY; Steve M. Slaby with H. Sanford Gum; Harcourt, Brace, and World, Inc.; 1966; 68 pages.

FOUR-DIMENSIONAL DESCRIPTIVE GEOMETRY; Steve M. Slaby with E. S. Lindgren; McGraw-Hill Book Co.; 1968; 129 pages.

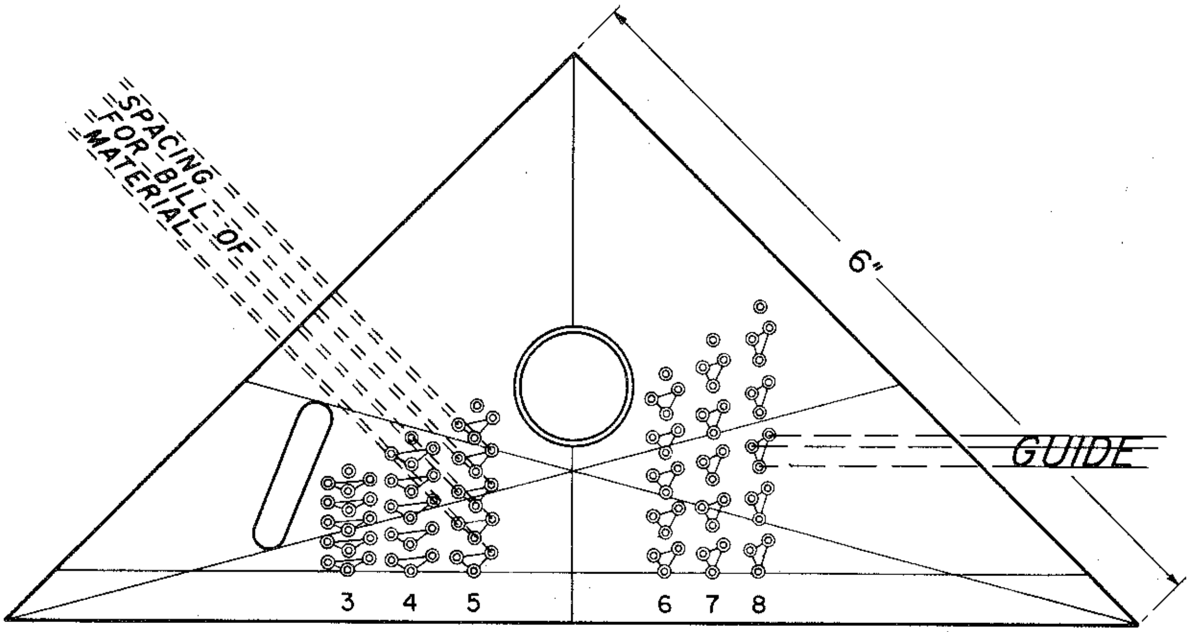


"The boss complimented me for thinking big . . . in a small sort of way."



"Your daughter thinks your son-in-law should have a raise, Pops."

BRADDOCK LETTERING ANGLES



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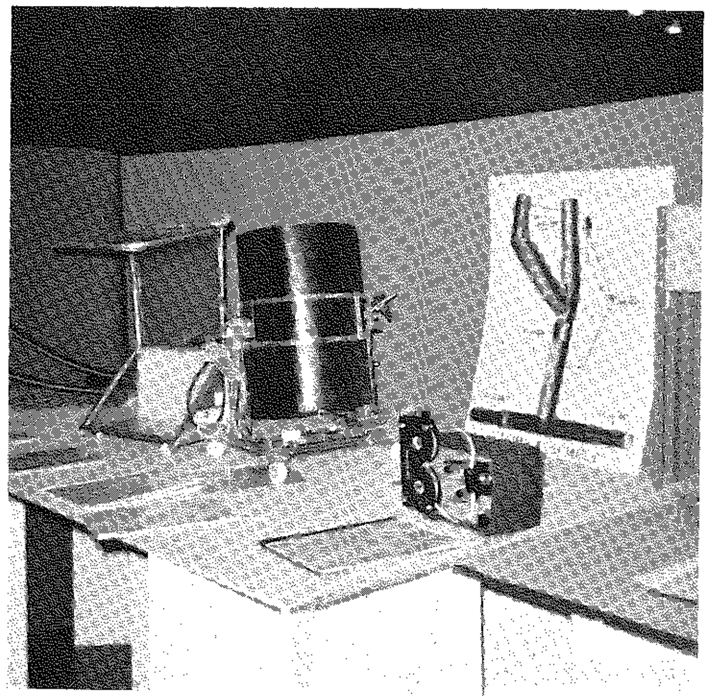
CREATIVE ENGINEERING DESIGN DISPLAY

June 22 - 26, 1970



Columbus, Ohio