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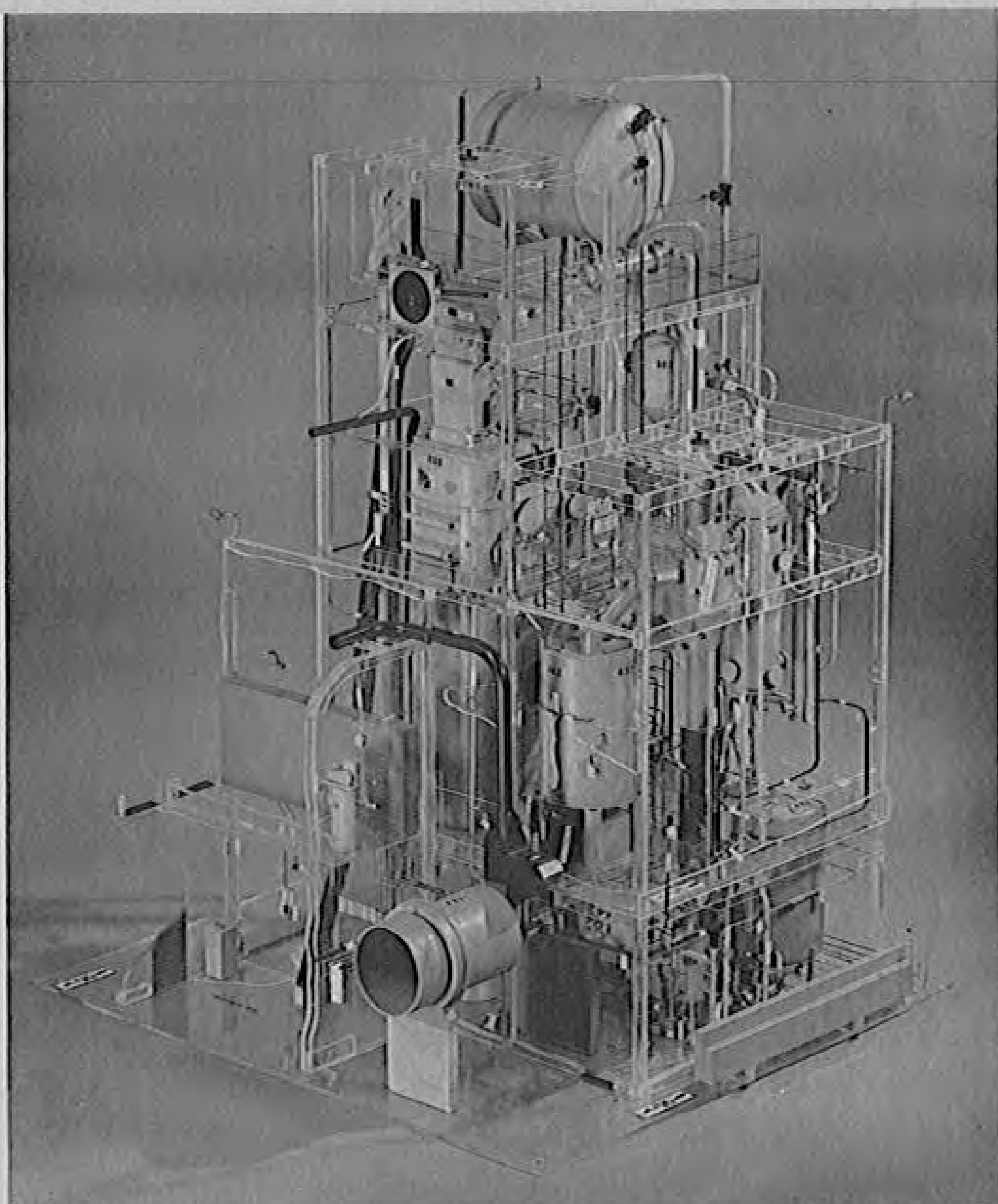

VOL. 24, NO. 2 MAY, 1960 SERIES NO. 71

PUBLISHED BY THE DIVISION OF ENGINEERING GRAPHICS
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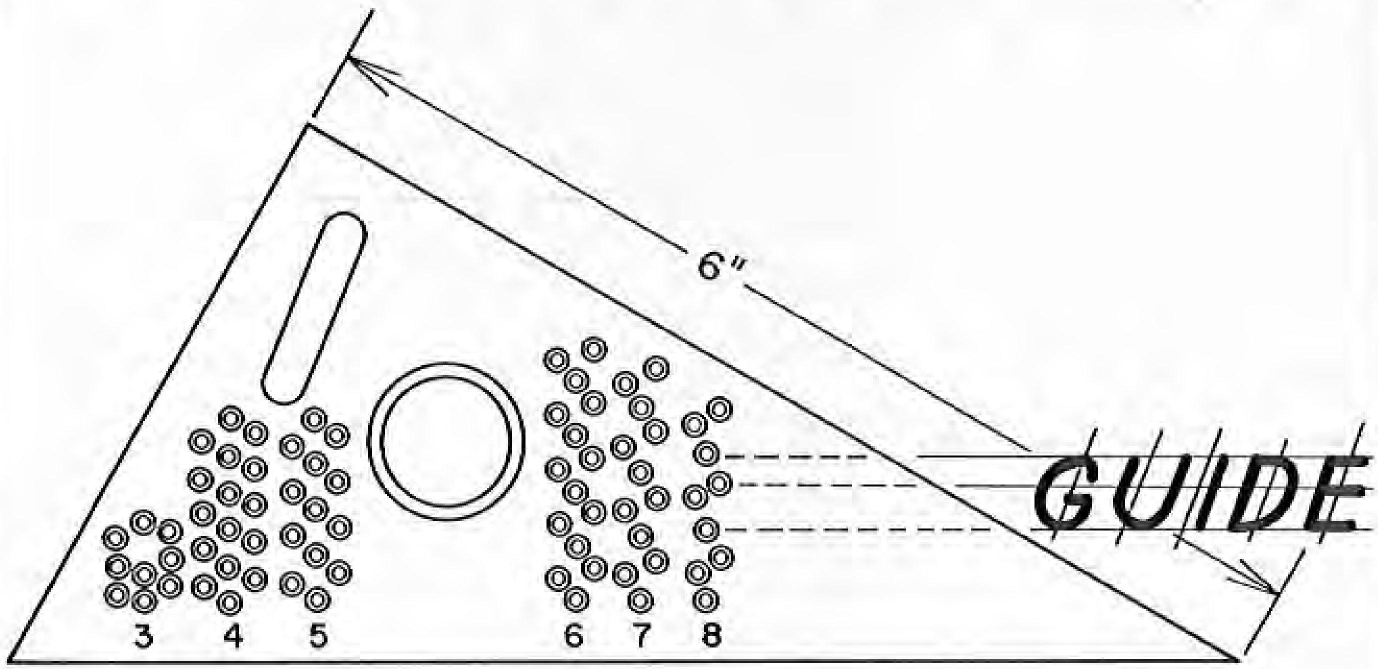

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6"-60		6"-60
7"-60		7"-60
8"-60		8"-60
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5"-45		5"-45
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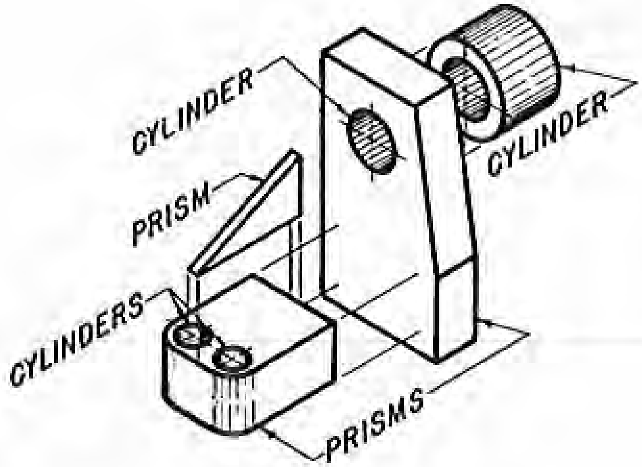

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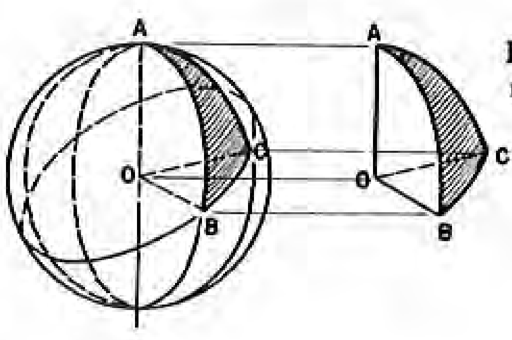

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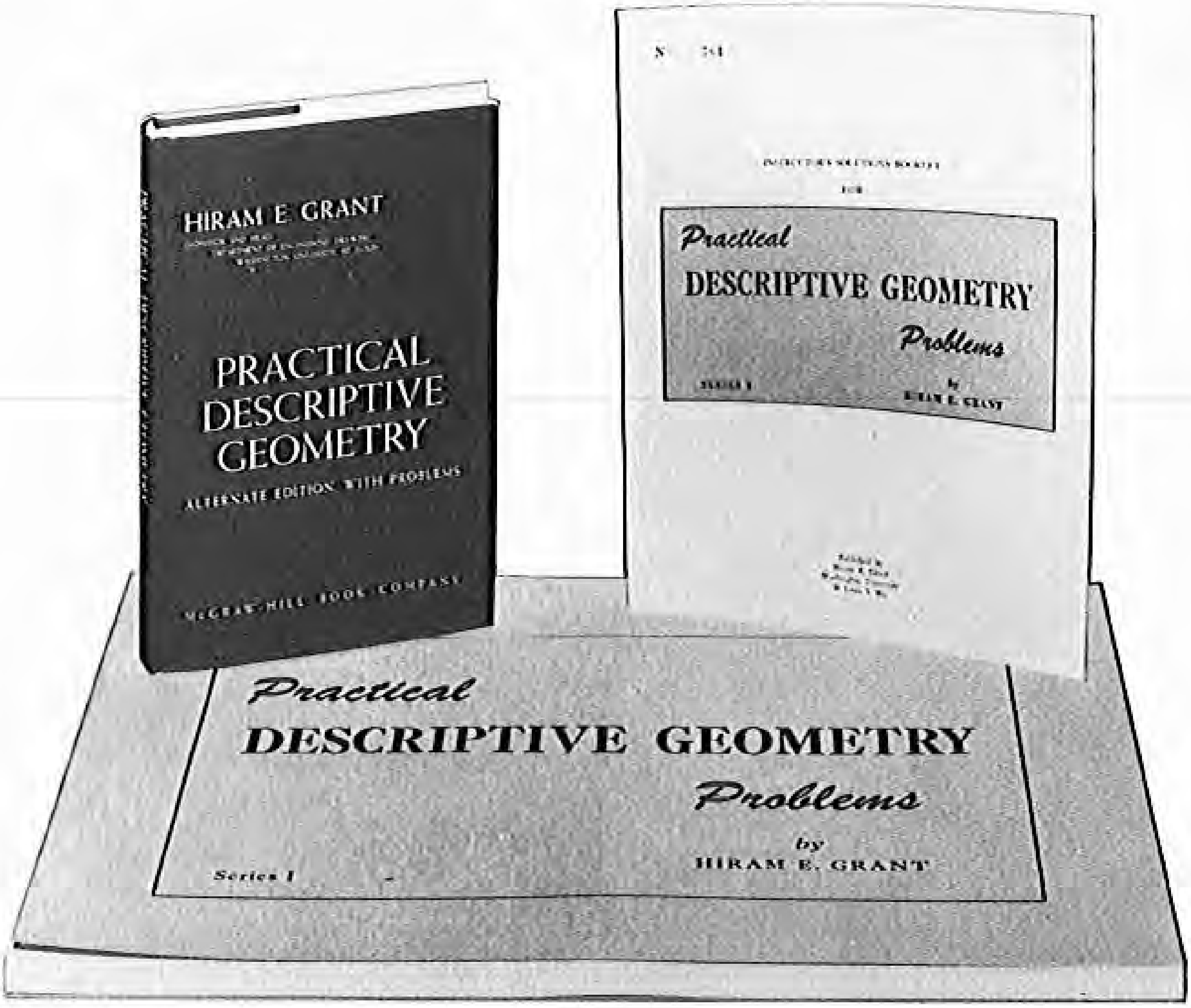

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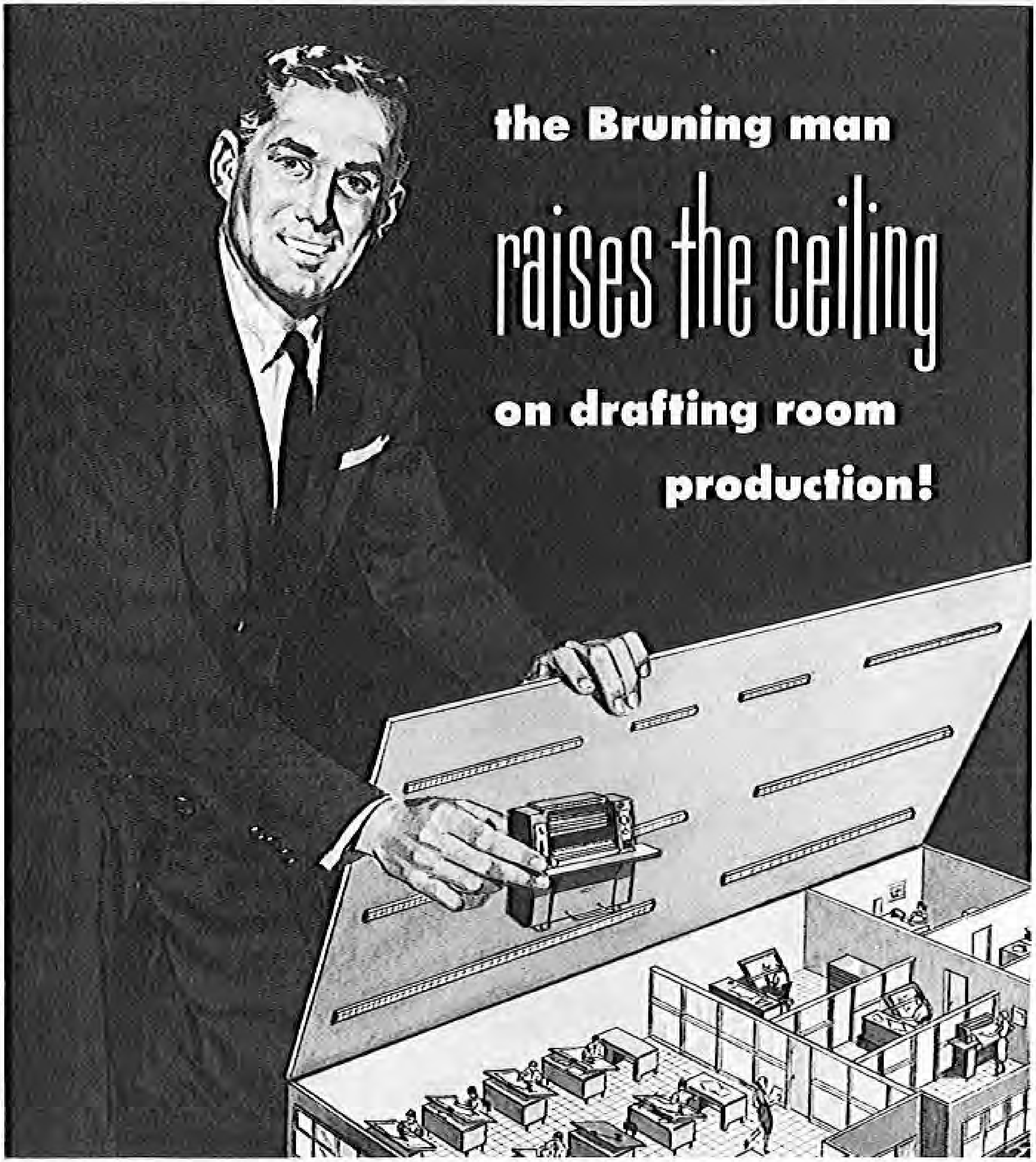

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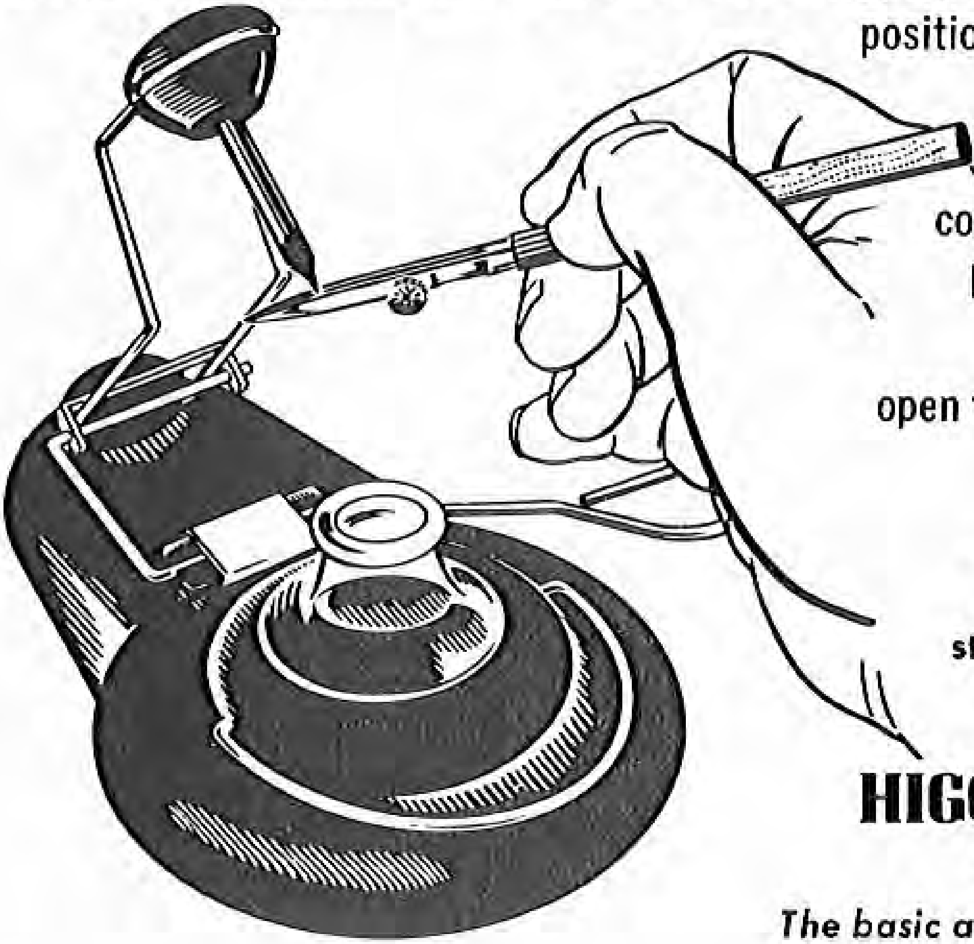

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ROLLA

Those who paid for a picture of the Rolla meeting and have not received one should write Professor Christianson. He also has copies of papers by Hunter, Schilling and Hendry.

JOINT SESSION

Our division and several others are co-sponsoring the session of June 20, 1960, 9:30 A. M. on "The Technical Institute in America." This will be one of the major events of this annual meeting of ASEE.

N S F

The University of Detroit is conducting another N S F Conference, "Graphics in Scientific Engineering," July 11-12, 1960.

ABOUT OUR COVER

By courtesy of Procter and Gamble Co., we show one of several models used in design and construction of production facilities. Mr. E. L. Dewey described this important work on the program of our annual meeting, 1959.

HONORS COURSE IN ENGINEERING GRAPHICS

By S. M. Slaby
Princeton University

The present trend towards a greater scientific orientation in engineering education places a greater responsibility on engineering educators to foresee and provide for the needs of future engineers. In line with this thinking an advanced course in Engineering Graphics was designed for freshman engineering students whose experience in graphics prior to coming to Princeton was of such a character as to potentially qualify them for advanced work in Engineering Graphics. The concept of an advanced Engineering Graphics course also in principle fits in with the policy of "advanced placement" of qualified students coming to Princeton University and also with the "Honors Course" policy which has been in effect for underclassmen courses.

In order to give the reader a general idea of the advanced placement procedure as carried out at Princeton the following is quoted from a general letter from the Board of Advisors of Princeton University to principles, headmasters, and guidance officers of high schools and preparatory schools:

1. A student who has done well in college level work in secondary school and who has been granted advanced placement may be enrolled in advanced courses in Princeton in the subjects in which he shows achievement.
2. Such a student is given credit toward fulfilling the distribution requirements and the proficiency requirement in mathematics or language.
3. A student granted advanced placement may, in his upperclass years, reduce the number of his elective courses in order to enroll in graduate courses or seminars, or to undertake independent work of greater scope.
4. A student who has gained advanced placement in three or more subjects may graduate in three years or less, without additional course or other requirements, and may be permitted to assume regular status as a sophomore in his first year of residence or as a junior in his second year of residence.

Under the Honors Course system a student may elect courses that are presented on a higher level than the regular course, provided he has the necessary qualifications. For example, the regular freshman mathematics course presents the classical material dealing with differential and integral calculus while the comparative honors freshman mathematics course presents the material more from a philosophical point of view leaving the applications and manipulations of differentiation and integration largely to the responsibility of the student. Therefore, under Princeton's system it is possible for the superior and well-prepared student to choose two avenues in his education, one leading to advanced placement and the other leading to the Honors courses.

The Honors Course in Engineering Graphics was presented as an experimental course for the first time during the fall term of 1959-60. In this course an attempt has been made to present Engineering Graphics more from the "science" point of view rather than from the "tool" point of view in keeping with the current philosophy of "engineering science". By doing this, the basic subject matter in Engineering Graphics is elevated above the "normal" level.

A qualifying test was given to approximately 40 students who volunteered to take the test. In order to take the test a student must have had one or more years of drawing experience in high school or in industry (summer work, etc.). The 15 students who earned the highest scores on this test were admitted to the Honors Course. There were three problems in the qualifying test which covered in general the areas of visualization, dimensioning, sectioning, and spatial relations (by means of a descriptive geometry problem). Of the 40 students who took this test only 4 attempted a solution to the descriptive geometry problem and of these 4 only one solved the problem correctly.

The Honors Course covered four major areas:

I. Fundamentals of Graphic Communication
II. Graphics Analysis of Space Geometry
III. Graphics of Vector Geometry
IV. Graphical Mathematics

Each area is discussed below. The total class time spent on the course was 14 weeks with three 2 hour sessions per week for a total of 84 class hours for the term.

I. Fundamentals of Graphic Communication

Since the qualifying test indicated that all students who were chosen to participate in the Honors Course had attained a reasonable level of comprehension and ability in graphic communication through previous work, this area of the course was limited to 3-2/3 weeks (22 class hours). Since students came from many schools where emphasis on topics varied, the following topics were covered to bring them to a similar level of attainment: theory of orthographic projection, principles of dimensioning, sections and basic conventions, theory of pictorial representation, graphical synthesis, and relative planar motion involving displacements only (project type problem dealing with the kinematics of a retractable tailwheel of an airplane).

II. Graphic Analysis of Space Geometry

In this section of the course an introduction to the elements of projective geometry was presented covering such topics as elements at infinity, the cross-ratio theorem, pencil of lines, and map nets. A speaker from the Civil Engineering Department presented some material on photogrammetry which was related to the work the students were doing with map nets. The speaker had a stimulating effect on the class and seemed to give more meaning to the work of the students since they were able to see a real use of the graphical theory as presented by an expert in the field of photogrammetry.

The introduction of the material dealing with projective geometry permitted a smooth transition from the communication concepts of graphics to the concepts involved in spatial graphic analysis. The material covered under "space geometry" also included classical descriptive geometry (using the "direct" method with mutually perpendicular projection planes) and also a number of problems dealing with the principles of perspective projection (one point and two point). Some of the material presented in this part of the course was referenced to mathematical methods to emphasize the relationship between the physical and symbolical handling of space concepts.

Since auxiliary projection was not handled under "Fundamentals of Graphic Communication" it was presented at the end of the section devoted to "Graphics Analysis of Space Geometry" as a special problem project which involved double auxiliary projection and complete dimensioning of a complex machine component. It was felt that introducing auxiliary projection at this stage was more logical than trying to do it before the students were familiar with the principles of descriptive geometry.

The total amount of time spent on this section of the course was 6-1/3 weeks.

III. Graphics of Vector Geometry

The concept of the "vector" is basically a graphical one which may be described mathematically and manipulated either with graphical or mathematical techniques. It has been my impression that many students do not have a real grasp of the vector concept, in spite of coming into contact with this concept in high school and college physics. Therefore, the presentation of the vector concept prepares the students for future work with vectors in various courses, such as mechanics, dynamics, and electronics.

Most of the problems dealing with vectors in this section of the course were three-dimensional space vectors and involved force systems of the following types:

(a) Nonparallel - Concurrent
(b) Parallel - Coplanar
(c) Parallel - Noncoplanar
(d) General - Noncoplanar - Nonconcurrent - Nonparallel

The concept of the "couple" was stressed as well as the funicular polygon and Varignon's theorem. In addition, relative motion problems involving displacement and time were analysed and solved. During the presentation of vector concepts reference was made to equations describing the various force systems through the use of the "vector notation" approach. The purpose was to emphasize the compatability of the graphical and mathematical analysis of vector systems.

IV. Graphical Mathematics

Since one of the origins of mathematics is the geometry of the ancients, and since Engineering Graphics also has its roots in this geometry, it is logical and desirable that an Honors course in Engineering Graphics contain a section dealing with the relation of Engineering Graphics to mathematics.

The general topics dealt with in this section of the Honors course were as follows:

(a) Graphical scale and scale modulus including scale equations.
(b) Plotting of data and curve rectification.
(c) Parallel line and "Z" nomographs.
(d) Graphs from engineering data.
(e) Graphical differentiation.
(f) Graphical integration.

It was my impression that many students in the Honors course appreciated the graphical explanation of differentiation and integration, especially when the fundamentals were illustrated, and when first and second derivatives of given functions were developed and plotted one above the other showing the relationships between the derivative curves and the curve of the original function.

The last week of the Honors course was devoted to a special project which involved the application of the principles learned under "Graphical Mathematics". This project involved the graphic integration of the static pressures over the surface of an airfoil. The project was concerned with the determination of the lift characteristics of an airfoil when it is subjected to various angles of attack relative to an airstream. Arrangements were made with the Aeronautical Engineering Department for the Honors class to visit a model wind tunnel laboratory where the airfoil used in the wind tunnel was the one with which the class was concerned. This airfoil has a series of orifices on its upper and lower surfaces which are connected to tubes leading to a multiple manometer. The airfoil was tested for various angles of attack and for each angle of attack a photograph was taken of the multiple manometer readings so that a permanent record of this experimental data would be available to the students. (Static pressures were recorded in inches of alcohol).

Each student received a photograph showing the data for a particular angle of attack and plotted his raw data using the ordinate as inches of alcohol (fluid used in the manometer) and the abcissa as the orifice spacing on the upper and lower surfaces. Using the method of graphical integration each student then determined the area enclosed by his particular curve. The area determined in this manner then had to be converted into pounds of lift per foot of wing span for the given airfoil for each angle of attack.

When each student determined the lift value for his particular angle of attack these values were listed on the blackboard and recorded by all the students. Each student then made a graph plotting the lift values and the angles of attack to show the characteristic lift curve of the given airfoil. Thus, individual student results were combined into a class result (the characteristic lift curve).

The total time spent on "Graphical Mathematics", including the special project, was two weeks. It is planned that in the future additional projects will be designed to involve all departments. The only restricting factor here will be the time available for these additional projects.

V. Conclusions

Student reaction to this course was most gratifying. Student morale was continually high; interest never seemed to be lacking, and pride in their work and their status as Honor students in Engineering Graphics was constantly apparent. The special projects were especially stimulating since the students were able to see the value of graphical theory and thinking applied to engineering analysis.

My observations and experience with the experimental Honors Course in Engineering Graphics indicate that the course was highly successful from every viewpoint. Graphical thought as a total concept was successfully introduced, and graphical techniques were tied together with mathematical techniques, and each assumed its proper perspective. A course of this type will always be in a state of growth and development and will perhaps never be totally fixed in scope or content as long as engineering science continues to develop.

A course of this type permits the expansion of Engineering Graphics as a science of analysis and is not limited to being only another tool of the engineer. An attempt has been made through the Honors Course to orient the thinking of students of graphics towards a total concept of Engineering Graphics.

Graphical thought processes can be as powerful as mathematical thought processes. Every effort should be made towards the further enlargement of the field of Engineering Graphics into its rightful position as a total concept.

ENGINEERING GRAPHICS DIVISION OF ASEE - ANNUAL MEETING

Purdue University - Lafayette, Indiana

June 20-24, 1960

- PROGRAM -

Monday--June 20

9:30 A.M.
Co-sponsor a conference of the Technical Institute Division
Subject: The National Survey of Technical Institute Education

6:30 P.M.--Executive Committee Dinner - Meeting
Presiding: A. Jorgensen, University of Pennsylvania

Tuesday--June 21

12:00 Noon--Luncheon and Business Meeting
Presiding: A. Jorgensen, University of Pennsylvania

2:00 P.M.--Conference
Presiding: M. McNeary, University of Maine

1. A Fully Integrated Course in Engineering Graphics or a First Course in Engineering--Myron G. Mochel, Clarkson College of Technology
2. Graphics for Non-Engineers--Edmund E. Ingalls Albion College
3. The Role of Descriptive Geometry in Teaching Basic Scientific Principles to Engineering Students--Mary F. Blade, The Cooper Union
4. Internal Views--F. G. Higbee, State University of Iowa

6:00 P.M.--Annual Dinner
Presiding: A. Jorgensen, University of Pennsylvania

Tuesday--June 21 (Continued)

1. Presentation of Awards:
   a. Nomography Award, by John Bryant, Editor General Motors Engineering Journal
   b. Distinguished Service Award, by I. L. Hill, Illinois Institute of Technology
2. Hieroglyphics of the Sky--P. E. Stanley, Purdue University

Wednesday--June 22

12:00 Noon--Co-sponsor a Luncheon Conference of the Engineering Economy Division

Thursday--June 23

2:00 P.M.--Conference
Presiding: I. Wladaver, New York University

1. A New Drawing System--Wayne L. Shick, University of Illinois.
2. Standards for Engineering Drawings, Associated Lists and Specifications, Department of Defense--James H. Mars, Bureau of Naval Weapons, Department of the Navy.
3. Evaluation of National Science Foundation Summer Institutes and Conferences for Engineering Graphics.

   Panel:
   A. S. Levens, University of California
   J. S. Rising, Iowa State College
   F. M. Woodworth, University of Detroit

NOMOGRAPHY: DO YOU PRACTICE WHAT YOU TEACH?

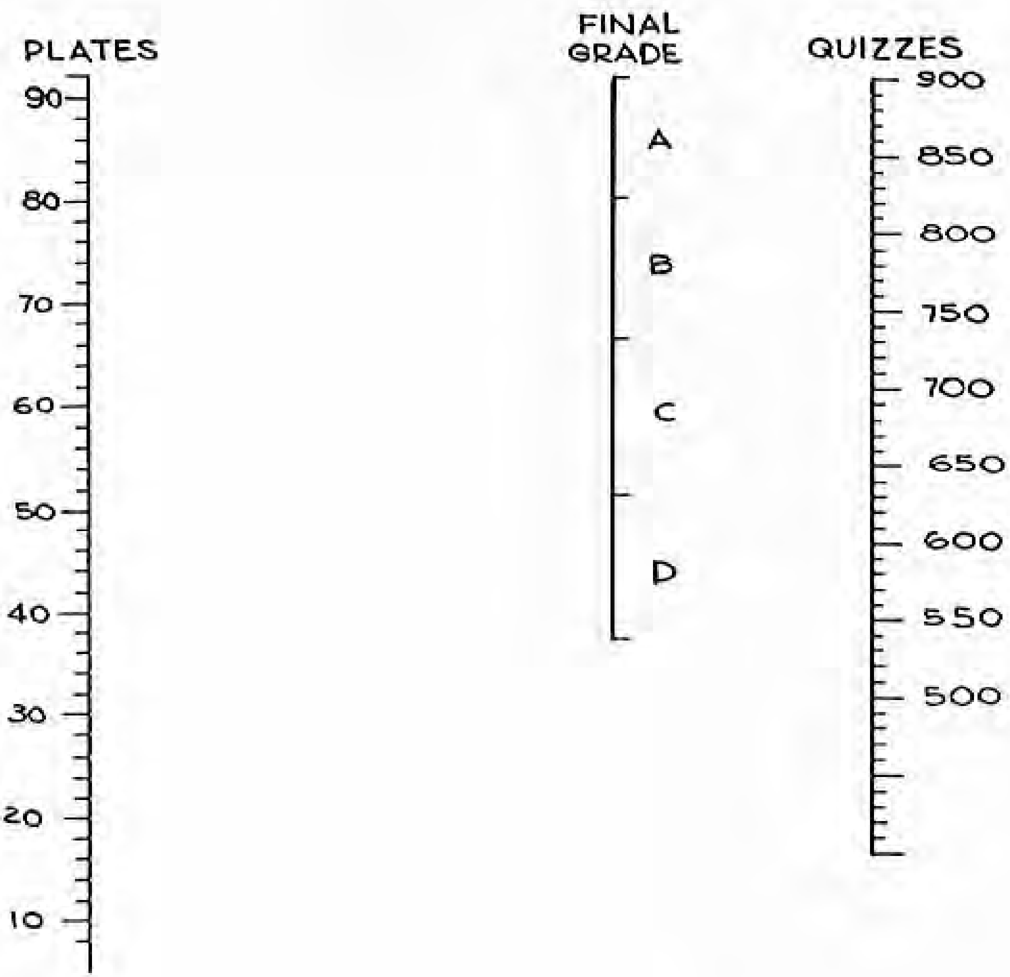
By Chet Foster

Michigan College of Mining and Technology

A nomogram for calculating final grades can be a valuable time saver at term end.

The accompanying nomogram was used to convert 23 numerical plate grades and 9 numerical quiz grades to a final letter grade. The plates were graded on a scale of zero to 4: A = 4, B = 3, C = 2, D = 1, and F = 0, and the quizzes on a 100 point basis. Averaging and conversions were eliminated by using totals only. It is believed that student interest in nomograms was stimulated when they saw an application of nomography on a subject dear to their hearts.

Plates count for 1/2 and quizzes for 1/2 of the final grade; no final exam is given. The Final Grade scale is not located midway between the Plate and Quiz scales because of the different scale moduli. The Final Grade scale was graduated by using the lower limits on the plate and quiz scales for each grade: 78 and 829 for an A, 57 and 765 for a B, etc. A total of 900 quiz points requires only 57 points on plates for an A.



PREVIOUS DRAWING EXPERIENCE OF ENGINEERING STUDENTS

By Robert P. Borri

University of Illinois

This survey is an attempt to gather relevant data about the background and preparation of the students enrolled in the beginning engineering graphics courses in order to determine high schools attended, and the amount of high school, college, industrial or other previous drawing experience. Such information will assist the faculty in providing for the needs of the students. Another purpose is to help solve the mutual problems of high school, junior college, industry and university graphics personnel.

High Schools Attended. Of the 1371 students enrolled in beginning graphics (G. E. 101, 106 and 107) about 88 per cent are from Illinois high schools. Others are from twenty-nine other states and thirteen foreign countries. Figure 1 shows the number of students from Illinois high schools, by counties; the highest enrollment is from Cook County with 27%.

Distribution by Curricula. Figure 2 compares the enrollment in the 22 curricula in which 1016 students taking G. E. 101 are registered. The curriculum with highest enrollment is electrical engineering with 26 per cent; next, is civil engineering with 15 per cent; general engineering has 13 per cent; mechanical and aeronautical engineering follow with about 11 per cent each; engineering physics has 9 per cent. The remaining curricula each have 2 per cent or less of the G. E. 101 enrollment.

Previous Drawing Experience. Figure 3 indicates that over half of the students enrolled in G. E. 101 have had previous experience in drawing. The amount of high school drawing varies from one-sixth year to four years. About one-half of those with high school drawing experience report taking one-half year's work, two-fifths indicate one year, and several report having two years. The 527 students who had high school drawing average 1.2 years of instruction. Eight per cent of such students also had industrial experience, ranging from a month to five years; the average was one year.

Number and Length of Class Periods. Most students reported having drafting on a basis of five periods per week with sixty minute periods. (See Figures 5 and 6).

Course Content. Twenty-two topics were reported in the various high school courses. (See Figure 7). Lettering, orthographic views, use of instruments, geometrical construction and dimensioning received the highest emphasis.

Proficiency Examinations. A proficiency examination in graphics is given so that the student need not repeat a subject if he can demonstrate proficiency and understanding of the subject. In 1959, from an enrollment of 1016 in G. E. 101, 21 students inquired about the proficiency, and 11 took the examination. Five students passed with a grade of C or better.

Summary. We can summarize the data from this survey by applying the statistical results to an average or typical class. With an enrollment of 1016 students (in G. E. 101) divided into 45 sections, the average class consists of about 23 students. About 20 of these 23 come from within the state of Illinois, with about one-fourth of the twenty, 5, from Cook County. Three students would be from other states and one out of every three sections would have a student from a foreign country.

From this "average" class about 6 are in electrical engineering, 3 or 4 in civil engineering, 3 in general engineering, 2 or 3 in mechanical and 2 or 3 in aeronautical engineering, 2 in engineering physics, and 2 or 3 from a group of the smaller curricula.

Forty-four per cent, or 10, of the 23 students of an average class have had no previous drawing experience. Twelve of the 13 students with drawing experience had an average of 1.2 years of high school drawing with five, sixty-minute classes per week. One of the class would also have had some drawing experience in industry.

FIGURE 1 NUMBER OF STUDENTS FROM HIGH SCHOOLS IN ILLINOIS COUNTIES ENROLLED IN G E 101, 106 AND 107

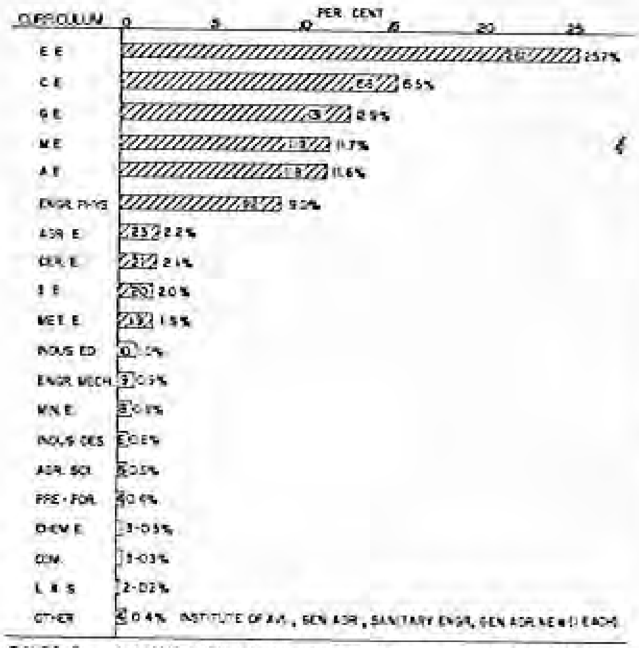


FIGURE 2 A COMPARISON OF THE ENROLLMENTS IN VARIOUS CURRICULA OF THE 1016 STUDENTS ENROLLED IN G.E. 101.

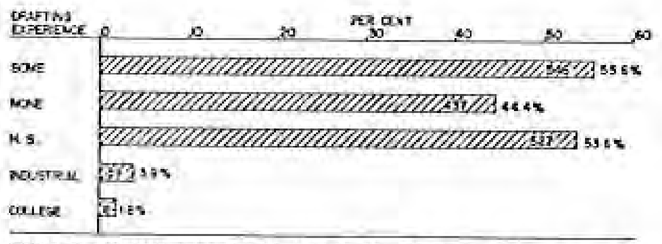


FIGURE 3 PREVIOUS DRAFTING EXPERIENCE OF 963 STUDENTS ENROLLED IN G.E. 101.

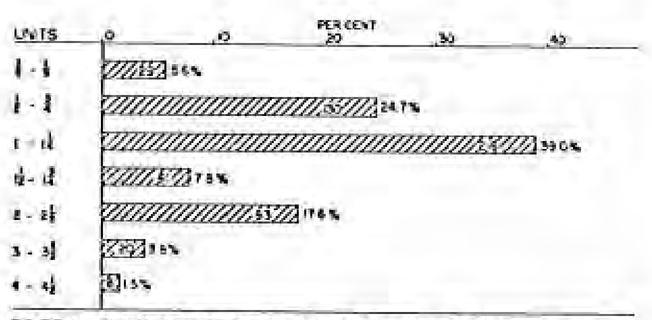


FIGURE 4 THE NUMBER OF HIGH SCHOOL UNITS (YEARS) OF DRAFTING TAKEN BY 546 STUDENTS ENROLLED IN G.E. 101.

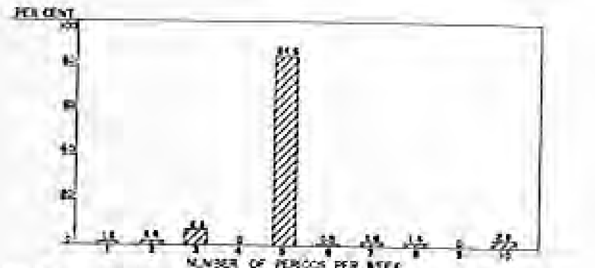


FIGURE 5 COMPARISON OF THE NUMBER OF DRAFTING PERIODS PER WEEK AS REPORTED BY 208 STUDENTS ENROLLED IN G.E. 101.

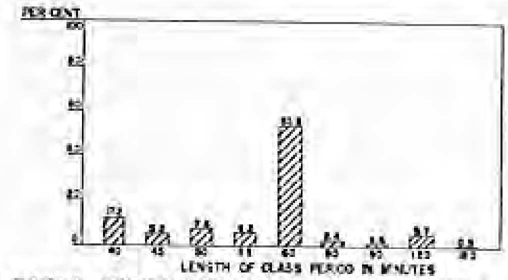


FIGURE 6 COMPARISON OF LENGTH OF HIGH SCHOOL DRAFTING PERIODS AS REPORTED BY 210 STUDENTS ENROLLED IN G.E. 101.

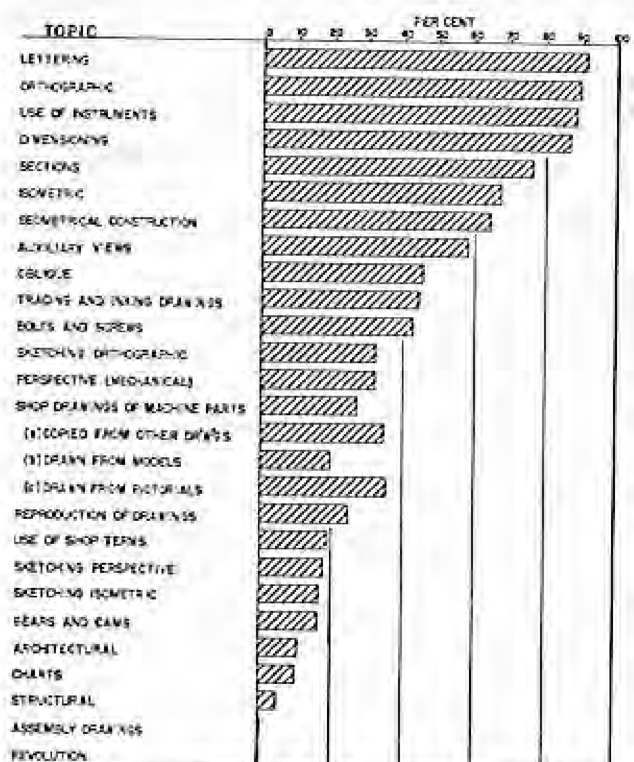


FIGURE 7 CONTENT OF HIGH SCHOOL DRAWING COURSES AS REPORTED BY 205 STUDENTS ENROLLED IN G.E. 101.

I NEED HELP

or

Are We Getting the Most Out of Our Nomenclature?

By R. H. Hammond

U. S. Military Academy

As I read over the recent new texts in the graphics field, one thing bothered me. I then checked other texts, and yes, there it was again. I suppose it is a rather small point that bothers me, but it is the small points that sometimes help a student to understand a problem.

The point that bothers me is the labeling of the folding line (or reference line or reference plane). Illustrations in many texts are labeled similarly to Fig. 1. The letters may be at opposite ends of the line, but they are on the same side of the line as in Fig. 1. This I feel is likely to give a false impression to the student. For instance; depth as seen in the Top view is measured perpendicular to the H-plane; or depth as seen in the Side view is measured perpendicular to the P-plane; or the Front view is bordered by the F-plane. Now I have been told that the H (as in Fig. 1) is on the H-plane, the F on the F-plane, etc. Of what benefit is this bit of information? If the student knows enough to construct the Top view, he also knows that it is on the H-plane.

I believe that the labeling should be done as in Fig. 2. There doesn't seem to be much difference between Fig. 1 and Fig. 2. However, I feel that there is a big difference. In Fig. 2 the lines are labeled correctly as to what they represent. When you are looking at the Top view, the folding lines represent the Edge views of the F-plane and the 1-plane. The F and 1 indicate that fact. When you are looking at the Front view, the folding lines represent the edge views of the H- and P-planes. It is a fact that depth is always measured perpendicular to the F-plane. This is graphically shown in the Top and Side views. It is a fact the height (or elevation) is always measured perpendicular to the H-plane. This fact is shown in the Front, Side, and first Auxiliary views. This method shows that the dimension to be laid off in the second auxiliary (oblique) view is actually the perpendicular distance from the plane of the first auxiliary to the point. We know that fact, but do all of the students? Thus when the student is constructing views and is using this method of labeling he immediately has information as to what dimension to use in the constructed view (or a check on the dimension that he did use). If the reference plane system is used, the same idea can be employed, as in Fig. 3.

I believe in the method of Fig. 2 and Fig. 3. I believe that it is a help to the student in his understanding of the spatial arrangement of the views. However, most of the texts do not use it. Those who do are rarely consistent. Am I in the position of the man who said, while watching a parade, "Everybody is out of step but my Johnny"? Is this too insignificant to worry about and to teach? I don't think so, but I would appreciate hearing your comments.

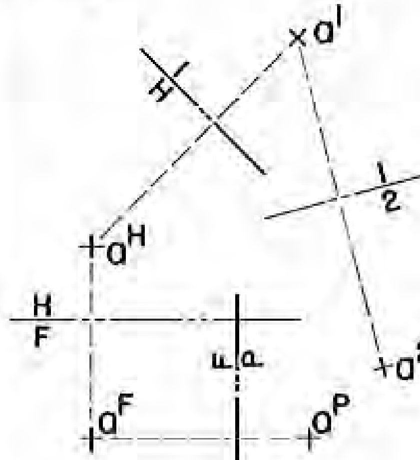


Fig. 1

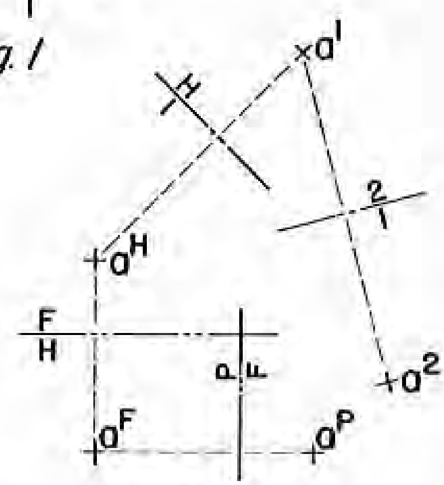


Fig. 2

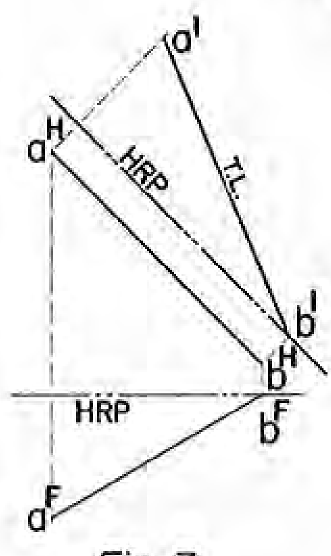


Fig. 3

CREATIVE EXPRESSION IN ENGINEERING

By R. L. Ritter, E. A. Lemke, and R. J. Panlener
Marquette University

Engineering drawing has not been deleted at Marquette University, but we have experienced the "squeeze" as have many others. Our first and only semester of Engineering Geometry is required of all students enrolled in the Mechanical, Electrical and Civil Engineering degree granting programs. Our Electrical sequences offer no further graphics training throughout the four year curriculum. However, students in our Mechanical engineering curriculum will experience additional graphics training required to satisfactorily complete future design sequences. In addition, Mechanical engineering students may now increase their drawing background through electives in Advanced Engineering Drawing and Tool Design.

The Civil engineering program has been reorganized and includes a required second semester freshmen graphics program in Civil Engineering Drawing specifically designed to offer additional training in the interpretation and preparation of Architectural and Structural standards and conventions.

The Creative Expression course is now a requirement for all second semester freshmen electing the Mechanical and Electrical curricula. These new sequences have been carefully labeled Creative Expression and are quite opposed in philosophy to courses in Creative Thinking now a fad on many Engineering and Business Administration campuses.

Classroom experiences with the principles of brainstorming and other problem-solving techniques have given evidence that a full semester is too much time to delegate to material of this nature. Students deplore additional and often repetitious assignments involving these techniques.

Our decision to initiate a series of Creative Expressions was derived after a careful evaluation of objectives and a thorough study of Frank Barron's work at the University of California.[1] Barron, as a part of the Institute of Personality Assessment and Research, had been involved in a seven year study to determine behavior patterns of creative people. Although the study has not produced concrete evidence to show a high positive correlation between behavior patterns relative to creative and non-creative groups, amazing results show this correlation to exist to a degree between creative artists and groups rated as creative by their colleagues. This latter group included mathematicians, engineers, anthropologists, physicians, and writers.

The results of Frank Barron's and a similar study[2] gave us courage to approach the development of Creative Expression through a utilization of the artist with his facilities, history and environmental factors as a foundation for the sequence of class instruction.

Throughout these units, therefore, an endeavor has been made to provide the media for stimulating occurrences of creative responses and investigation. At the present time there exists no purpose to an attempt at classification relative to the creative and non-creative personnel among the participants.

Psychological studies to date have offered slight evidence to support a correlation between existing standard test performance and any creative potential. However, additional studies growing from our selected areas of creative expression may someday prove fruitful in this respect.

This endeavor to classify, therefore, has not been attempted as an immediate finale to the exercises provided. Instead, a real objective has been the immediate development of enthusiastic instructor-student relationship to provide a unique rapport suitable for the promotion of effective creative processes. Although not completely categorical, an analysis of the complete semester program will indicate testing, development of modern art, industrial design and constructivism to be our important areas of creative endeavor.

Our continued research has provided the current sequences shown in Figure 1 as the most meaningful and stringent series of experiences:

Sequence of Instruction for a Semester
Course in Creative Expression

Period*		Sequence
1	-	Psychological Testing
2	-	Introduction to Modern Art
3	-	Development of Cubism
4	-	Abstract Sketching
5	-	Collage
6	-	Dadaism, Surrealism and Purism
7	-	Purism
8	-	Field Trip - Idea Analysis
9	-	Constructivism
10	-	Project Development
11	-	Design Fundamentals
12	-	Sketching
13	-	Problem Solving Techniques
14	-	Functional Problem
15	-	Functional Problem

Figure 1.

*Two Hours

The purpose of the course is not to dominate the student, but rather to lead him in a series of exercises and expressions, the solutions of which cannot be found through preconceived fantasms or environmental influences. These exercises, drawn together through an understanding and appreciation of aestheticism of art movements, may develop the imagination, wit and judgment of the student and thus build confidence in his creative ability.

> "Art educates the receptive facilities and revitilizes the creative abilities. In this way art is rehabilitation therapy through which confidence in one's creative power can be restored."[3]

We are not trying to teach art, and surely our laboratory assignments do not suggest this endeavor. The collage, shown in Figure 2, a creation of cardboard and color paper, is an example of immediate response utilizing the "Building Blocks"[4] or intellectual abilities relative to creativity, i.e., flexibility, fluency, originality and the ability to think in images and analogies. The subject for the collage exercise was "The Burden of Freedom," but it could have been anything. The title is not important and is subservient to the creative expressions involved. The techniques of construction and the beautiful colors are not to be completely appreciated in a black and white reproduction, but the student's own explanation of his work will indicate the vigor with which he has applied his abilities in a heretofore unexplored creative activity. He explains,

"...... Experience dictates that man is easily able to grasp ideas concerning physical reality since he is surrounded by objects of this nature. Difficulty is encountered, however, when a person is called upon to depict, describe or define abstract concepts such as happiness, justice, and a host of others. It might be stated, then, that the physical world is clear whereas the mental is somewhat obscure. Consequently, the illustration of an item such as freedom calls for a reversal of the normal.

"Such being the case, the background of this work was composed of pictures of physical objects which were deliberately concealed to the point of near total obscurity. Though these 'real' items may be found and identified, it requires a great amount of study to do so, the same being a prerequisite if one is to seek out and define mental pictures in everyday life.

"This same background also pictures the encompassment of the human race (the group of faces) and the earth (the dark blue circle) with devices of a material nature.

"The blue circle, a representation of not only earth but also man's mind is the base of a huge balance on which is weighed good (the white shape) and evil (the black). These were left as abstract forms for two reasons: (1) It is often difficult for the individual to differentiate between good and evil, in fact, it is sometimes hard to even find and/or identify them. (2) 'Good' and 'evil' are abstract concepts.

"It should be noted that 'good' points upward and 'evil' downward - a simple symbolic sign.

"The balance is constructed off-center, and by recollection of a simple law of leverage this may be determined to represent the fact that a small good may do much to correct a great evil. The horizontal position of the arm indicates the existing equilibrium in the interplay of these forces. The mechanism is 'supported' on the point of a nail which connects this abstract with reality.

"The rough black 'cross' behind the scale recalls the Crucifixion, the event and the party (Christ) both having more to do with man's freedom than any others in history. The six red spikes joining at the focal point of the collage represents his six wounds (five of them the physical wounds, the sixth Christ's great mental anguish).

"A top view of the balance is also depicted by these spikes, the inference being that a particular evil must be balanced by a diametrically opposite good if the arm is not to tip from its mounting. That is to say, a certain evil may not be counteracted by indiscriminate good, the correction must be of the right 'weight' and must be properly placed if balance is to be maintained.

"The large size and mass of the scale are indicative of the great weight (responsibility) which man must bear if he is to deserve and maintain his freedom."

Marc B. Rojtman, 42 year old president and general manager of the J. I. Case Company of Racine, Wisconsin, finds art "a terrific stimulant for design--it gives me a sense of balance and aesthetics that helps translate machinery into industrial design."[5]

Perhaps the most exciting experiences derived from the series of expressions are those in constructivism. The idea, the collection of materials and the implementation, all utilize the previously mentioned intellectual abilities to derive stimulating and completely satisfying sequences of creative responses. The form, shown in Figure 3 and entitled "Activities in Front of the Room," may be termed a classic in non-objective construction. The materials, form, and the very conception of the idea have been combined by its creator into a meaningful and beautiful expression.

The artist conceives the graceful, melodic motion of the curved surfaces at the very top of the model to represent the student's open mindedness and thoughtful observation of material being presented. The sharp, crisp lines of intersecting surfaces indicate alertness, while the white planes are symbolic of his awareness of professional ethics in relationship with fellow students. A strong scholastic background is characterized by the sturdy, dark base.

To paraphrase a statement by Nagy,[6] ..... the student has thought a thought and worked around the think. Interpretation by others is not important. True evaluation will have been realized by the artist, in this case the student, whose collective responses have been expressed in the finished model. If provocative in its final form, the model will surely stimulate a sense of inventiveness in others through judgment, particularly if curiousity is culminated without obedience to the original idea.

Other results of the expression laboratories in sketching, The Collage, purism, and constructivism are shown in Figure 4, and are representative of a public exhibition recently shown in the Marquette Memorial Library. ".... The exhibition has probably attracted more attention than usual and the comments ranged from surprise to appreciation...."[7] William Ready, Director of Marquette University Libraries has qualified the "surprise" in his analysis as indicative of the unique and excellent results by freshmen in a heretofore little explored area of engineering education.

A block to creative expression in the area of constructivism has been experienced by our students who lacked facilities to implement an idea. This situation is expected to improve when proposals for laboratory space and equipment are realized.

To be completely entrenched in a realm of fancy

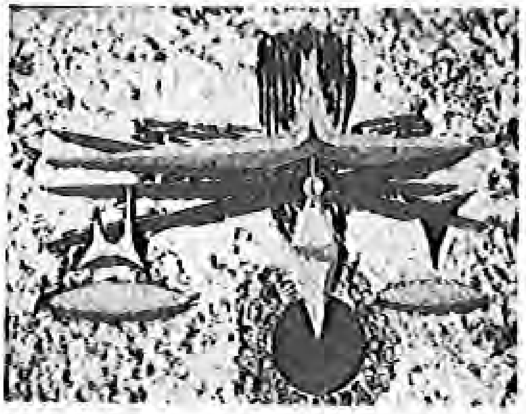


Figure 2
"The Burden of Freedom"
Paper and cardboard collage

Figure 3
"Activities in Front of the Room"
Abstract in plaster & plastic — an assignment in constructivism.

Figure 4
Display of work completed by students in creative expression laboratory.

would invite serious criticism. Our educational business is competitive and demands a touch of reality to permit the successful realization of the University Aim. We may shy from the dictates of an outside curriculum expert who feels obligated to advise relative to our course content and objectives. However, total disrespect for industrial wishes will certainly promote contempt among those eventually interested in our product.

Marquette's venture in Creative Expression has sought the opinion of industry. A forceful member of this industrial group is Mr. Thomas G. Johnson, Assistant Director of Industrial Relations, Danly Machine Specialties, Chicago, Illinois. Inasmuch as he has been extremely critical of recent movements to curtail graphics activities at the University level, his comments relative to our Art oriented experiment should be provocative. Mr. Johnson says,

"We in industry find that the beginning engineer very frequently has difficulty visualizing in three-dimensions the product he designs or develops. With automation engineered into the industrial equipment of today, this difficulty becomes even more serious and pronounced. A clear conception of the space relationship of parts--one to the other--becomes absolutely essential. It is interesting to note that the 'visualizing of relationships' is a basic building block in the approach of this Creative Expression course.

"We have wondered why this inability to visualize is so common. Perhaps exercising the imagination is too often done for all of us by others--our thinking is channelled and too often creativity is stifled.

"The graduates acquired from engineering colleges usually have a firm grasp of the subject matter of their profession--but in many cases they are so disciplined in only objective subject matter that they lack even the approach to creative expression which is so essential at this time when all things are pyramiding in complexity.

"We find there are two weaknesses in the new graduate--one is the lack of creative thinking--and the other is the inability to communicate. It appears to us that this communication weakness is also attacked in this course.

"As new complexities develop, one can't always get the precise answer from text books. There must be new educational methods developed to meet changing conditions. The mere exercise of the brain to be imaginative will improve individual capacity to visualize. It is vitally important to us to know that the engineer is creative--is aware of the importance of originality--and has the thinking process to implement it.

"We endorse this creative expression emphasis as a supplement to the other necessary academic course work. Creativity to an engineer is like a spark plug that starts an engine. The trained engineering mind needs an injection of creativity to get going--otherwise he may become nothing more than a draftsman or lab technician--vocational rather than professional in outlook.

"We are looking for the kind of person this course can produce. We, and others in our industry, are carefully watching the development of this course with considerable interest."[8]

The committee for the study of the Visual Arts at the Massachusetts Institute of Technology has considered this definition of an ideal Creative Expression program:

"It will include means to establish the nature and differing qualities of vision; it will extend its discipline to amplify and enrich other forms of communication. It will develop aesthetic sensitivity and encourage discrimination generally. It will draw attention to the human control of form and space and color no matter where it occurs, in the land or in the machine, in the monument or within the home; and will relate varying styles to the societies which have fashioned them beyond the requirements of pure utility. It will foster a coordination between eye and hand to qualify the theoretical by the empirical; but it will also tolerate the person who is realistically afraid of his manual awkwardness and will at least make him aware of the values which he might better learn by skillful doing. It will exercise critical faculties by challenging prejudice and by provoking imaginative opinion. It will avoid the narrowing dogma of a single educational medium; rather, it will depend on self-motivating practicalities such as studio experience, exhibitions, lectures, motion pictures, and library references for its source material and will urge the discovery of museum facilities farther afield. Art should be sought in the life of the individual and the community, not alone in history book or classroom. It will utilize recreational as well as assigned hours and make certain that the prescribed duty of the latter never infringes on the liberty of personal exploration permitted by the former. It will explain that aesthetic 'good' and 'bad' are relative terms, not absolutes, and that although the forms of civilizations improve technically throughout the centuries, their artistic significance cannot be counted by time but is borne on the tides of man's fluctuating consciousness. . ."[9]

In conclusion, we admit that these exercises, even if followed with purpose and a real sense of self-duty, may not necessarily guarantee the ultimate development of a better engineer. Their completion, however, should provide a serious sense of reverence relative to the measure of man's ability to reason, to inquire with purpose, and to avoid the spontaneous infliction of meaningless ridicule, to regard cultural artifacts with a more generous understanding, and to behold a more complete awareness of creative expressions existing as evolutions of contributions through past generations.

Our purpose is not to destroy the Graphics program, but to strengthen it through a united effort with all curriculum agencies for a contribution toward a more meaningful engineering education. We sincerely hope continued experimentation will indicate to some degree the implementation of our Creative Expression objectives to have been an important element in the development of good students, and ultimately, good engineers--and good citizens too.

[1] Frank Barron, The Psychology of Imagination, Scientific American, September, 1958, pp. 151-169.

[2] Louis Cassels, Eight Keys to Creativity, Nations Business, February, 1959, pp. 58-64.

[3] L. Moholy Nagy, Vision in Motion, p. 28.

[4] Eugene Raudsepp, The Creative Engineer, Machine Design, June 11, 1959.

[5] Business in Person, The Milwaukee Journal, October 24, 1959.

[6] L. Moholy Nagy, Vision in Motion, p. 26.

[7] Marquette University Library Bulletin, Vol. 2, No. 4 and 5, September-October, 1959, p. 2.

[8] Program, Annual Meeting, Engineering Graphics Division, ASEE, June, 1959.

[9] Art Education for Scientist and Engineer, Massachusetts Institute of Technology, 1957, pp. 15-16.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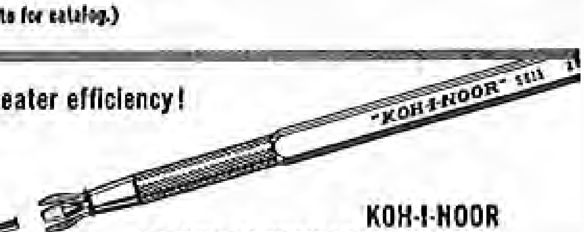

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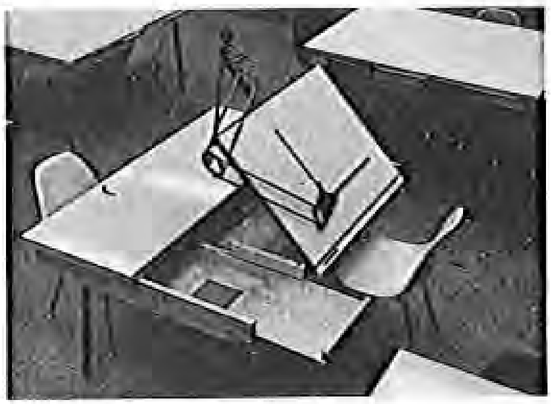

At M.I.T., in addition to design courses, freshman subjects in graphics are offered. These are taken by a larger number of students, with less stringent requirements on refinement of equipment. The same drawing desks are used for these elementary subjects, but each desk is occupied by two students at a time, working on the closed desk top on small portable drawing boards. The ability to use each drawing room in these two different ways results in more efficient use of facilities, and the rooms can be in service a larger proportion of the time.

The normal height of the desks with cover closed is 29 inches, standard desk height, and contoured fiberglass chairs are used in place of the old-fashioned drafting stools.

The legs of the tables are tubular steel, with provision for height adjustment up to two inches.

The tops measure 44 x 60 inches. They are hinged in the center as well as along one edge, so as to be easy to open.

The internal drawing boards measure 26 x 36 inches. The angle of the boards is adjustable in increments from about 15° to about 75°. The drafting machine linkage is counterbalanced by a spring whose tension is adjustable to compensate for any angle of the board. The board may be removed from its frame for storage. In this way the same desk may be used by different students at different times.

Tops are covered with a very hard durable plastic, and four compatible colors have been selected, so that the design rooms have a light, cheerful atmosphere.

When used in the open position, there is a space for drafting tools and equipment at the left of the drafting board, and the hinged back cover serves as a desk, so that the occupant may make use of both types of working area simultaneously.

There is incidentally an inducement to the freshman to continue into more advanced courses in which he will be able to use the more advanced professional equipment.

The drafting rooms are also used quite extensively as conference rooms and regular classrooms, since the desks do not by their nature limit their use to drafting alone.

Steven Anson Coons
Assistant Professor
of Engineering Graphics
Massachusetts Institute of Technology
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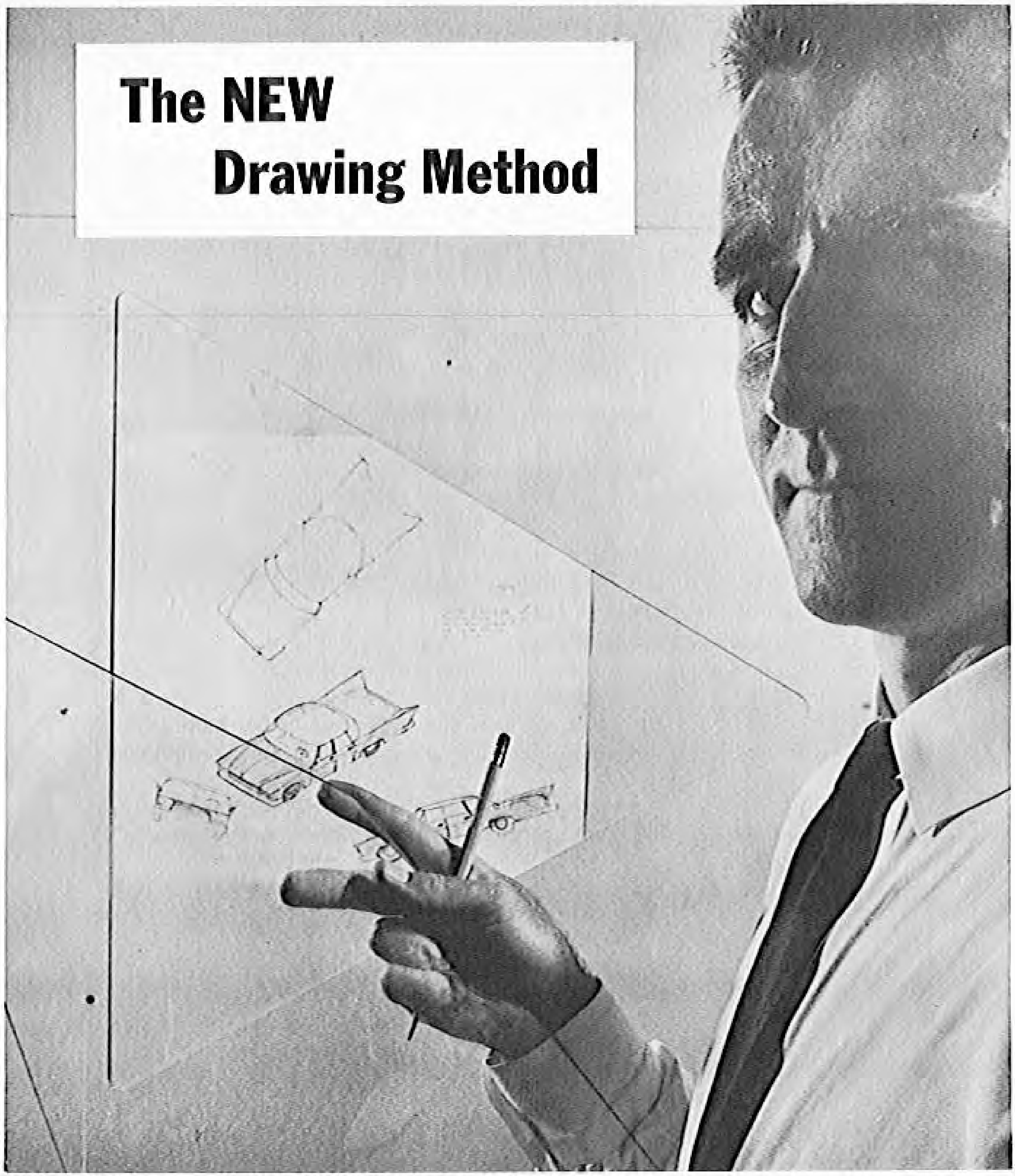

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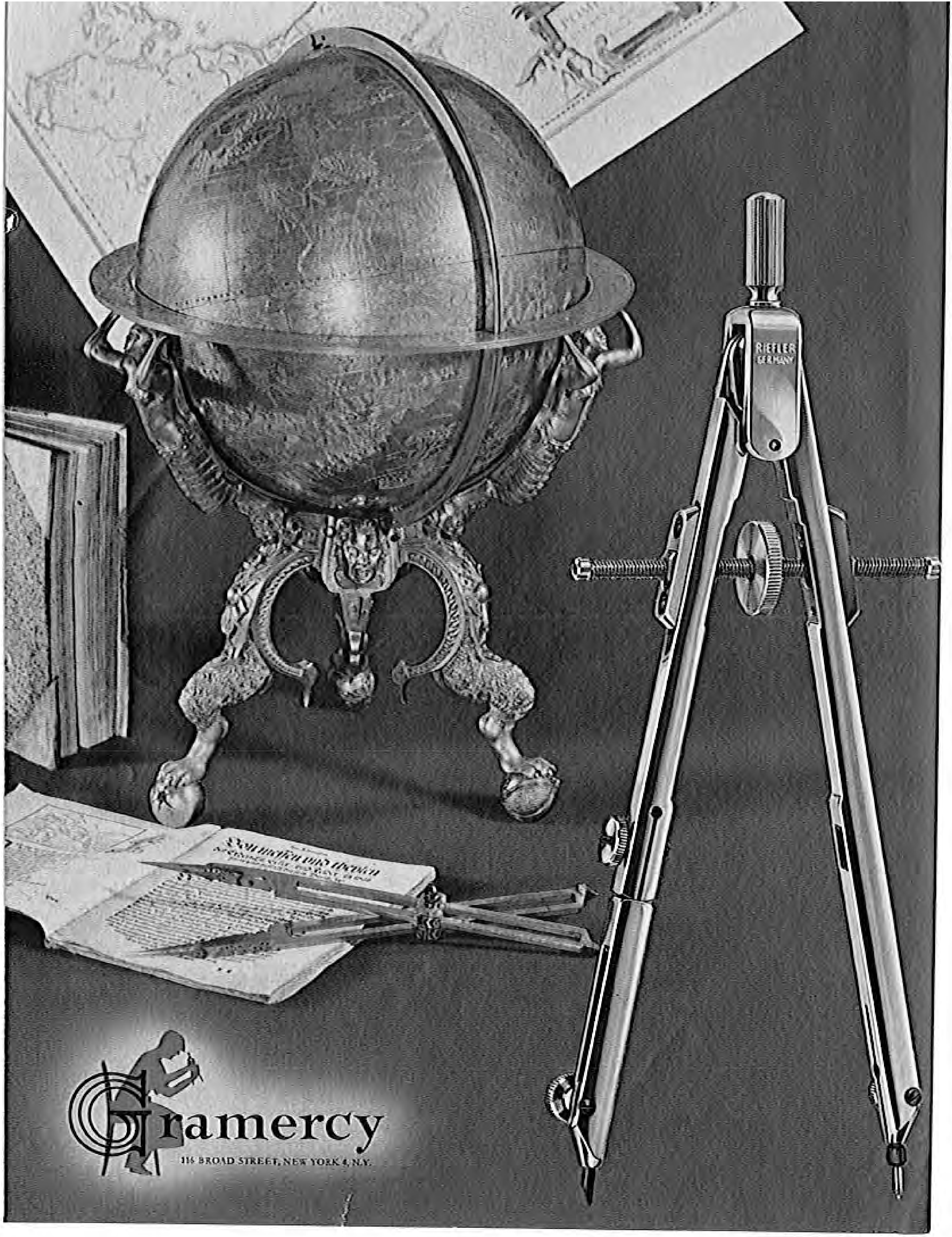
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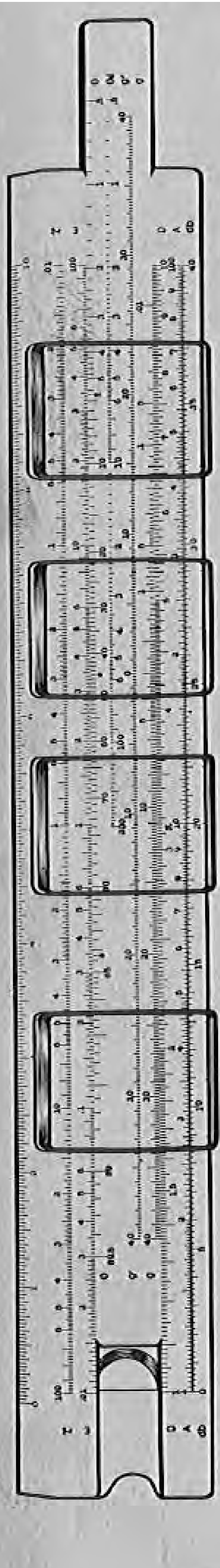

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