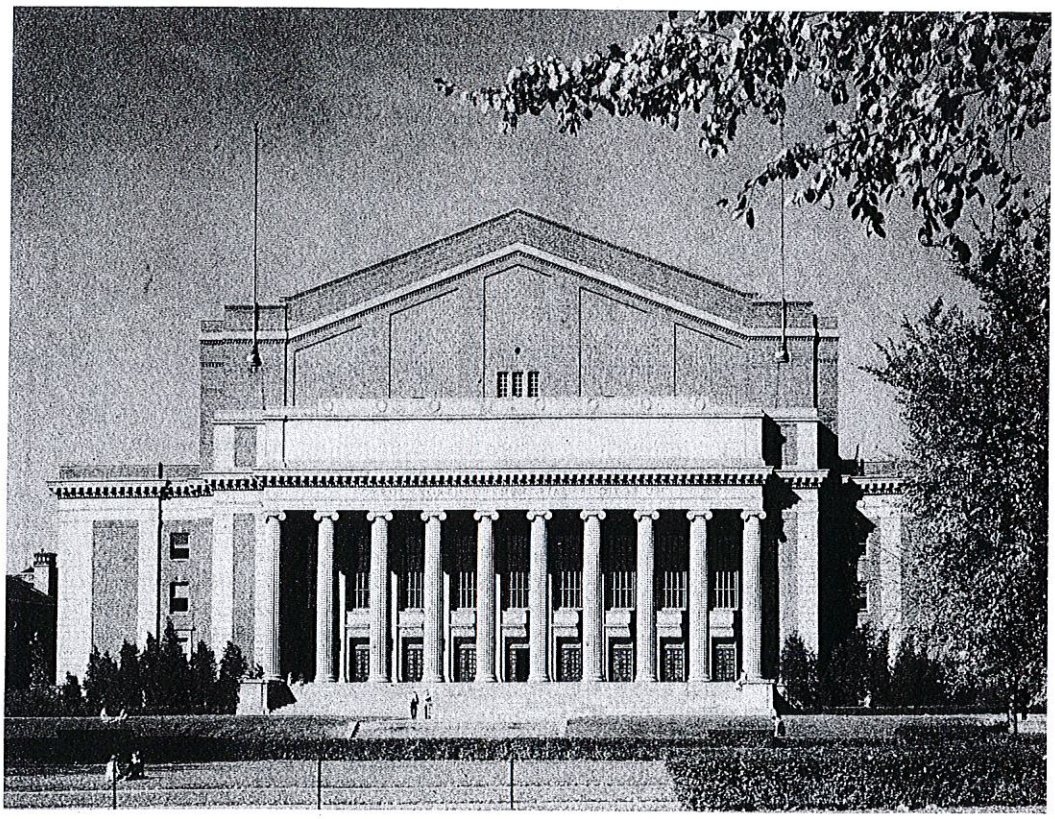
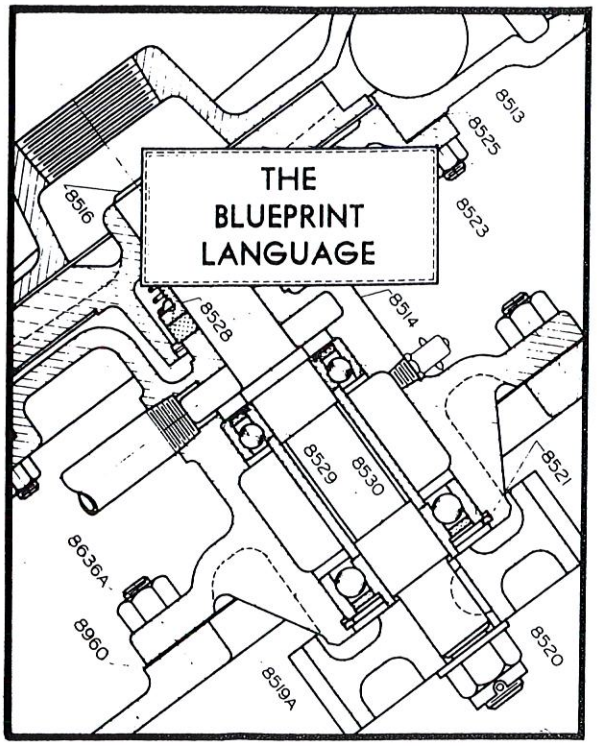
JOURNAL OF ENGINEERING DRAWING

VOL. 11, NO. 2 MAY, 1947 SERIES NO. 32



CYRUS NORTHROP MEMORIAL AUDITORIUM
UNIVERSITY OF MINNESOTA

PUBLISHED
BY
THE
DIVISION
OF
ENGINEERING
DRAWING
AND
DESCRIPTIVE
GEOMETRY
A S E E



THE BLUEPRINT LANGUAGE

By **Henry C. Spencer,** *Chairman of the Technical Drawing Dept., Illinois Institute of Technology,* and

H. E. Grant, *Associate Professor and Chairman of the Department of Engineering Drawing, Washington University.*

This new combination text and workbook provides an unusually complete and realistic training in the essentials of blueprint reading for the machine industries. Over 100 major industrial companies have cooperated with the authors in the development of problems and illustrative material toward making *The Blueprint Language* meet the practical requirements of industry. Emphasis is placed on the visualization of machine parts and their uses. The book contains extensive chapters on shape description, including views of objects; normal, inclined, oblique, and cylindrical surfaces and edges; and sectional and auxiliary views. There is a whole section on modern shop processes.

The Blueprint Language is profusely and entirely illustrated with facsimiles of actual commercial blueprints which cover general principles thoroughly and provide a wide variety of typical industrial problems. Pictorial drawings of the production-illustration type are used liberally throughout. Work sheets are provided for each blueprint, and problem sheets are given at the end of each chapter. A teacher's key, providing solutions for all work sheets, will be available for use with this text.

Winter, 1947. $4.75 *(probable)*

AIRCRAFT DRAFTING

By **Hyman H. Katz,** *Supervisor of Engineering Training, Republic Aviation Corporation*

Written by an "insider"—a design engineer who has worked in a number of large aircraft companies and has supervised the training of hundreds of draftsmen for the aircraft industry—this book includes much practical information useful to the aircraft draftsman in addition to full training in the essentials of technical drawing and their application to aircraft. There is, for instance, considerable aircraft design data, information on lofting technique and processes, and information on such matters as change groups, bills of materials, and weight calculations. All the fundamentals of drafting are very clearly explained and fully illustrated. Wherever possible, illustrations are used in place of lengthy explanations, and the basic topic of orthographic projection has been presented in color to facilitate rapid comprehension. Pictorial drawing, now widely used in industry, and particularly in aircraft design, is stressed. All drafting fundamentals are specifically applied to aircraft problems. All illustrations have been done by skilled draftsmen, experienced in aircraft design.

386 pages, $5.00

MAKING PATENT DRAWINGS

By

Harry Radzinsky

Patent Attorney

Complete, step-by-step instructions for making drawings for all types of patents and trademarks according to the special requirements of the U. S. Patent Office. Includes much expert advice on all aspects of patent drafting. Fully illustrated, $3.00

THE MACMILLAN COMPANY • 60 FIFTH AVENUE • NEW YORK 11, N. Y.

JOURNAL OF ENGINEERING DRAWING

PUBLISHED IN THE INTEREST OF TEACHERS OF ENGINEERING DRAWING
AND RELATED SUBJECTS

VOL. 11 NO. 2 | MAY, 1947 | SERIES NO. 32

CONTENTS

FRONTISPIECE: Illustrated by Professor J. S. Blackman, University of Nebraska. . . . . Page 4

INDUSTRIAL APPLICATION OF DESCRIPTIVE GEOMETRY, by Professor Frank M. Warner, University of Washington. . . . . Page 5

MINNESOTA WELCOMES YOU, by Professor H. C. T. Eggers, University of Minnesota . . . . . Page 9

LINE SHADING TECHNIQUE OF MECHANICAL OBJECTS, by Traugott Tschudi, chief design engineer, Knapp Mills, Inc. . . . . Page 10

TEACHING TOLERANCES, by Professor Jasper Gerardi, University of Detroit . . . . . Page 12

PLAY PROBLEMS. . . . . Page 15

COMMITTEES Engineering Drawing Division A.S.E.E., by John T. Rule, Chairman. . . . . Page 17

THE PI SCALE, by George Mitchell . . . . . Page 20

GUIDE LINES FOR DIMENSIONING by Professor Francis C. Bragg, Georgia School of Technology . . . . . Page 24

THE WALRUS AND THE CARPENTER, News Items of General Interest. . . . . Page 26

CAN SPEED BE TAUGHT? by E. Bruce Meier, University of Nebraska . . . . . Page 28

Report of MID WINTER MEETING Engineering Drawing Division. . . . . Page 34

Annual Subscription Price, $1.00

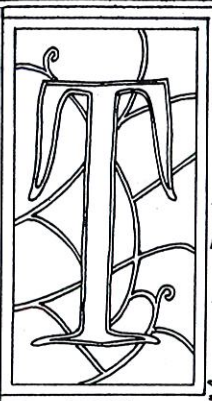
PUBLISHED IN FEBRUARY, MAY, AND NOVEMBER BY
THE DIVISION OF ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY OF THE
AMERICAN SOCIETY FOR ENGINEERING EDUCATION

PUBLICATION COMMITTEE

T. T. Aakhus, Editor
University of Nebraska
LINCOLN, NEBRASKA

J. N. Wood, Advertising
Kansas State College
MANHATTAN, KANSAS

Ralph T. Northrup, Cir. & Treas.
Wayne University
DETROIT, MICH.



HESE ARE THE TIMES THAT TRY MENS SOULS THE SUMMER SOLDIER AND THE SUNSHINE PATRIOT WILL, IN THIS CRISIS SHRINK FROM THE SERVICE OF THEIR COUNTRY BUT HE THAT STANDS IT NOW DESERVES THE LOVE AND THANKS OF MAN AND WOMAN TYRANNY, LIKE HELL, IS NOT EASILY CONQUERED; YET WE HAVE THIS CONSOLATION WITH US THE HARDER THE CONFLICT THE MORE GLORIOUS THE TRIUMPH

J Blackman scripsit 1947

TOM PAINE

APPLICATION OF DESCRIPTIVE GEOMETRY TO INDUSTRIAL ENGINEERING PROBLEMS

by

Frank M. Warner, Professor of Engineering Drawing
University of Washington

Engineering graduates who studied descriptive geometry twenty-five years ago well remember their struggles to understand a difficult and uninteresting subject. They often questioned its value in practical engineering work and assumed that the course was required because of a valuable training it was supposed to offer. It is true that the course, as then taught, did have some value in training students to visualize three-dimensional situations. Also it presented methods for using fundamental principles which would enable one to arrive at a required result. However, training did not transfer as expected because the methods taught were so far removed from actual engineering practice that their application to industry was exceedingly difficult. The situations given in problems were not even closely related to actual engineering work but were almost purely abstract. Under these conditions there was little interest on the part of the student in trying to solve problems which seemed to have no connection with engineering situations and consequently the training value was minimized. I have heard many graduates express this same opinion of a subject which can be made so interesting and so practical.

Several of the leaders of our teaching profession in the past few years have sensed this deficiency and, thanks to their efforts, new methods have been developed which are now closely related to commercial practice. These methods are now applied to engineering situations. A student now has a keen interest in the subject because he sees how useful it can be in industrial work. While the fundamental principles taught remain almost exactly the same, the new methods developed with a closer application to industry have greatly improved the attitude of students and industry itself toward our subject. Engineers in industry have a far greater respect for descriptive geometry than they used to have, a fact which has been amply proven by our war experiences. Doubtless there were many schools during the war that had experiences similar to ours at the University of Washington. Our night war training classes in descriptive geometry were crowded and had to be offered to twenty-six sections of students, many of whom came at the suggestion of the company for which they worked. These students were largely college graduates with three to five years of drafting experience. They had nearly all passed a course in descriptive geometry once and some had had it twice, and still they could not use it well enough on the job. They came from manufacturing plants, steel companies, shipyards and aircraft plants to learn how to use descriptive geometry because they found it so essential in their work. This is undeniable proof that our subject has finally come into its own and established its respected and deserved place in industry.

For the purpose of illustrating the application of descriptive geometry to industrial engineering problems, I have selected just a few of the many problems which have come to me personally direct from industry. They are taken from almost every major branch of the engineering profession. Space does not permit showing the solutions of these

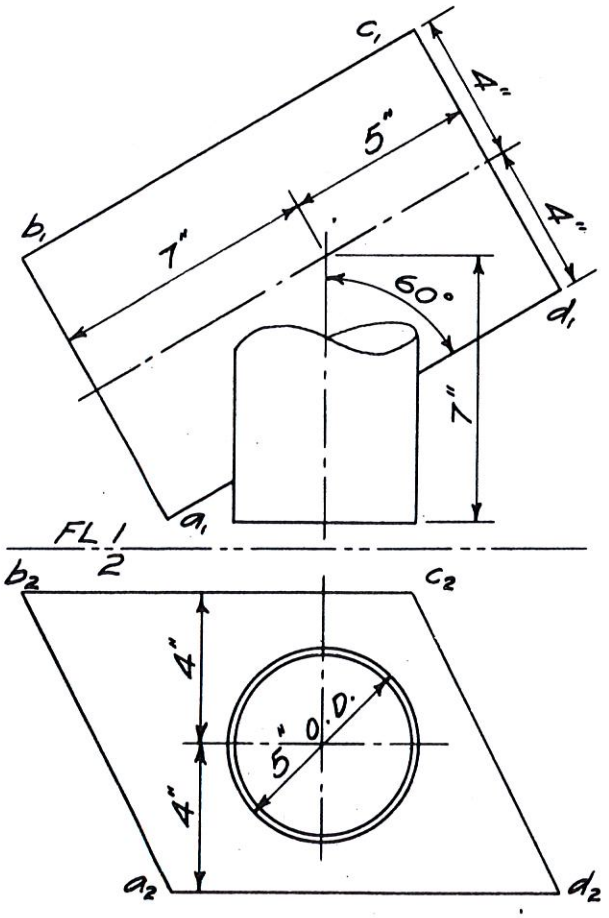


Fig. 1

problems but a few cuts will show the settings approximately as they were obtained from industry.

1. A foreman from the Boeing Aircraft Company came to me for help in solving the problem shown in Fig. 1. A tube was to fit flush against an aileron on a plane and he wanted a quick and accurate method for finding the angle to cut the tube off. I gave him a solution which, he has since told me, he has used over many times with accurate results and with a saving of time.

2. The U.S. Engineers recently constructed near Seattle the famous Mud Mountain Dam, one of the highest earth dams in the world. One problem encountered there is shown in Fig. 2. A large cylindrical valve house was built on a slope and had a conical roof which was a regular right cone of revolution. A gable roof with a level ridge had to be constructed so it would fit flush against the conical roof, or, in other words, it would be tangent to it. The problem was to give the carpenters the exact pitch of the roof. This is a very simple problem when descriptive geometry principles are known. However it caused some trouble until these principles were applied.

3. The district engineer for the U.S. Bureau of Fisheries recently presented to me the problem shown in Fig. 3. The job was under construction and a definite solution had to be made promptly. AB and CD were the centerlines of two level 12-inch pipes, but the pipe AB was at a higher elevation. He wanted to connect these pipes by using standard 12-inch 45-degree flanged elbows which he had in stock. The problem was to find the distance M which the face of one flange would be from the building line and to find the distance between flanges of the connecting pipe. Since this has been installed another similar problem has arisen.

4. Some problems come from industrial trade magazines. Such a problem is shown in Fig. 4 which came from the Foundryman's Magazine. The problem was to find the elevation at which a stock trap would have to be installed so the tail pipe would lead into the stock branch in the main sewer line. The centerlines of the tail pipe of the trap and the lateral from the branch would have to be colinear. This problem concerned industry sufficiently to publish it, together with their solution, in a national magazine. However their solution was entirely a rule-of-thumb method which was very complicated and not applicable to all cases. I sent them a much simpler and clearer solution, based on descriptive geometry principles, which they appreciated enough to publish.

5. Another problem, taken from the Aero-Digest Magazine, concerned the retractable landing gear shown in Fig. 5. The problem

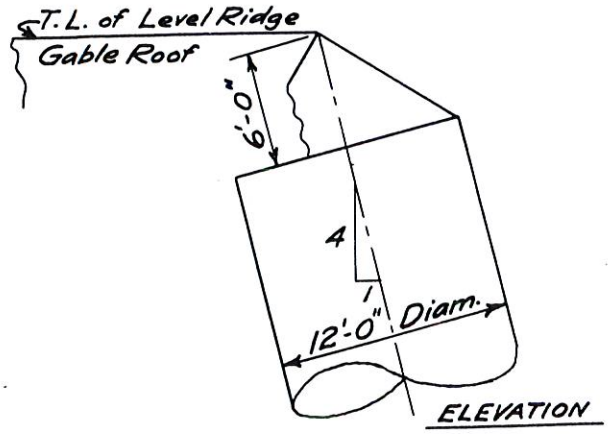


Fig. 2

was to locate the centerline of a shaft about which the wheel could be retracted, by rotation, into the wing as shown in the elevation view. At the same time it had to be moved back 30 inches as shown in the plan. This problem is more difficult to solve by cut-and-try methods. However by the use of descriptive geometry principles a logical analysis can be made and the solution easily obtained. There are at least three different methods which may be used, all of which give the same exact location of the shaft.

6. One of our electrical engineering graduates was assigned the following problem to solve as one of his very first jobs. A high-tension power line hung in a loop, called a jumper, where it was fastened to a pole by insulators. Guy wires supporting the pole were fastened at the ground. His company asked him to determine whether there was sufficient clearance between the jumper and the guy wires to prevent the current from jumping to the guy wires and grounding.

(Continued on page 16)

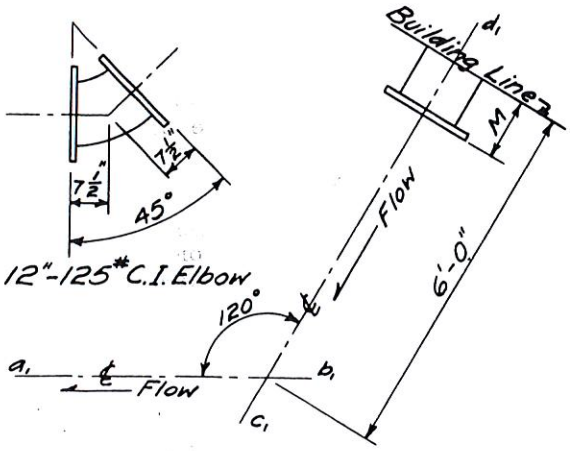
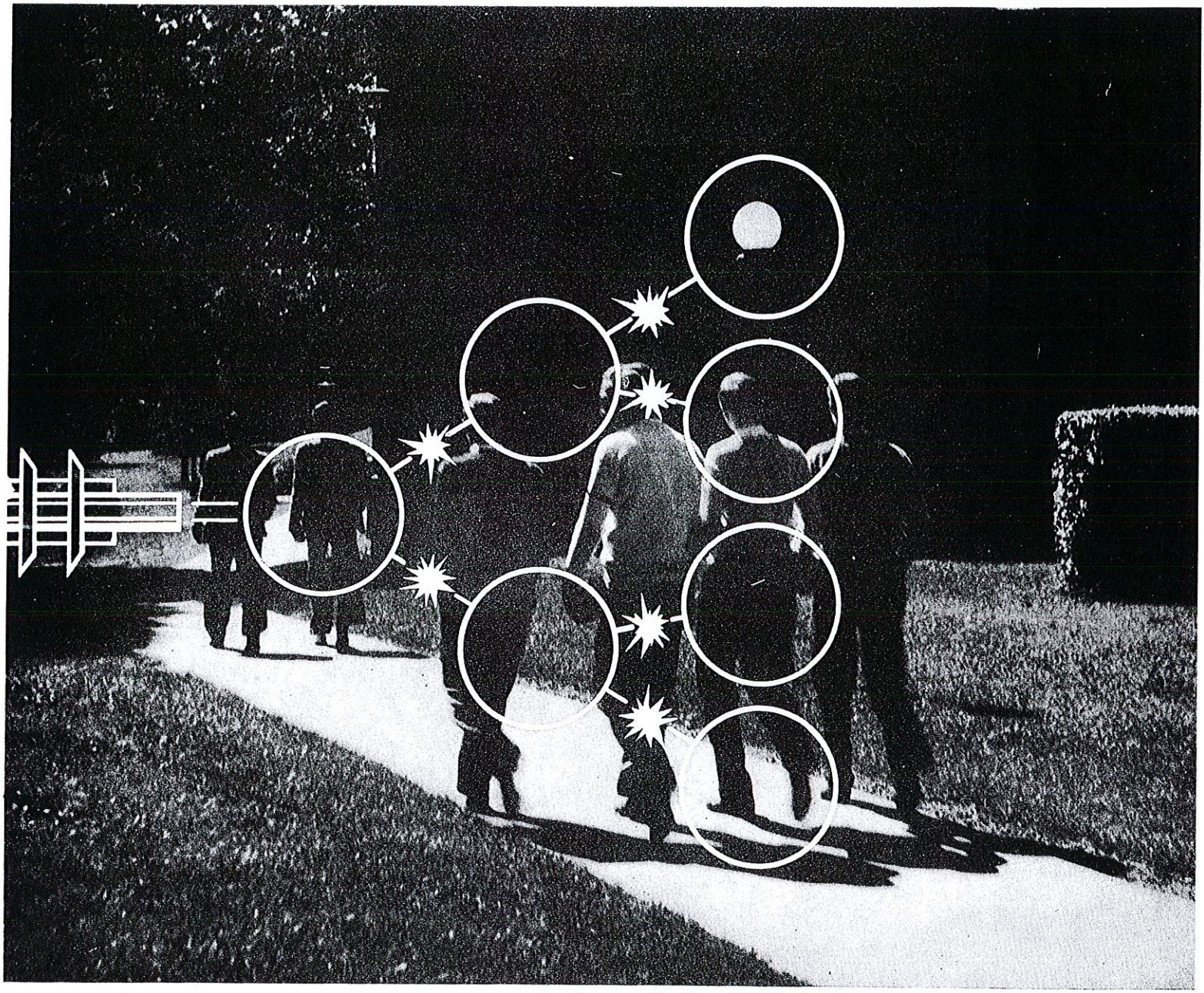


Fig. 3



The Lesson of the Atom

Mankind has always been profligate in its use of energy. Whole areas of the world's irreplaceable resources have been spent as casually as a child might toss away a dime. But men of science, caretakers of the human race, have always gone against *that* grain, seeking ways to husband nature's stores, to make their expenditure more productive. Recent progress in atomic research is a case in point.

Equally prodigal has been mankind's use of mankind's potentials: energy misspent; careers terminated before they began; evident abilities starved of sustenance; talents left dormant or squandered in dead-end streets: huge areas spent as at the flip of a coin. And equally have men of education, caretakers of the human race, gone against *this* grain. As they have pushed their study ever closer, as they have peered into the mysteries of the human mind, they, too, are learning how more fruitfully to exploit the potentials of the Johnnie Joneses, the Johnnie Greens, the Johnnie Smiths in their classrooms for the fulfilment this nation or any other nation dedicated to democracy must have.

Here, too, it is a question of initiating a chain reaction in the youngster's life: illuminating clearly his goal; establishing in him a desire to achieve it; setting the feet of the Man of Tomorrow on the path; clearing obstructions from the flow of his energy so that it may be self-generating and self-sustaining.

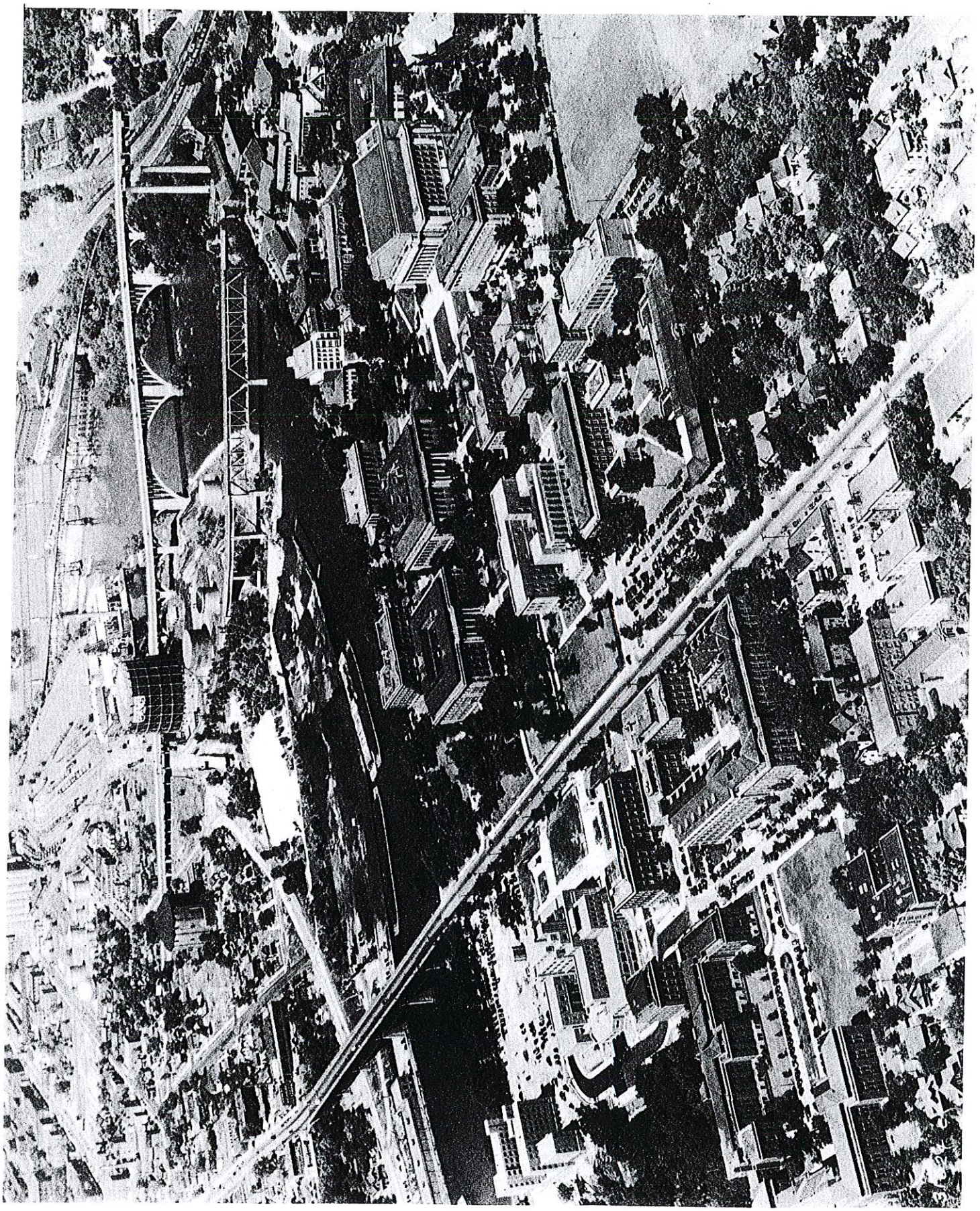
As far apart as success and failure are, the fork in the road is almost unperceptible; subtle are the reasons why one boy responds to a pictured goal and another does not; the problem is so complex that not one factor dare be overlooked. When a boy comes to drafting class for example, carelessness must not be the keynote of his introduction. The human mind works by analogy. If the boy's drawing instruments are cheaply made and carelessly chosen, then casual indeed may be his response to the work. If these tools of engineering achievement are not vested with value—yes, and with glamor, none need be surprised if the boy's imagination does not take fire. It is the boy's future that is at stake: almost unperceptible is the forking of the roads; a touch on one side or the other may be enough to swing him from right to left. Petty economy has no place in a situation such as this.

EUGENE DIETZGEN CO.

Chicago • New York • San Francisco • New Orleans • Pittsburgh
Los Angeles • Philadelphia • Washington • Milwaukee
Dealers in All Principal Cities

DIETZGEN
EVERYTHING FOR
DRAFTING AND SURVEYING

(Printed in U.S.A.)



MINNESOTA WELCOMES YOU

by

Henry C. T. Eggers
Chairman Department Drawing and Descriptive Geometry
University of Minnesota

Minnesota, Land of Ten Thousand Lakes bids you a hearty welcome.

If you are coming by rail from the East you will find unexcelled service and equipment over any of the competing roads between Chicago and Minneapolis. People, in the Know, claim this to be the best railroad service in the country.

Within the State we have two stretches of highway which compare in scenic beauty to any in the United States. They are the famous North Shore drive along Lake Superior from Duluth to the Canadian border and the drive along the Mississippi River from La Crosse, Wisconsin to Red Wing, Minnesota. If you are traveling by car from the East, South or West you can include the latter of these two drives without loss of time or mileage.

The Twin Cities are the headquarters for Northwest Airlines so if you are traveling by air you will find excellent service.

A one-half hour drive from Minneapolis will bring you to Lake Minnetonka whose beauty has been extolled in song and verse. We feel that, as lakes go, Minnetonka is the jewel of them all and we have ten thousand to pick from.

Within the city limits of Minneapolis we have a chain of six beautiful lakes of which we are justly proud. Swimming is good so be sure and bring your bathing suits.

We are proud of our University which is situated on the bluffs overlooking the Mississippi River. Why we are so large and blessed with so many students (27,000) we don't know but we do know that we are anxious to show our school off to our visitors. We are not too proud of our temporary buildings, now being erected, but they may interest you since they represent one means by which we are attempting to meet the problems presented by our rapidly expanding student body. The University maintains its own private golf course and its facilities will be open to the use of our guests so if you like golf bring your clubs with you.

The Department of Drawing and Descriptive Geometry normally has a staff of 12 members and serves about 1100 students. At present the staff has 38 members and we have 3850 students taking work in the department. Needless to say we have our problems but we are trying to meet them and keep the students happy. As you probably are having the same problems to meet we should have plenty to talk about.

I have tried to give you reasons why you should attend the Annual Convention in June but after all the main reason is because you are our friends and we are anxious to again shake you by the hand and try to return a little of that hospitality which we have experienced elsewhere. You have all heard of "Southern Hospitality." Well, there is also a Northern variety with a slight Scandinavian tang which we are anxious for you to sample in this, the North Star State.

TECHNIQUE OF LINE SHADING MECHANICAL OBJECTS

by

Traugott Tschudi, Chief Design Engineer
Knapp Mills, Incorporated
New York City 4

In recent years, the field of illustration has seen a mounting resurgence of the techniques employed by the old Masters with such perfection and artistry, and whose engravings continue to be a source of inspiration, despite the passage of centuries.

This transition has possibly been brought about by two factors. First, accomplishments in various fields of human endeavor appear to go through periods of temporary neglect, only to emerge again when circumstances and alterations in the thinking and viewpoint of people have caused them to reshape their beliefs. It is also true that we humans, in our constant endeavor to shorten methods of achievement, frequently sacrifice highly developed skills because they require painstaking effort and training, in favor of procedures which accomplish a suitable result by short cut methods.

A second factor, which is evidently influencing this increased interest in line shadings employed by the old engravers, is a rebirth of interest in true art. As a result, people are again developing a newer set of standards based on sounder values.

This trend is best illustrated by the ever increasing use of line drawings by national advertisers, as found on examining more prominent newspapers and magazines. These line drawings are often not ordinary pen and ink sketches, but drawings executed with the care and patience of an etching, with numerous parallel lines of pre-determined thickness and spacing which render the tonal value of an object with such fidelity as to give it true photographic reality. The object itself may be simply a food package, yet the illustration has a distinction of its own, when compared with a halftone picture and its monotonous grays.

This renewed interest in line drawing can be applied with similar advantage to the illustration of mechanical subjects. Here too, the pen line can be refreshing, provided a suitable technique is employed. First of all, the reproduction must always be a faithful copy of the original drawing. No elaborate airbrush equipment is required. A school drawing outfit which includes an irregular curve is sufficient for the most comprehensive illustrations. The photo engravers charge for a line cut is much less than a halftone plate.

The procedure of making an illustration of a mechanical device can be generally divided into three steps. First, some rough sketches are made to determine the most advantageous view of the object. Next, a careful outline drawing is constructed, in most cases directly from a blueprint on which the location of highlights and shadows are indicated. Finally, the tonal values are rendered by a suitable medium, which is, in this case, the pen line. While the subject of composition, and that of orthographic or perspective projection is outside the scope of this article, the author would like to mention a method of constructing the ellipse which he found most expedient for this type of illustrating. The importance of a correctly drawn ellipse cannot be overemphasized in such work. As most mechanical devices have surfaces that may be classified simply as flat, cylindrical, conical or spherical, we are, in constructing an outline drawing, continually confronted with the drawing of an ellipse. There are several methods to draw an ellipse, but the one described in the following has the advantage that it can be drawn with the compass and once memorized, it can be constructed quickly.

Referring to Fig. 1, A-A is the major axis, B-B the minor axis. With compass centered at O, swing arc from A to C. Divide distance C to B into three equal parts. Project one part from B to D. Pick up distance D to O with divider and project inward from A on horizontal line to establish points E&E, which are the centers of small arcs. Draw 30 degree lines through E to intersection F, which is the center of the large radius.

Because the surfaces of mechanical objects are to the greatest extent uniform, smooth and exact, it follows that line shading must be applied MECHANICALLY, and free hand drawing reduced to a minimum. Shading lines can be roughly divided into two groups, straight lines and curved lines. The straight lines are applied

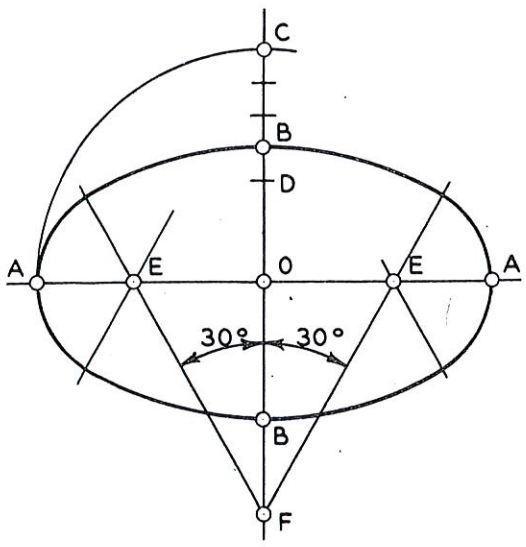


Fig. 1. Ellipse Construction.

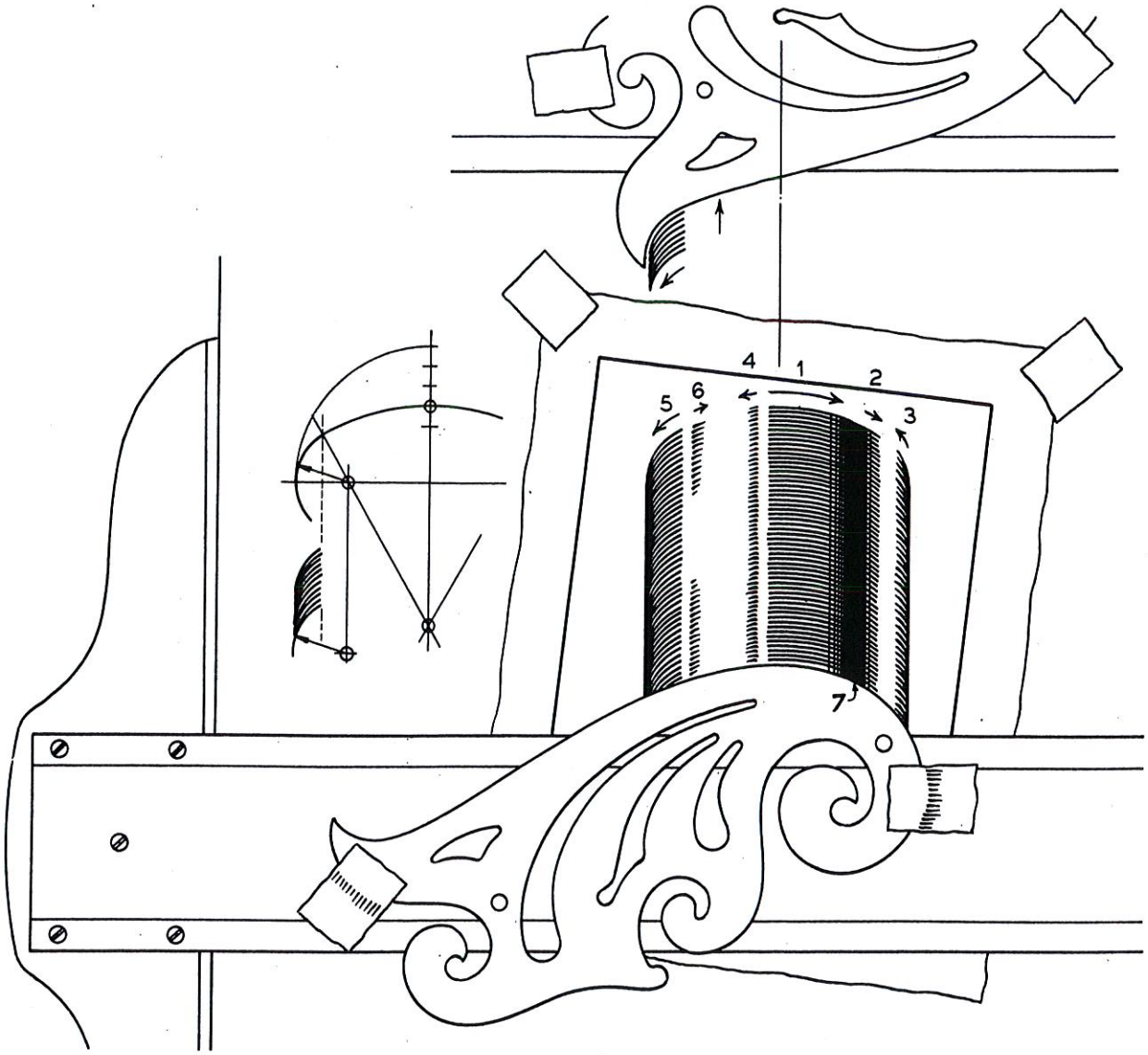


Fig. 2. Construction of line shading on a cylindrical surface.

with a ruling pen by means of the T-square and triangles. For the curved lines, the most versatile equipment is the irregular curve.

A typical working method of line shading is illustrated in Fig. 2. A polished steel shaft is to be shown in orthographic projection. After the outline drawing is completed, the location of highlight, shadow and middle tones are plotted in longitudinal pencil lines, the drawing is then taken up, and refastened to the board so that the center line of the shaft is exactly at right angle to the T-square. It will be noted that in this example, the ellipse of the shaft is the key to the entire curved shading. The various shading planes are indicated in number which are in order of application. The first plane to be shaded is No. 1. The irregular curve is placed on the T-square, and located so that its contour for shading planes 1 and 2 matches with the ellipse for that portion. The curve is then fastened to the T-square with adhesive tape to prevent it from shifting. The shading of plane 1 proceeds now with a ruling pen, by moving the T-square downward for each new line. The shading is from left to right, as indicated by arrow. Next, plane two is applied in a similar manner.

One may assume that planes 1 and 2 could be shaded at one time, but this would require a twisting of the ruling pen along the line to follow the changing direction of the curve, all of which is more tedious, and may tend to affect the sureness of the pen line. It is quicker to draw each shading plane separately. Plane 3 is applied with flexible writing pen, freehand. Plane 4 is likewise applied freehand. A slight pressure should be exerted at the start of the short line, so as to give it a tapered effect.

To proceed with plane 5, the curve is taken up from its fixed position of the T-square, and re-set after the drawing board is turned upside down, or the drawing is taken up from the board and turned 180 degrees. Shading 6 is applied free hand in the direction shown. The longitudinal shadow and shadings No. 7 is

(Continued on page 22)

TEACHING TOLERANCES

by

Jasper Gerardi
Director of the Department of Engineering Drawing
University of Detroit

"All fractional dimensions ±.010 unless otherwise specified."

"All decimal dimensions ±.005 unless otherwise specified."

These notes, or some modification of them, usually appear in small print in the upper right hand corner of a sheet of drawing paper, or they may be printed in a title block. Notes for tolerances are usually printed, at the request of the industry concerned, or may be lettered on a drawing by the draftsman.

The graduate engineer who may begin his career in a drafting room, as a rule, pays little or no attention to the notes, and according to complaints made by some chief draftsmen, these graduates have very little knowledge or appreciation of the subject of limit dimensioning. Although the men in industry have a responsibility in training the young engineer, it is probably true in many cases that we, the teachers of engineering drawing, are not allotting sufficient time to this important subject.

The purpose of this article is to encourage a discussion of this subject by contributors to the Journal of Engineering Drawing. By an exchange of ideas we may adjust our courses in drawing, and thereby satisfy to a greater degree the needs of industry, particularly in view of the fact that today the industries and the public are "precision minded." Furthermore, precision work today is so common that .005" is no longer considered an expensive control, and such terms as "mirror finish" and "Micro-inches" are becoming a matter of common usage.

Some teachers of engineering drawing will argue, and rightly so, that the subject of tolerances cannot be taught in an ordinary two semester drawing course. It is further argued, that the contents of a drawing course are so compressed in the time allotted, that too many of the fundamentals of drawing are not being efficiently taught, and therefore the subject of tolerances is one which properly belongs in a course such as machine design. These arguments are valid, but as a rule, the drafting work of an apprentice engineer is in part a reflection of that which was taught to him by his drawing teacher, and most of the criticisms made by his superiors (usually not constructive) will be directed to that teacher. In self-defense, therefore, teachers of engineering drawing must utilize the time allotted in a more efficient manner.

It is not reasonable for industry to expect the engineering schools to teach their students to be experts in all phases of shop or field work connected with drawings made in school. It is reasonable, however, that they may expect the student to be familiar with the terminology and the fundamentals which are inherent in the drawing. It is with this objective in mind that the following discussion of tolerances is presented.

The subject of tolerances may be introduced, if properly co-ordinated, following the study of general dimensioning and preceding the study of detail drawing. Actually, in the study of detail drawing, if the details of a unit have mating parts, it is impossible to dimension the parts properly if consideration is not given to the allowance necessary for the proper functioning of the mechanism, let alone production and other considerations. As a matter of fact, it is almost impossible to teach general dimensioning without introducing the word tolerance. This may be illustrated by considering a common error made in some text books, particularly in examples which are supposed to be correctly dimensioned.

It is not uncommon to see a view of an object with lateral dimensions as shown in Figure 1, below.

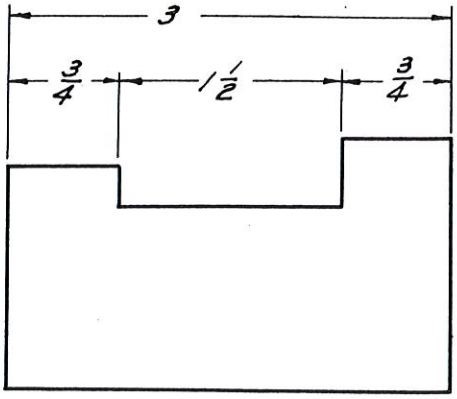


Figure 1

The above dimensioning may be considered as correct if it is known that precision and interchangeability are of secondary importance. It will also have to be assumed that the teachers objective is purely to teach placement of dimensions, contrast in lines, the forming of arrow heads, etc. If the bracket under consideration, however, is made in Detroit, and assembled to its mating part in New York, and if the manufacturer requests that "all fractional dimensions are to be ±.010" then the dimensions in Figure 1 have to be altered to read as shown in Figure 2; otherwise, any one of the four dimensions in Figure 1 may be as high as .030 oversize or undersize and cannot satisfy the specification concerning tolerances for fractional dimensions.

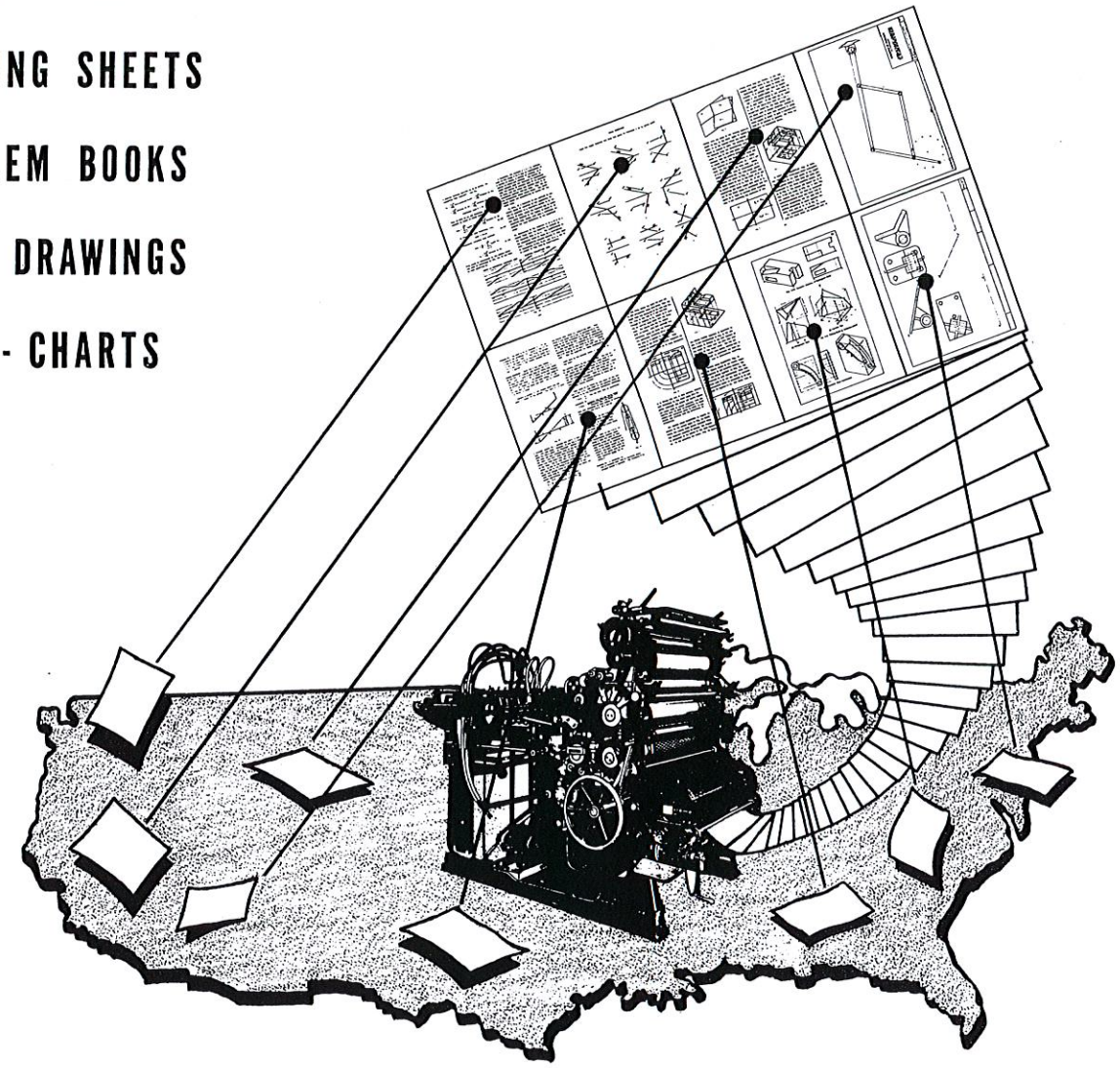
Simple illustrations such as the one presented do not task the mind of an ordinary freshman, and introduce enough material to make the student conscious of the importance of related dimensions. The student also realizes that contrast in lines, lettering, and neat harrow heads are not the only requisites of a good drawing.

(Continued on page 14)

The JOURNAL OF ENGINEERING DRAWING

. . . is produced by the Planograph process

- COLLEGE PUBLICATIONS
- DRAWING SHEETS
- PROBLEM BOOKS
- MECH. DRAWINGS
- MAPS - CHARTS



☆ JOHN S. SWIFT CO., INC

OPERATING FOUR PLANTS

New York 1, NY	Chicago 7, Ill	St. Louis 3, Mo	Cincinnati 2, O
455 West 30th St	17 N. Loomis St	2100 Locust St	3rd and Vine Sts
LAckawanna 4-1144	MONroe 7020	CHestnut 7141	PArkway 4148

(Continued from page 12)

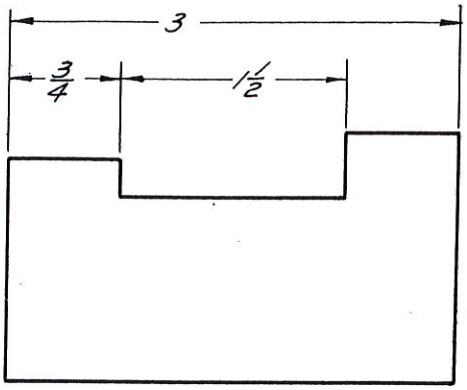


Figure 2

The proper method of designating limit dimensions on a drawing is often confusing to a student. The general rule that for external dimensions the maximum limit is placed above the line, and for internal dimensions the maximum limit is placed below the line is a good one, particularly if the dimensions apply to a circular hole and a round shaft; but in some cases, such as Figure 3, it may be difficult to tell whether the elements of the parts are internal or external. The proper designation of the limit dimensions does not always depend on whether the part is internal or external. Once the allowance for the mating part has been established, then the proper designation of the dimensions is also dependent on whether the elements of the piece may be made larger or smaller. For example, if in Figure 2 the fractional dimensions are replaced by decimals, and the student does not consider that groove (A) can be made wider and the tongues (B & C) could be made narrower, he might dimension the part as shown in Figure 3.

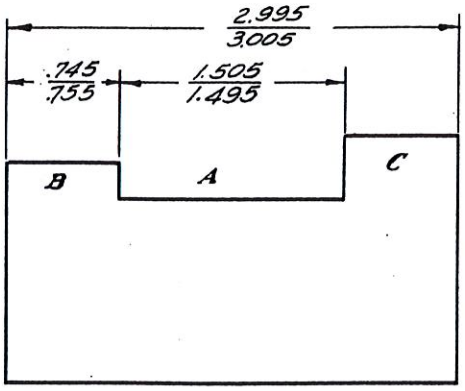


Figure 3

If, however, the student gives the proper consideration to the shop operations involved in making the part, then he would dimension it as shown in Figure 4. If fractional dimensions were desired, and a unilateral system of tolerances would be more suitable, then the dimensioning shown in Figure 5 would be more advantageous.

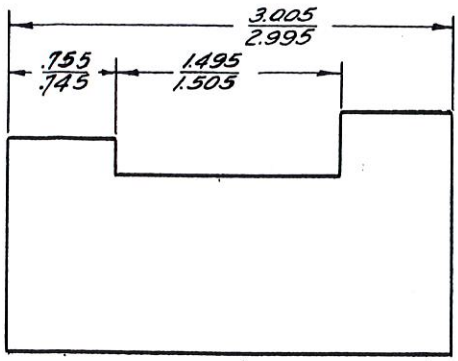


Figure 4

The most difficult phase of teaching tolerances is the "stack up" or accumulative tolerances. Although this phase of the work is generally associated with mating parts, it may also be introduced to students by simple illustrations of single parts.

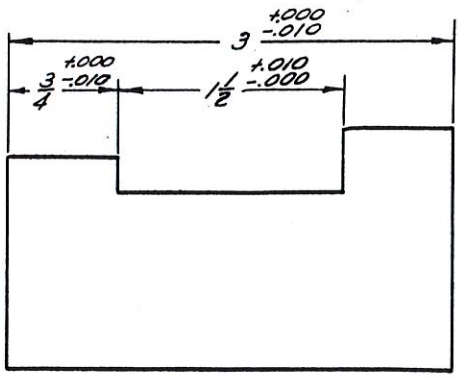


Figure 5

For example, let us consider Figure 4. If the micrometer measurement of tongue A was 0.760", and the groove B was 1.510", and the total width had been held to 3.000"; then the tongue at (c) would be 0.730" indicating that all the errors were allowed to accumulate on the right side of the part. If the mating part could stand this much variation, then the linear method of dimensioning would be satisfactory; but, if more rigid control were desired, it might be more advantageous to work from a finished edge as a reference plane and use the step form of dimensioning, distributing the total tolerance of the over-all dimension into the component dimensions of the piece, as shown in Figure 6.

With illustrations such as those shown in Figure 5 and 6, a student may readily see the advantage in changing the form of dimensioning if a minimum accumulation of tolerances is desired. The teacher, however, should be quick to emphasize that the cost of maintaining these tolerances shown in Figure 6, would be high compared to those in Figure 4, but if such a degree of accuracy was necessary for the functional performance of the part, then the step form of dimensioning would be worth while.

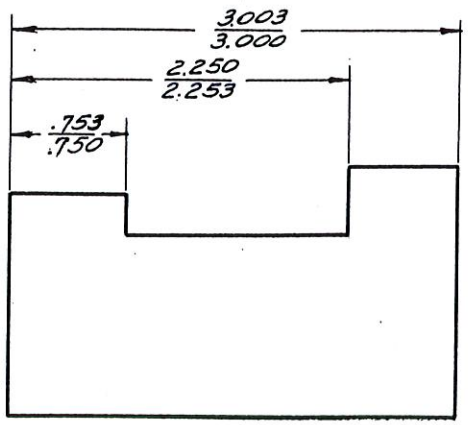


Figure 6

An attempt has been made in the foregoing discussion to show that by means of simple illustrations the subject of tolerances may be introduced to freshmen and sophomore students. By using a similar approach, and allowing approximately five hours for lectures, the following could be included in a one-year course in engineering drawing:

1. Definition of the following terms:
   a. Tolerance
   b. Allowance
   c. Limit Dimensioning
   d. Unilateral Tolerance
   e. Bi-lateral Tolerance

2. Methods of calculation.
   a. Basic hole
   b. Basic shaft
   c. Calculations based on wear of tool

3. Care in the computation of tolerances to eliminate, as much as possible, accumulative tolerances ("stacking").

4. Common sense in the assignment of limits to dimensions.

5. Limit dimensioning and its effect on the cost of the product.

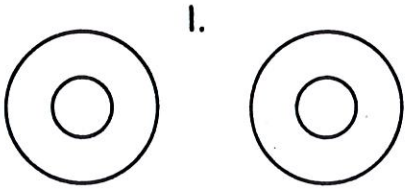
6. Shop processes related to precision work.

It is obvious from the

It is obvious from the above outline that a student will not become an expert. He should, however, be able to grasp enough of the fundamentals of tolerances to discuss the subject intelligently with his employer, and thereby help to reduce the friction which often exists between men in industry and the drawing teachers.

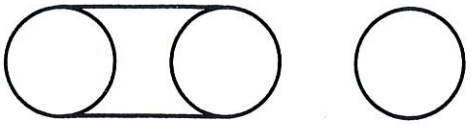
PLAY PROBLEMS
(For Your Spare Time)

1.



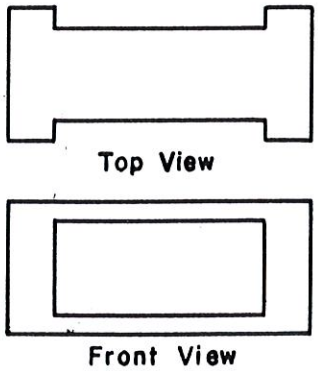
Front View Right Side View

2.



Front View Right Side View

3.



Top View

Front View

1. Draw The Top View.
2. Draw The Top View.
3. Draw The Right Side View.

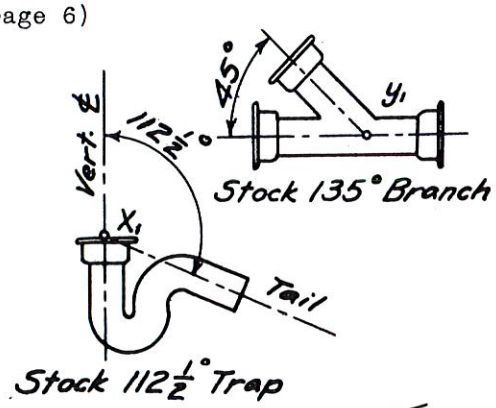
(Continued from page 6)

7. The steel industry uses descriptive geometry principles in detailing steel connections at unusual angles. Unfortunately all draftsmen do not know these principles well enough to apply them. One small company had a difficult set of stack bracing to detail which was too large for making a mock-up in the shop. The company I was working for loaned me to this company for two days to detail for fabrication the complete job. It was a very complicated job but our methods made it possible to produce drawings by which the work could be completed. This is real evidence of the value of our subject to industry.

8. Civil engineering has many opportunities to use descriptive geometry. A drift-barrier was constructed across a river in Western Washington. It consisted of fourteen concrete piers with all four sides sloping. Between these piers were wire cable nets fastened to 1-1/2 inch round eye-bars set in the piers. Since these bars protruded from the sloping sides by the same amount, they were all different lengths. These lengths had to be predetermined and the eye-bars fabricated in the shop because they were too heavy to be made in the field. Also there are numerous concrete transitions in irrigation canals in our state, the transition being from an open V-shaped canal to a closed syphon. These surfaces are all hyperbolic paraboloids and must be understood to give correct details for building the forms.

9. Mechanical engineers too often leave such jobs as locating bolt-holes in a flange to be done in the field. The chief engineer for a large gas company in the east told me that for years he had located holes in unusual flanged connections by cut-and-try methods or by simply marking them "to be drilled in the field". He was surprised to learn how easily and accurately they could be determined by descriptive geometry methods and drilled in the shop at a considerable saving of time and money.

The illustrations just cited present only a few of the problems from industry which have come to my personal attention. There are many other lines of industry where descriptive geometry has been used and could be used very much more effectively. The aeronautical industry probably uses more descriptive geometry than any other industry. Application of this subject is made in obtaining detailing information for all kinds of bent plates, odd fittings and connections, jigs and dies, and landing gear mechanisms; also in determining the location of special guide pulleys and in studying the clearance between cables or other moving parts. All wing surfaces or ship surfaces are laid out by lofting which is an advanced application of descriptive geometry.



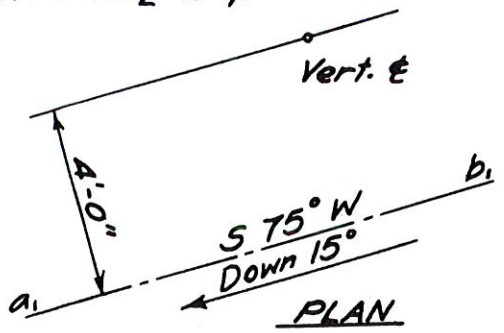


Fig. 4

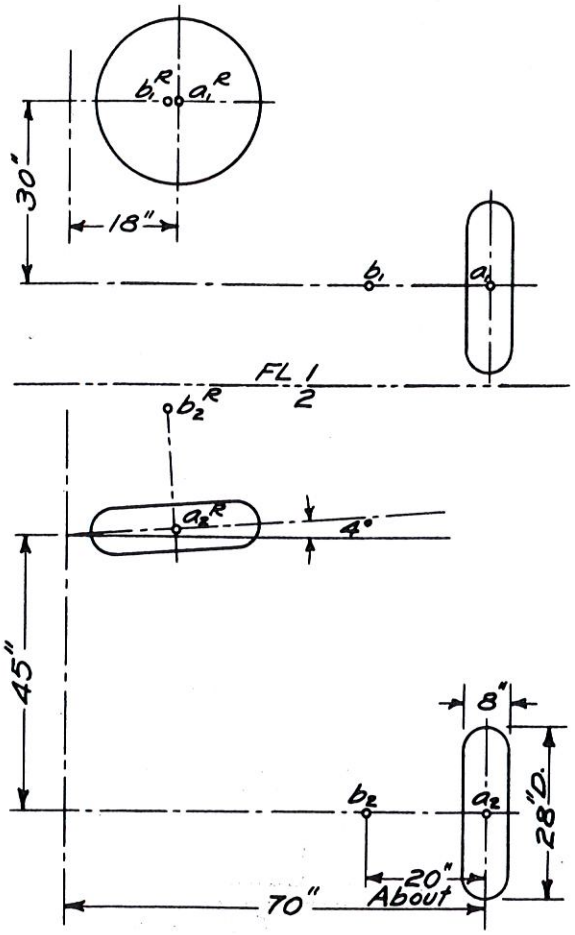


Fig. 5

Another field where our subject could be applied much more than it is today is in mining and structural geology. In one of our recent magazines there was an article on the application of descriptive geometry to structural geology. The cumbersome methods illustrated there show that there is a big opportunity to introduce our modern methods to mining engineers. I recently had an experienced graduate mining engineer in my own class and he was amazed to learn how much easier it is to solve geology problems by our present methods than by the methods he learned and which are still in geology texts.

Sheet metal work offers another large field where our methods could be used more extensively. Too many jobs are built by rule-of-thumb methods which apply only to one particular job. Definite and sure principles may be applied to any developable metal job to give a quick and accurate solution. In the field of mechanics stresses can be analyzed in a non-coplanar structure by our graphical methods in less than half the time required to calculate them. And the graphical results will ordinarily be sufficiently correct for use in design. If greater accuracy should be required, in this, or in any other problem solved by our methods, closer results may be obtained by solving mathematically a few right triangles appearing in the graphical solution.

The purpose of this paper is to try to convince all teachers of descriptive geometry, and especially those who are just starting their career, that there is an immense field where our subject can really be of great service to industry. This field is unlimited and it is our interesting task to make every possible contact with industry in order to discover how we can better serve them. We should make an active effort to acquire experience and contacts which will enable us to use more practical situations for teaching problems and thus make our subject more interesting and more worth while to our students.

COMMITTEES
Engineering Drawing Division A. S. E. E.

by

John T. Rule, Chairman

CREDITS COMMITTEE

Prof. Ralph S. Paffenbarger, Chairman, Ohio State University
Dr. Maurice R. Graney, Purdue University
Prof. John Russ, State University of Iowa
Prof. R. P. Hoelscher, University of Illinois
Prof. W. M. Christman Jr., Penn State

MINIMUM STANDARDS COMMITTEE

Prof. Arthur B. Wood, Chairman, University of Tennessee
Prof. Herman L. Henry, Louisiana Polytechnic Institute
Prof. F. C. Bragg, Georgia School of Technology

COMMITTEE ON VISUAL AIDS

Prof. H. B. Howe, Chairman, Rensselaer Polytechnic Institute
Prof. Frank M. Warner, University of Washington
Professor J. Lawrence Hill, Jr., University of Rochester

BIBLIOGRAPHY COMMITTEE

Prof. Harold H. Fenwick, Co-chairman, University of Louisville
Prof. Hiram E. Grant, Co-chairman, Washington University (foreign div.)

ADVANCED GRAPHICS COMMITTEE

Prof. Frank A. Heacock, Chairman, Princeton University

★ *McGraw-Hill Book Company*

TEXT—FILMS ON EN

correlated with

French's ENGINEERING DRAWING

★ ***SOUND MOTION PICTURES*** — For Explanation and Demonstration

★ ***SILENT FILMSTRIPS*** — For Follow-Up Class Review and Discussion

{Ready for release early this summer}

Selected parts of the French text are being supplemented by a series of 7 sound motion pictures, anc 6 coordinated silent filmstrips. Terminology and general approach is identical in films and textbook. How ever, the purpose of Text-Films is extended coverage of the subject rather than mere duplication on film o what is already in the book.

The motion pictures explain theories and demonstrate techniques in those phases of the subject tha are generally found to be most difficult for the student to understand. Averaging 15 minutes showing time each motion picture covers only as much subject matter as the average student can assimilate in one clas period.

The filmstrips are planned primarily as follow-ups to the motion pictures. They re-emphasize key point in both motion picture and textbook, present review questions, and offer additional factual material. Eacl filmstrip consists of about 40 individual frames that can be projected one at a time and held on the screen a long as desired.

Description of Film Contents

Film 1—INTRODUCTION TO ENGINEERING DRAWING. (*Approximately* 10 *minutes*)
Describes the role of Engineering Drawing as the working language of modern production and indicates the importance of its study.

Film 2—ORTHOGRAPHIC PROJECTION. (*Approximately* 20 *minutes*)
Explains theory of orthographic projection and demonstrates the making and reading of the drawing.

Film 3—AUXILIARY PROJECTION. (*Approximately* 20 *minutes*)
Defines and explains auxiliary projection, and demonstrates the construction of the different types of single auxiliaries. Also shows that on some drawings an auxiliary view is needed before one o the principal views can be completed.

Film 4—OBLIQUE OR DOUBLE AUXILIARY VIEWS. (*Approxi mately* 15 *minutes*)
The theory of the double auxiliary or oblique view is describec in detail. This is followed by demonstration of the steps involvec in drawing an object with an oblique face.

Film 5—SECTIONING. (*Approximately* 15 *minutes*)
Demonstrates the need in some cases for simplifying the presenta tion of important interior details of an object, and shows how thi is accomplished by the sectional view. Explains the meaning o special symbols used in sectioning, and describes principles and practices followed in constructing various types of sectional views.

Announces . . .

GINEERING DRAWING

Film 6—SHOP PROCEDURES (*Approximately 15 minutes*)
Describes the relationship between the making of the drawing and the various production operations in shop and factory. Also gives the student a glimpse of the organization of modern production methods, and provides knowledge of the working of basic machines. Brings out some of the reasons for certain drafting requirements, thus laying a better understanding of dimensioning which is taken up in the next Text-Film.

Film 7—DIMENSIONING
The motion picture and filmstrip on Dimensioning each presents material not covered in the other. The filmstrip, designed for use independently of the motion picture, stresses techniques, choice and placement in standard dimensioning practice, and explains the meaning of various dimensioning signs. The motion picture, approximately 20 minutes long, introduces and describes principles which govern the choice of dimensions.

Five Reasons Why—

These films should be valuable aids to effective learning in ENGINEERING DRAWING

1. Demonstration of theories is accomplished by a unique combination of animated diagrams and animated photography of specially prepared models that provide remarkable three-dimensional effects.
2. Images of projected shapes and objects actually move through space and assume their proper inter-relationships in synchronization with a carefully developed and professionally narrated explanation of the principles involved.
3. The inherent expository capacities of the film medium are fully exploited so as to provide the instructor with a powerful means for stimulating the student's interest in the subject.
4. The films offer the advantages of varied repetition of subject matter. The motion pictures explain theories and then demonstrate practical applications of theory; the filmstrips stimulate review discussions of both theory and application by the members of the class.
5. Scope of the films has been directed at those phases of the subject of Engineering Drawing most difficult for the average student to understand, as determined from a survey among instructors.

TEXT-FILMS ALSO AVAILABLE ON MECHANICAL DRAWING

A separate series of McGraw-Hill Text-Films, consisting of 7 sound motion pictures and 6 coordinated silent filmstrips, is also being produced on Mechanical Drawing. This series, correlated with French and Svensen's MECHANICAL DRAWING, is designed for high school drafting classes. Film titles in this series are:

1. Introduction to Mechanical Drawing
2. Shape Description—Part I
3. Shape Description—Part II
4. Auxiliary Views
5. Sections
6. Drawings and the Shop
7. Size Description

McGraw-Hill Text-Films will be available through outright purchase of prints from:

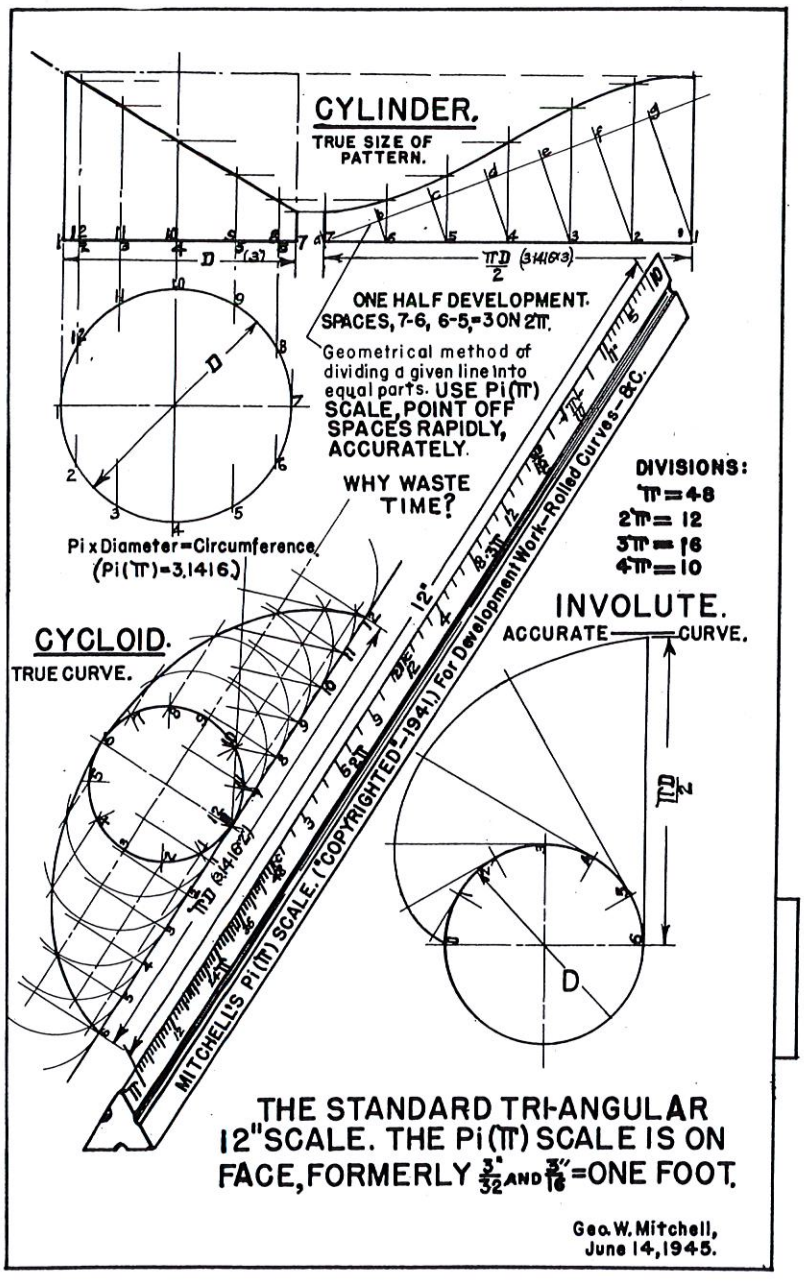
THE McGRAW-HILL BOOK COMPANY, Inc.

330 West 42nd Street New York 18, N. Y.

THE PI SCALE

by

George W. Mitchell
Hotel Holley
New York, N.Y.



Drafting students have long been accustomed to following the old-fashioned method approximation in laying out the rolled curves (the involute, cycloid) and development work, a method which should be discontinued. The following illustrations show some of the examples given in schools where Architectural and Mechanical Drawing is taught.

The student is told to divide the circumference into an equal number of parts, (12 or 16 for a 2 inch circle). Take the dividers with the chord of one of these small arcs. Step this length on the base line as many times as there are divisions on the circumference. This is an approximate length of the circumference since the chord is less than the arc. This error multiplied by 12 or 16 is considerable.

Another method given in some text books on drawing is to compute the circumference by the formula $\pi D = C$ (3.1416 x Diameter = circumference) and divide this length by the geometrical method as illustrated, but this takes time.

With the Pi Scale the true length of circumference is laid off without computation and the subdivisions are also taken directly from the scale.

With the use of this scale true curves are drawn as well as exact patterns in development.

The twelve (12) inch triangular scale is universally used in all school drafting courses. There is no change in shape, size, or length of the present standard scale.

The Pi scale is substituted for the 3/32-3/16 = 1 ft. found on one edge or face. This scale is seldom if ever used, not being adapted to school work. π(Pi) is divided into 48 equal parts, 48 being a multiple of (2,4,6,8,12,16,24) so that the circumference can be divided into any number of these equal parts and the true length of the arcs marked off directly from the scale: 2π into 16 equal parts, 3π into 12 parts, $4\frac{1}{2}\pi$ into 5 (or 4π into 10). This leaves a remainder of more than one inch.

The one inch is divided into 10 equal parts. Thus a tenth (decimal) scale is added which is often used in modern drafting, avoiding procurement of an extra scale.

The Pi scale is a "copyright" design. The full scale or parts thereof may not be reproduced in any form without permission of the author to whom the copyright was issued.

DESCRIPTIVE GEOMETRY

By John T. Rule and Earle F. Watts, Massachusetts Institute of Technology

A new text that describes the methods of solving engineering problems by graphical means.

Note these outstanding features:

- Emphasis on the solution of problems.
- Inclusion of the properties of plane figures as a proper part of a textbook on graphical methods.
- Chapter on stereoscopic drawing. No other published work exists on this subject except articles in professional journals.
- Excellent organization and development of material.
- Solution of a few fundamental problems stressed.

The authors do not believe in limiting the teaching of Descriptive Geometry to one method of attack as is done when either the "direct" or "Mongean" method is presented alone. They DO believe that all methods are a part of the subject; consequently this study points out the various possibilities of attack on the basic group of problems underlying the subject.

This work is for use as a basic text in Descriptive Geometry, Engineering Drawing, or Graphics courses.

College List, $3.00

FUNDAMENTALS OF ENGINEERING DRAWING *Revised*

By Warren J. Luzadder, Purdue University

After several years of outstanding classroom success this popular text has been revised and newly illustrated. Improvements include:

- Newly illustrated chapters showing the clearest possible picture of each operation.
- Material expanded in chapters on Dimensioning, Screw Threads and Fasteners, and Freehand Drafting.
- Many new problems added, improved organization of material, and new tables and bibliographies.

College List, $3.75

Send for your approval copies

PRENTICE-HALL, INC. 70 FIFTH AVENUE, NEW YORK 11

(Continued from page 11)

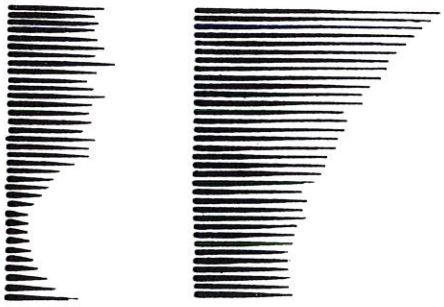


Fig. 3. Plane surface line shading.

applied last, because otherwise, even if dried, they would tend to run the wet shading lines which is one of the peculiarities of India ink.

As indicated in a detail on Fig. 2, shading No. 5 can also be drawn with a compass having the same radius as the ellipse. As the compass must be re-located for each shading line, the spacing may not be maintained uniform. This method is, however, useful and satisfactory on short runs, such as the circumferential surface of a pipe flange.

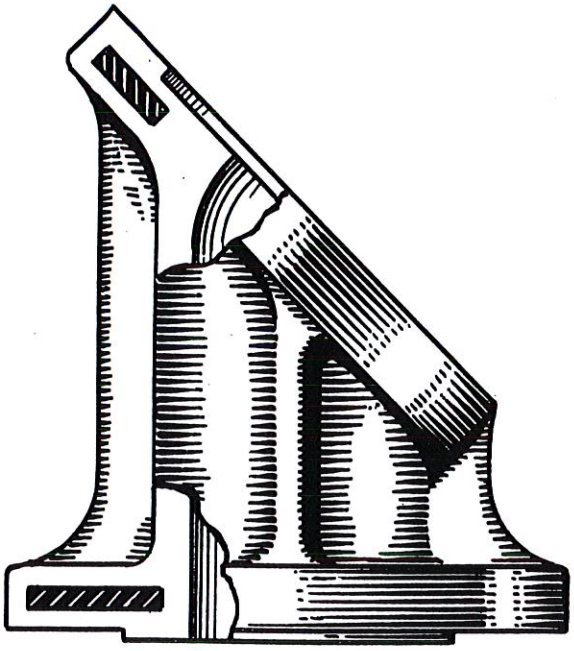


Fig. 5. Full size reproduction of line shading of an orthographic drawing.

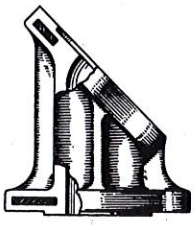


Fig. 5a. Two-thirds reduction of Fig. 5.

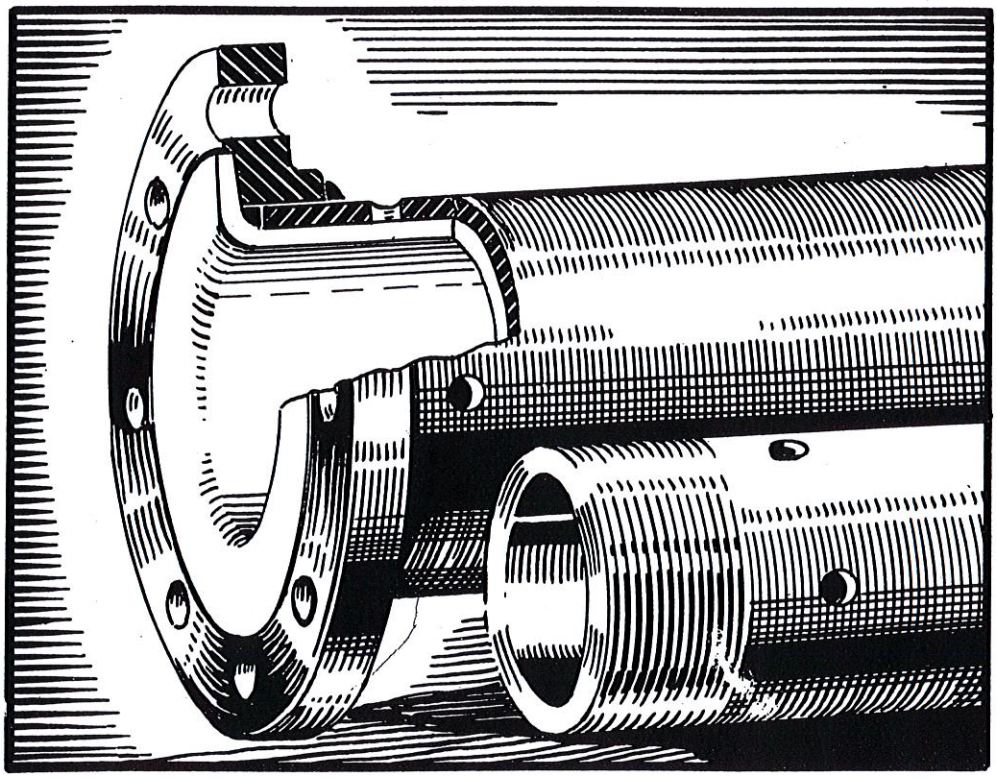


Fig. 4. Full size reproduction of an original.

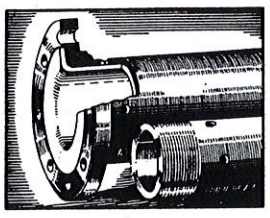


Fig. 4a. Three-fourths reduction of Fig. 4.

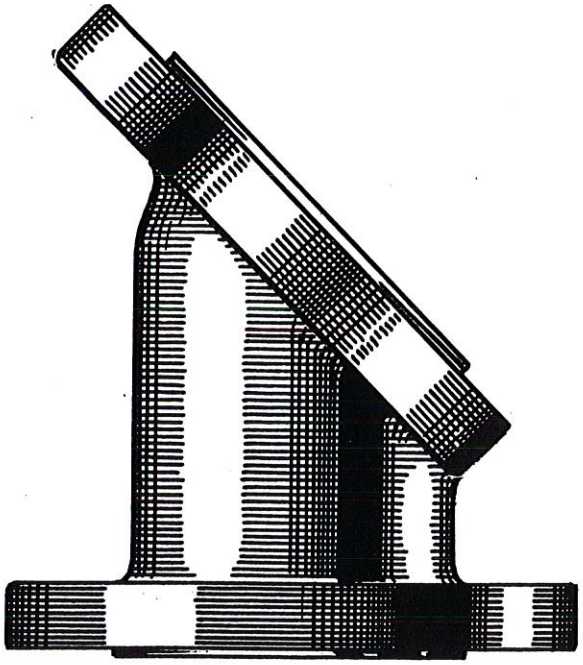


Fig. 6. Full size reproduction of a line shading on an orthographic view.

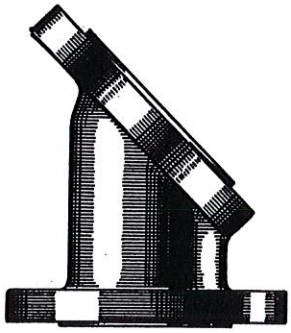


Fig. 6a. One-half reduction of Fig. 6.

It will be noted that the shaft shown in Fig. 2 has two highlights. The cue for this is gained from modern photography. In previous years, a cylindrical surface was considered to have one highlight and two shadows. The industrial photographer, if he desires to emphasize a simple object, places two floodlights in opposite positions and thereby obtains two or more highlights with various intermittent tone values. There is no reason why the same modern effect cannot be applied to line shaded drawings. A study of unretouched industrial photographs made by a competent photographer can be highly recommended in this connection.

Line shaded drawings for reproductions should be made about 2-1/2 times the size of the final print. Shading lines are then conveniently spaced at about 20 to 25 lines per inch.

An interesting shading, although only practical for straight lines, can be effected with regular drawing pen. This is shown in Fig. 3. A short but flexible drawing pen should be used. The T-square blade is tipped upward with the index finger of the left hand, while the pen is passed along it. First, pressure is applied which is relieved as the pen passed from left to right.

To draw a line shaded illustration in the manner described here is not an arduous task. Once the sureness of handling has been acquired, after some practice, a moderate sizé drawing can be planned and completed in as little time as 3 hours. Those who wish to pursue this technique further, let us say as art for art's sake, will gain much benefit and inspiration from the study of the work of 19th century engravers.

Prints by such masters as Cousen, Roffe, Heath, Bourne, Sharpe and Sonnenleiter that were once the pride of collectors, can now be found in Print and Book Shops, where they are sold at a moderate cost. In the technique of line rendering of various surfaces and substances, they are a veritable mine of information.

It may sound paradoxial to look at past centuries for guidance on modern techniques, yet much remains in the field of true art, which we must admit represents a pinnacle of achievement nor surpassed to date. In examining examples of craftsmanship, as evidenced by old engravings, it must be remembered that these men worked with tools extremely difficult of manipulation, compared to the equipment of the modern pen and ink artist. Then, everything depended on the human element, and a single error in employment of engravers' tools might ruin the result of long and arduous toil.

The craftsmen engraved each line in the actual size in which it was to be printed, and a typical engraving of the period easily contained fifty thousand separate lines, Nor, could the craftsmen rely on photo mechanical processes to reduce the original drawing. A slip of the tool, or a mistake in technique, could not be conveniently hidden.

In the belief of the author, it should be the constant endeavor of our present students of line drawing techniques to achieve the same patient mastery of detail perfected in the engravers' Guilds. Our student of today is not under comparable handicaps, either in the equipment at his disposal, nor in the necessity to carry out drawings to such a degree. Yet, when the work entrusted to him is viewed with the attitude referred to, and after the development of a reasonable skill in lihe shadings, as described herein, his work on completion will bear the stamp of excellence which is the goal of every true artist.

* The lined shaded drawings used to illustrate this article were supplied through the courtesy of the American Smelting and Refining Company, New York City.

GUIDE LINES FOR DIMENSIONING

by

Professor Francis C. Bragg
Georgia School of Technology

The subject "Guide Lines for Dimensioning" has been rather scantily covered, especially in the older textbooks. Several of the textbooks that touch on the subject, scarcely, do more than recommend their use. Some of the older texts recommend a size ratio of three to five for whole numbers and fractions. One of the more recent publications recommends a one to two ratio and guide holes in the Braddock Angle as follows:

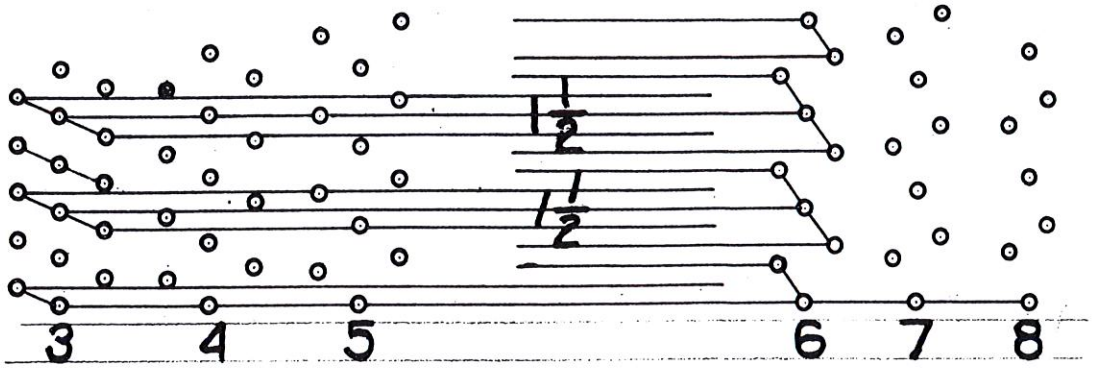
1. In the #3 letters - the 1st, 2nd, 3rd, 4th and 6th holes numbering from the lowest hole.
2. In the #4 letters the 3rd hole. (This is the middle hole and should be placed on the dimension line.)
3. In the #6 letters, the 3rd hole.

The above schedule for guide lines is also included in one of the books which shows whole numbers and fractions with a three to five ratio in the text. This arrangement of guide lines is the best that has been published to date, but more guide lines are given than are necessary; only one set of guide lines can be drawn at a time.

In connection with the Braddock angle, the following system can be used effectively at considerable saving of time over any other published method.

First, space all dimension lines 5/16 of an inch apart and the same distance from the outline of the object to be dimensioned. This can best be done by setting the Braddock angle with the lower holes in the several sizes of letters in line with the outline of this object, then using the middle holes in the #6 letter to locate the several dimension lines desired. Next, use the two outer rows of holes in the #6 letters to draw the top and bottom guides for each dimension line as needed. Finally, it will be noted that there is a middle hole in the #3 letters which corresponds with each middle hole in the #6 letters. With the outer holes in the #3 letters, next to the above mentioned middle holes, draw guide lines for the top and bottom of the whole numbers. This will give two or more complete sets of guide lines and at least three dimension line locations at one setting.

The accompanying figure illustrates the general set-up. A series of lines with 1/16 inch spacing results from the use of the designated holes. This indicates the possibility of other uses for the set of guide lines as shown above, as well as demonstrating that any means of producing lines with 1/16 inch spacing will give satisfactory guide lines for dimensioning.



• • • CALLING ATTENTION TO *the imminent publication of*

ENGINEERING DRAWING PROBLEMS

By Eliot F. Tozer, Northeastern University

and Eugene G. Paré, Massachusetts Institute of Technology

This set of problems was designed as a lecture-laboratory course for engineering college freshmen with no previous experience. The course leads to advance work that utilizes visualization — particularly to courses which require engineering drawing such as Machine Drawing, Machine Design, and Structural Drafting. The book provides ample material for the thorough training of the student in the fundamentals usually included in engineering drawing courses. Since nearly all the problems were prepared from interesting practical applications, they are essentially self-motivating. The material is designed to do more than train the student to make carefully executed drawings; rather it is designed additionally to develop the student's sense of space.

CONTENTS: Use of Equipment; Technique Practice; Capital and Lower Case Lettering; Applied Geometry; Conic Curves (by definition methods); Technical Sketching; Visualization (missing view problems — freehand); Visualization (missing view and completion type problems — mechanical); Primary Auxiliary Views; Secondary Auxiliary Views; Sectioning; Tracing; Isometric Drawing; Oblique Drawing; Perspective Drawing; Helix and Thread Conventions; Fasteners; Dimensioning; Simple Assembly Drawing; Details from Assembly; Intersections; Development (sheet metal); Introduction to Nomography; Graphical Solutions of Engineering Problems. In many cases the work titled above is spread over a number of lessons.

SOME OUTSTANDING FEATURES ARE:

- The problem statements are brief.
- It may be used with any standard textbook.
- The problems are of a practical nature.
- It contains large sized sheets that closely approximate commercial practice.
- The fundamentals of the graphic language are covered in accordance with the latest American Standards.
- The incorporation of pertinent sections of latest American Standards.
- Blank sheets provide space for extra problems the instructor may wish to assign.

Send for an examination copy of:

ENGINEERING DRAWING PROBLEMS

168 Pages | 11 x 17 | Paper | Illustrated | Probable Price $3.25

D. VAN NOSTRAND COMPANY, Inc.

250 FOURTH AVENUE NEW YORK 3, N. Y.

THE WALRUS AND THE CARPENTER

A recent news release from the University of Detroit announces the appointment of Jasper Gerardi, associate professor of engineering drawing, as acting dean in the College of Engineering. Professor Gerardi received his bachelor of civil engineering degree at the University of Detroit in 1929 and his master of science degree from the University of Michigan in 1935.

Other items of interest that seem to assure us that the Gerardi coatails are more or less continuously popping behind him are:

1. The University of Detroit College of Engineering has enrolled 2200 students.
2. Professor Gerardi is responsible for the administrative work connected with 1400 freshman and sophomore students and about 60 faculty members. In addition to which -- 3. he is teaching as well as directing the activities of the Drawing Department.
4. The Gerardi's have a new baby boy as of March 16, 1947.
5. The current article entitled "Teaching Tolerances" is one of a series of three of which the other two will appear in early issues of the Journal.

* * *

A recent release from Harding College at Searcy, Arkansas announces the awarding of an honorary Doctor of Laws degree to Professor W. E. Street of Texas A. and M. This degree was awarded in recognition of his outstanding work in Engineering Drawing.

Professor Street, who is head of Engineering Drawing at Texas A. and M. received his B.Sc. degree from Texas Technological College in 1930 and his Master of Science Degree in 1933. Author and Co-Author of six text books now in use in American Colleges and Universities, Dr. Street gained special recognition for his work supervising war training drafting work in 30 Texas towns during the four years of World War II.

This note is especially appropriate here because he was the editor of the Journal of Engineering Drawing from 1944 to 1946.

* * *

Of the three "play problems" that are shown in this issue--for your amusement, and edification two were submitted by Professor H. E. Grant of Washington University, and the third was submitted by Elden Mathauser Instructor in Engineering Drawing University of Nebraska. We wish you luck in solving them!

* * *

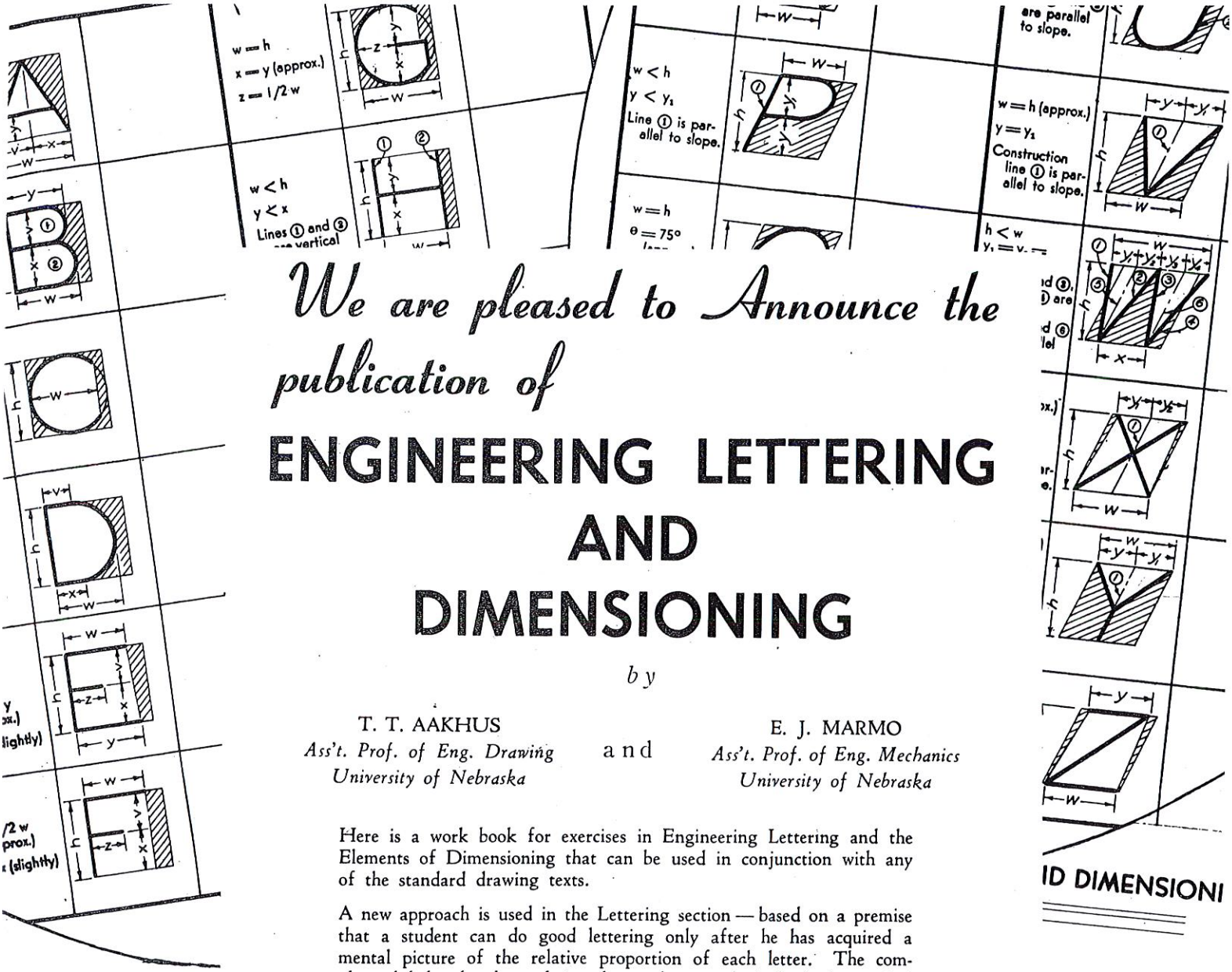
The lack of contributions for this issue of the question mark page is explained by the fact that the first notice of that page came out so shortly before the publication date of the current issue. It is noped that material will be submitted for this page in the next issue.

* * *

Professor Henry formerly of the Illinois Institute of Technology has transferred his activities to the Mechanical Engineering Department of the Louisiana Polytechnic Institute, where he is in charge of Engineering Drawing and Descriptive Geometry.

* * *

Announcement has been made of a new film series that is to be placed on the market in the spring of 1948. This specially prepared film series is designed to augment and to correlate with French's Engineering Drawing. The announcement is noteworthy in that it marks the entry of McGraw Hill, a text book company into the Text-Film field.



We are pleased to Announce the publication of

ENGINEERING LETTERING AND DIMENSIONING

by

T. T. AAKHUS
Ass't. Prof. of Eng. Drawing
University of Nebraska

and

E. J. MARMO
Ass't. Prof. of Eng. Mechanics
University of Nebraska

Here is a work book for exercises in Engineering Lettering and the Elements of Dimensioning that can be used in conjunction with any of the standard drawing texts.

A new approach is used in the Lettering section — based on a premise that a student can do good lettering only after he has acquired a mental picture of the relative proportion of each letter. The complete alphabet has been designed to a large scale in both the vertical and sloped style.

The Dimensioning section is presented in a progressive manner by a series of exercises covering plane areas and simple solids, followed by nomenclature and notations relative to shape operations and processes.

This book contains 22 leaves printed on high quality ledger paper. All sheets are removable so that students can do their work on drawing boards.

Price 75c per copy

We will gladly send an examination copy upon request.

WM. C. BROWN COMPANY *Publishers* DUBUQUE, IOWA

CAN SPEED BE TAUGHT?

by

E. Bruce Meier
Instructor of Engineering Drawing
University of Nebraska

Any duty or responsibility can usually be sub-divided into component parts. As the requirements of each part are satisfied, so the responsibility is discharged. If any portion of a duty is poorly done, the overall effectiveness of one's efforts is necessarily tempered. Complete satisfaction comes only when all phases of a job have been well done. This is true of all tasks, including the teaching of engineering drawing.

The responsibility, then, of teaching engineering drawing can be sub-divided into its component parts, analyzed and put back together. An effort will be made to do just this and as the parts are examined, to inject several suggestions for your consideration.

The teaching of engineering drawing might be divided into four sub-divisions or components. Namely,

1. Course content
2. Lines and lettering
3. Technique
4. Speed

The first category, course content, would include the fundamentals of engineering drawing such as visualization, orthographic projection, what a counterbore looks like on paper, nomenclature, etc. This component of teaching engineering drawing is handled quite satisfactorily by most institutions and can be given the classification of "well done".

The second component, lines and lettering, includes, of course, the alphabet of lines for both pencil and ink work and the standard engineering alphabet of letter forms. This is standard procedure and probably well done by the accredited schools.

The third component of teaching engineering drawing, technique, would include techniques of accuracy and methods of improving the appearance and readability of a drawing, which could be further discussed along the lines of arrangement of views, general notes, etc. Techniques vary in point depending upon the place of employment or the institution of learning. The overall accomplishment, however, can also be given the classification of well done.

The fourth factor, teaching speed, is the component of teaching engineering drawing with which this paper is principally concerned. Are we teaching speed? If we are not, then is it possible to teach speed? Also, if we are not teaching speed does this partial failure in our responsibility temper the effectiveness of our overall programs?

Let us take stock, for a moment, of just how indirectly this problem is being approached. Some institutions are sacrificing the very important factor of neatness and excellence of appearance in the interest of speed. This procedure is being sponsored and originated within some departments of engineering drawing. Do we not have enough difficulty in promoting neatness and good draftsmanship among our embryo engineers? This vital asset must be injected at the freshman level with sufficient vigor to weather the minimizing of its importance by some of our colleagues in the more advanced phases of engineering curricula. Sponsorship of poor quality in any product is, at best, an emergency measure. It appears that this method of promoting speed leaves much, too much to be desired.

The general method of attempting to cause the student to draw more rapidly is the establishment of deadlines or due dates for drawings. Failure on the part of the student to comply with the prescribed time limit results in mark downs or other penalties. It is not to be denied that the time table arrangement is necessary and vital to the efficient operation of any organization. Due dates cannot be dispensed with. The point is, however, that meeting deadlines does not help the student to draw faster, but in many cases causes him to spend a considerable amount of extra time on his drawings outside of the class room. In effect, he is operating in a "do-this-or-else" atmosphere. Would it be safe to say that his efforts would increase many-fold if he knew that we were teaching him to draw faster in a logical direct manner instead of attempting to force him to do so? That is to say, make the student feel that we are helping him to meet a deadline instead of daring him to meet it.

The student is taught lettering by first exposing him to sample letters of good form. The characteristics of proportion and construction are pointed out to him. Then, he is assigned several classroom hours to practice and develop, under direct supervision, his techniques and skills in the art of lettering. In these periods he has his mind on lettering. He is very much aware of the fact that he is being taught how to letter. He soon learns to know his own weaknesses and is able to criticize his own procedure with accuracy. After the initial discussion and supervision by the instructor, the student rapidly becomes his own teacher because the process has reduced to a "practice-then-criticize" procedure for him.

In other words, we teach lettering by devoting several laboratory hours with a lecture to lettering alone. Could not this be done in the matter of teaching speed in engineering drawing? Let us consider, then, how this might be done.

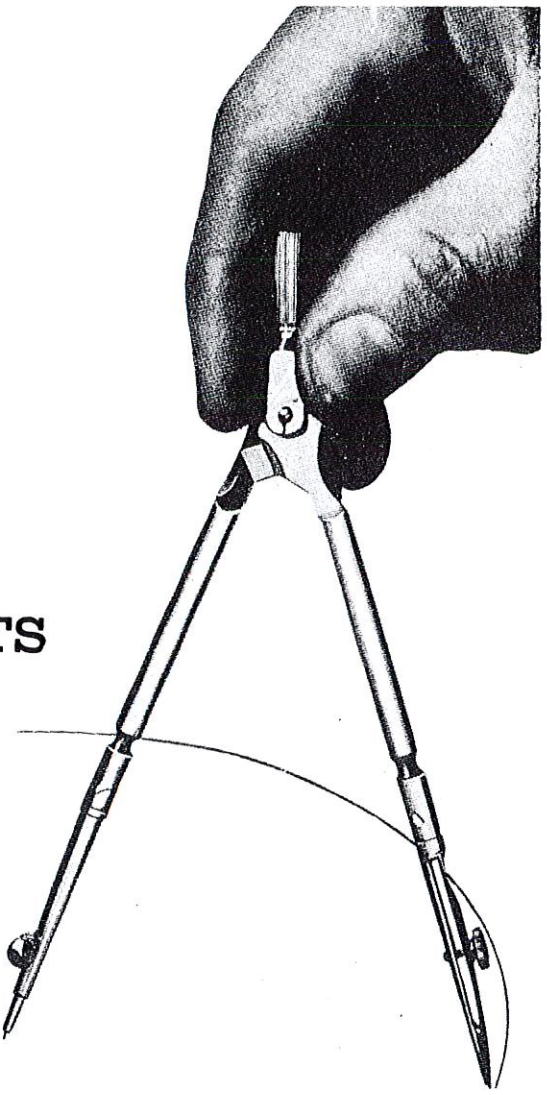
Immediately, it is conceded that an individual can draw no more rapidly than he can proceed mentally.

(Continued on page 30)

Quality....

WEBER

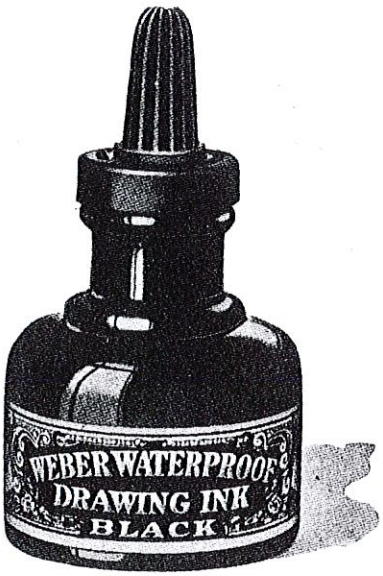
DRAWING MATERIALS



DRAWING INSTRUMENTS
IN SETS

DRAWING AND
TRACING PAPERS

WATERPROOF
DRAWING INKS



STUDIO, SCHOOL AND
DRAFTING ROOM FURNITURE

Catalogue, Vol. 700, on Request

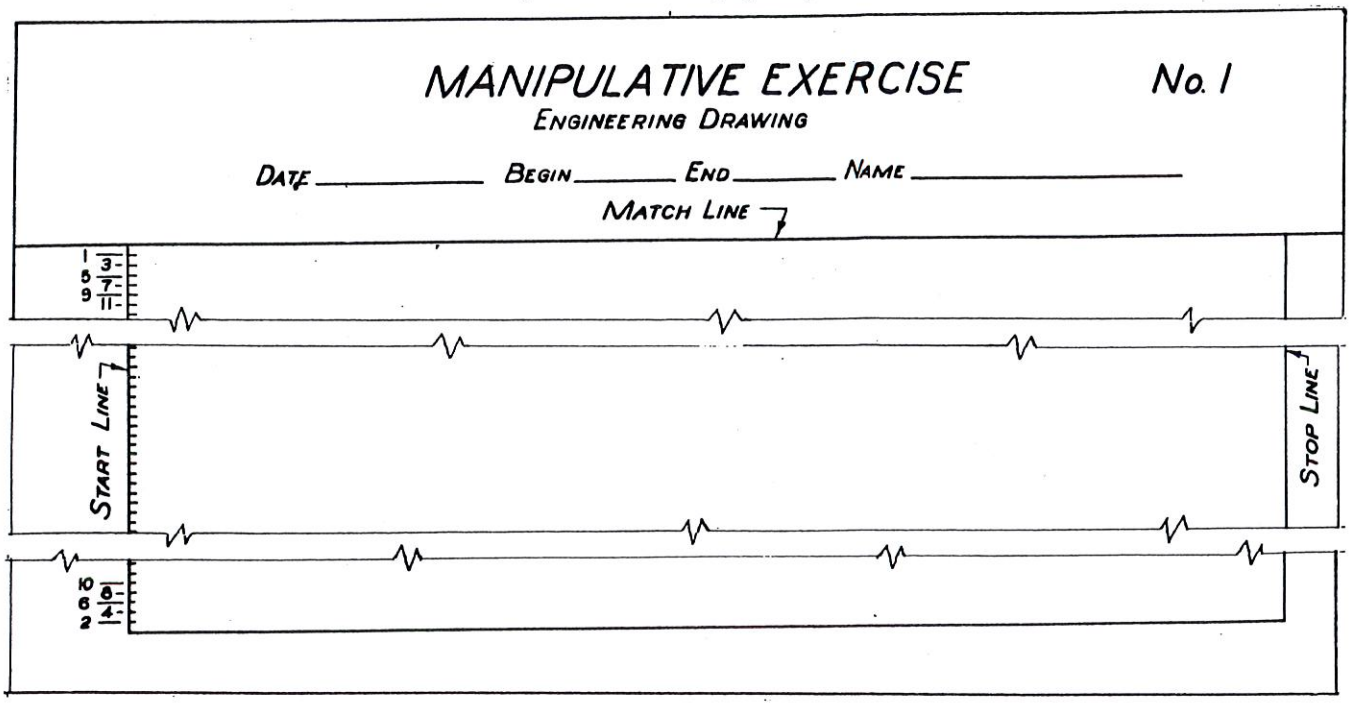
F. WEBER CO.

FACTORY ADDRESS:
1220 BUTTONWOOD STREET
PHILADELPHIA, PA.

Branches:

705 PINE ST., ST. LOUIS, MO.
227 PARK AVE., BALTIMORE, MD.

(Continued from page 28)

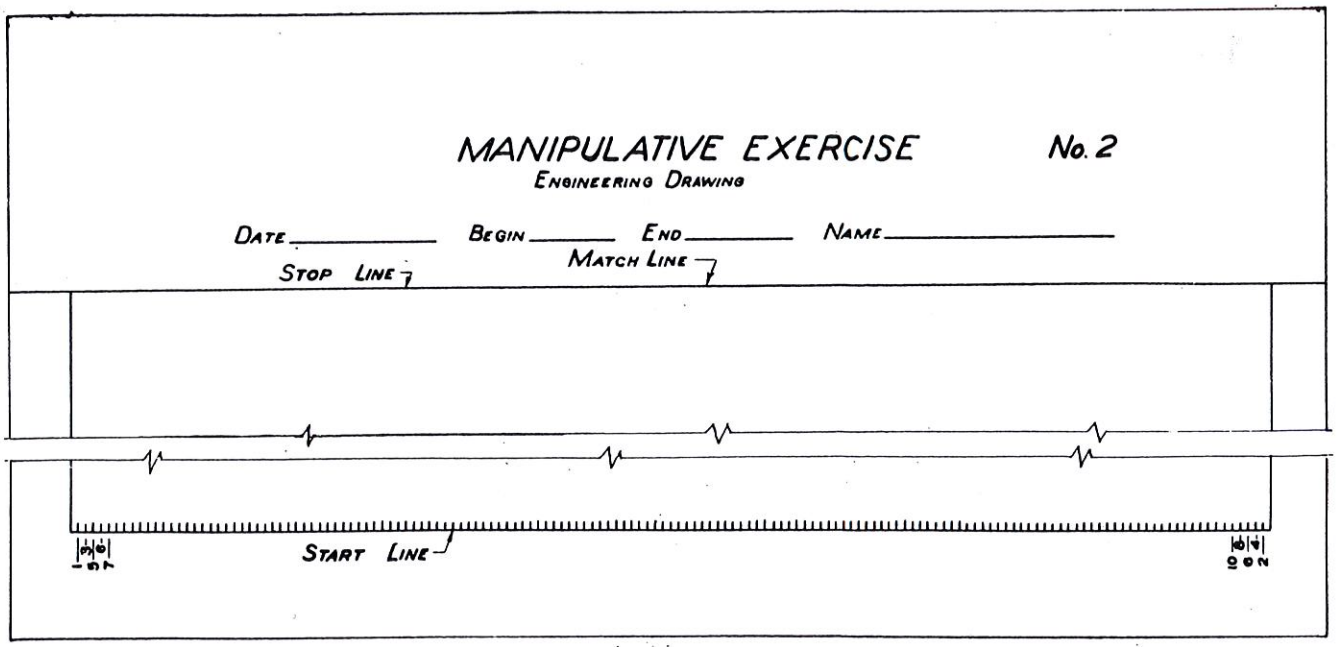


His powers of visualization, ability to solve problems, experience, etc. are all contributing factors. In the final analysis, however, manipulative ability in the matter of handling one's drawing instruments is one of the most important factors in drawing rapidly. Fortunately, this aspect is most easily separated from the rest and much can be done to improve a student's manipulative ability.

There is a corresponding factor in teaching piano pupils. It is recognized that practicing the scales is of fundamental importance in the development of finger usage not only to the beginner, but to pianists of all degrees of accomplishment. Whether one's immediate degree of accomplishment permits him to play only the simplest compositions or the most difficult contributions of the masters, his advancement is limited by his performance of the scales.

Practicing scales is to the pianist as practicing manipulative exercises is to the draftsman. If the draftsman can't draw rapidly, he must think very rapidly in order to meet the competition of his colleagues. Very rapid thinkers are in the minority and for this reason, the teaching of speed can effect

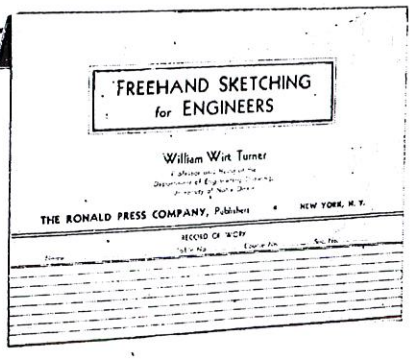
(Continued on page 32)



The Two New Texts by William Wirt Turner

Professor and Head of the Department of Engineering Drawing, University of Notre Dame.

FREEHAND SKETCHING FOR ENGINEERS



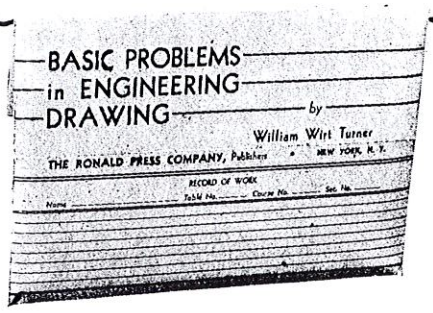
THIS course has been developed to meet the urgent need for improvement in the sketching ability of students and engineers. The material is deftly organized to show how to analyze problems, select the proper views to present the object clearly and completely, relate these views to one another, and annotate and dimension them correctly. Also teaches the theory underlying drawing and trains in the reading of drawings.

Methods and work sheets have been carefully tested in university classes. Work may be done with instruments if the aim is to learn to make and read drawings rather than to learn to sketch. Based on new American Standard practices.

97 sheets, 8½ x 11. 55 sheets of problem layouts and illustrations, and 9 sheets of practice paper. Packaged in envelope. Teacher's Manual available. **$2.50**

Revised Edition

BASIC PROBLEMS IN ENGINEERING DRAWING



THIS revision is an outgrowth of the shorter series of work sheets developed and used with such success during the war period. The material in this new series can be used with any text on engineering drawing. It is based on third angle projection and is in keeping with the prevalent trend of coordinating engineering drawing and descriptive geometry courses. Includes work commonly taught in freshman year.

An outstanding job of organization characterizes the make-up of this series. Material is presented systematically in graduated steps and considerable care has been taken to eliminate purely repetitious types of practice. Based on new American Standard practices.

102 sheets. 8½ x 11. 74 sheets of problem layouts and illustrations. 7 sheets each of practice and tracing paper. Packaged in envelope. Teachers Manual available. **$2.50**

Other Texts by Professor Turner -

SIMPLIFIED PERSPECTIVE

This sound textbook on the theory and practice of perspective drawing is prepared to meet the working needs of architectural and engineering classes, and of practitioners. The treatment equips the user to make architectural, mechanical, and production drawings such as the exploded views which are finding increasing use in manufacturing.

The subject is developed in simple, clear cut, graduated steps. Develops a clear understanding of the reason for each step followed in the practical preparation of the drawings.

(in preparation)

BASIC PROBLEMS IN DESCRIPTIVE GEOMETRY

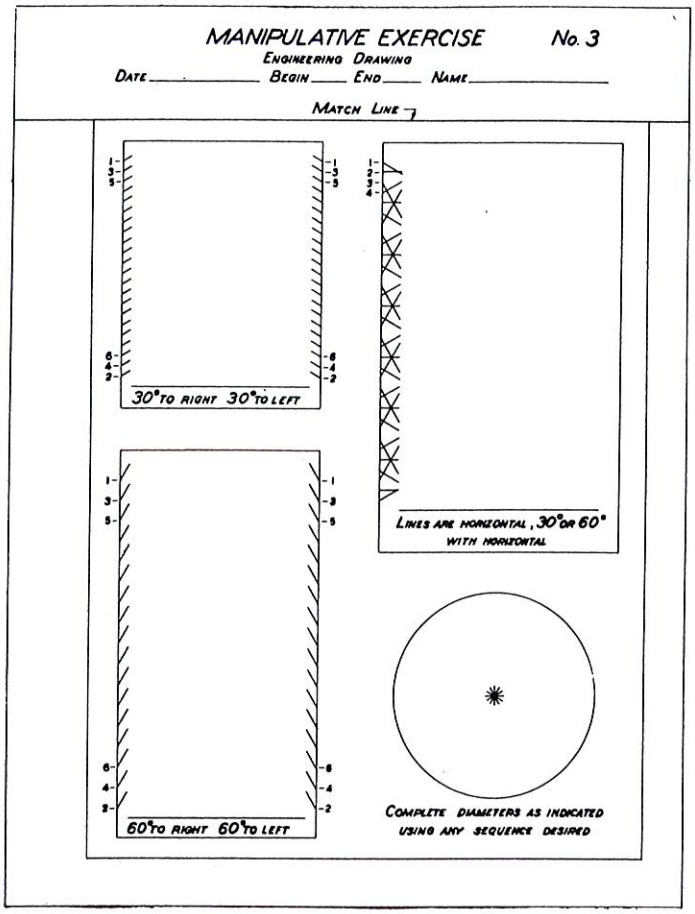
(written in collaboration with CARSON P. BUCK*)*

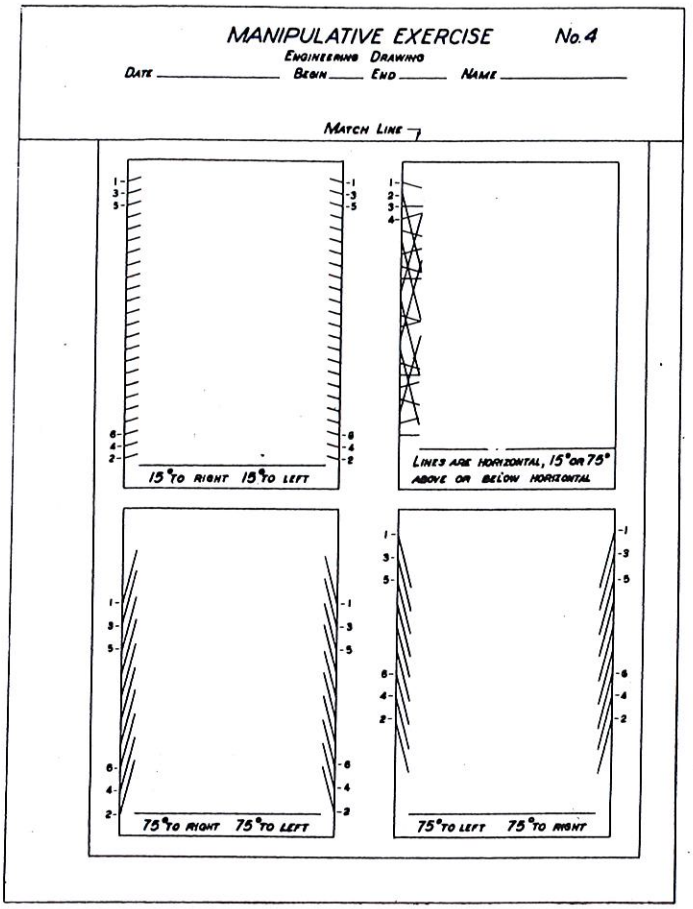
This successful series of work sheets is based on third angle projection. It is composed of carefully chosen practical problems which have proved their worth through classroom use by students of varying abilities and previous preparation; also it has been used in special classes of engineers and of draftsmen from industry. The series is general in character and is prepared for use with any standard text in descriptive geometry which employs the direct or auxiliary plane method.

75 sheets, 8½ x 11. 60 sheets of problem layouts, 8 sheets of practice paper. Packaged in envelope. Teacher's Manual available. **$2.00**

THE RONALD PRESS COMPANY, 15 East 26th Street, New York 10, N. Y.

(Continued from page 30)





its most far-reaching assistance to the student by being approached in the classroom from the standpoint of manipulative dexterity.

The following figures are presented as tentative completion-type manipulative exercises to be used experimentally in engineering drawing at the University of Nebraska. They will be used somewhat as described below.

It is proposed that a short resume of suggestions contributing to greater speed in drawing be issued to each student at the beginning of the semester. This pamphlet would include suggestions as to arrangement of equipment on the desk top, such as location of drawing instruments, pencils, erasers, triangles, etc. with emphasis on developing orderliness as a habit. Fumbling for a pencil that is never to be found in the same place can waste minutes. When these minutes are added to those wasted in searching out an eraser, compass, etc., the accumulative effect is noticeable.

"All motions not involving accuracy or appearance can be done rapidly." This is a helpful statement to beginning students. Little skill is required to turn a pencil sharpener quickly or to erase a pencil line. Little skill is necessary to wipe a pen rapidly or to draw guide lines for lettering.

These are just a few of the suggestions which will be included in the pamphlet of helpful hints.

The individual exercises will be graded on a time basis except that a minimum standard of line quality must be met. The exercises are designed for an average completion time of ten minutes. The student will write the date and his name in the spaces provided and will write in the "begin" time as announced by the instructor. It is expected that there will be at least a six minute spread in performance time by the class and thus the instructor will write the "end" time on each plate as it is handed in, using minutes and some convenient subdivision thereof. The first six exercises will be done in pencil and the last two in ink.

Exercise No. 1 involves tee-square lines only. The student will align the "match line" with his tee-square and at the signal will begin the exercise. His lines will run across the page from the "start line" to the "stop line" and the first line is at the top marked number "1". The second line is across the bottom of the page marked number "2"; the third back at the top, etc. Practice will thus be obtained in moving the tee-square rapidly from top to bottom of the page.

Exercise No. 2 involves the use of the tee-square and one triangle in the making of vertical lines with alternation from the left side to the right side as numbered for the first ten lines.

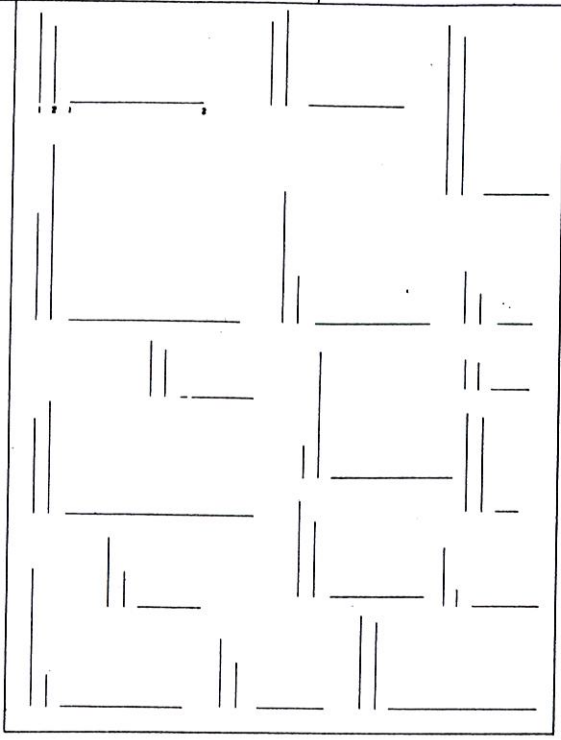
Exercise No. 3 involves the use of the 30° - 60° triangle and the tee-square in the making of 30 and 60

MANIPULATIVE EXERCISE No. 5

ENGINEERING DRAWING

DATE _____ BEGIN _____ END _____ NAME _____

MATCH LINE

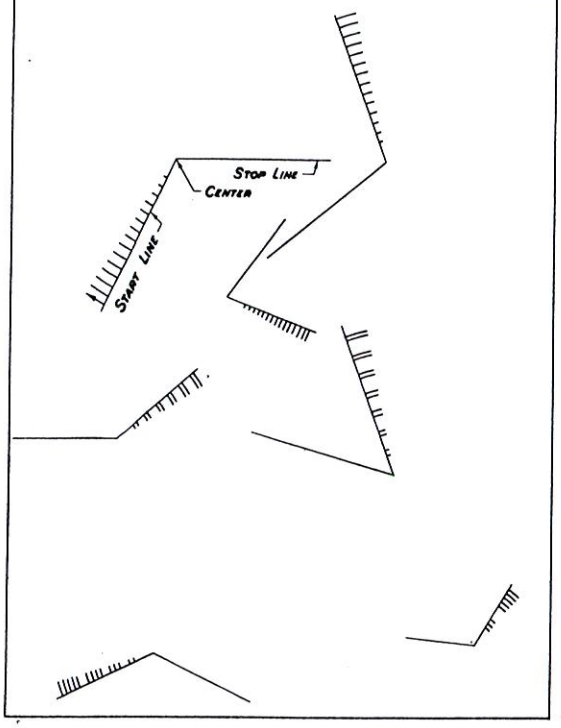


MANIPULATIVE EXERCISE No. 6

ENGINEERING DRAWING

DATE _____ BEGIN _____ END _____ NAME _____

MATCH LINE



MANIPULATIVE EXERCISE No. 7

ENGINEERING DRAWING

DATE _____ BEGIN _____ END _____ NAME _____

MATCH LINE

TO BE INKED

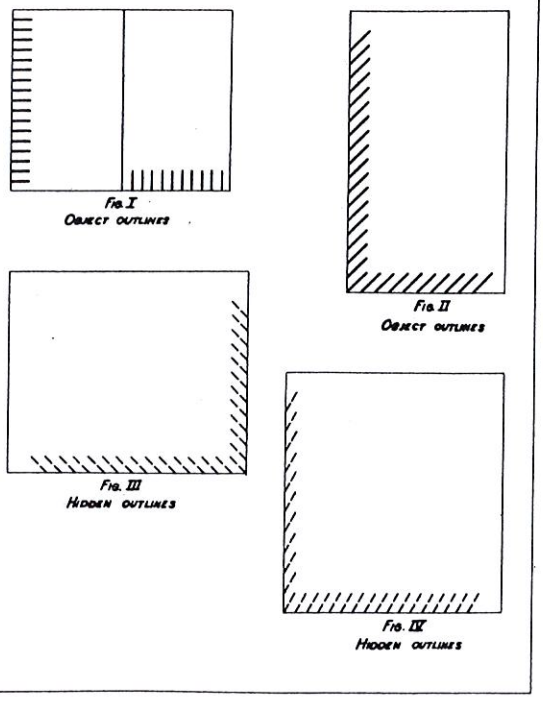


FIG. I
OBJECT OUTLINES

FIG. II
OBJECT OUTLINES

FIG. III
HIDDEN OUTLINES

FIG. IV
HIDDEN OUTLINES

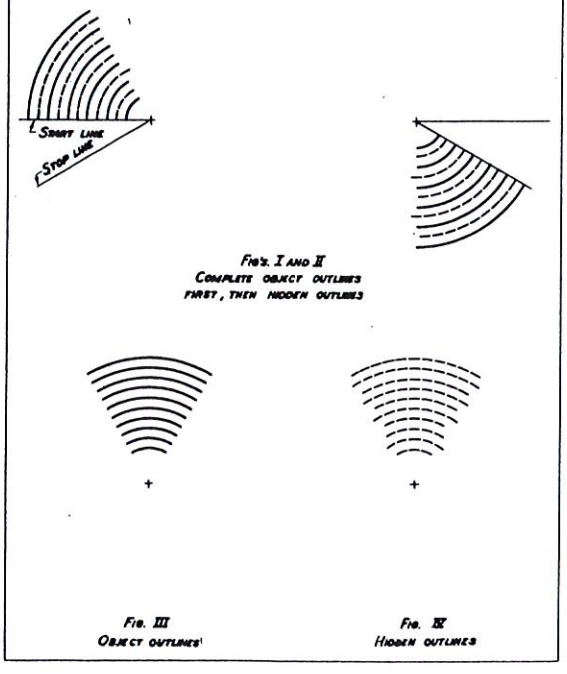
MANIPULATIVE EXERCISE No. 8

ENGINEERING DRAWING

DATE _____ BEGIN _____ END _____ NAME _____

MATCH LINE

TO BE INKED



FIG'S. I AND II
COMPLETE OBJECT OUTLINES
FIRST, THEN HIDDEN OUTLINES

FIG. III
OBJECT OUTLINES

FIG. IV
HIDDEN OUTLINES

degree lines to the left and right and with two general exercises involving these and a few tee-square and vertical lines.

Exercise No. 4 adds the 45° triangle in combination with the 30° - 60° and the tee-square in the execution of 15 and 75 degree lines in the various directions.

Exercise No. 5 uses the compass and a triangle as a random straight-edge in the construction of triangles with three sides given, the construction being based on the tee-square line in each case. The length of the left vertical line is to be used as the upper left side of the triangle and the length of the right vertical line to be used as the length of the upper right side in each triangle. This is indicated by using line number 1 with end number 1 of the horizontal base line, as shown on the first triangle. This exercise and Exercise No. 6 require frequent changing of the compass setting, the portions of each circle in No. 6 being completed from the radii of the given arcs.

Exercise No. 7 uses the ruling pen with the 45° triangle and the tee-square to complete the lines in the weights given; that is, object outline and hidden outline.

Exercise No. 8 uses the pen compass to complete the circles or portions of circles as indicated. Here again only object outline and hidden outline are used.

The pencil excercises all involve the maintenance of pencil and compass lead points in order to make lines of acceptable quality, just as the ink exercises involve the trials and tribulations of inking.

For these exercises to accomplish what is hoped, it is necessary that each student understand completely what is expected of him. He must be able to proceed as rapidly as his hands can carry him without the possibility of delays resulting from doubt as to details of procedure.

It is expected that these exercises will be given during the third and fourth weeks and the sixteenth and seventeenth weeks of the first semester freshman drawing course. Also there will be "spot" use of the test in the advanced drawing sections for purpose of comparison. Prior to the giving of the tests to the first semester students, it will be announced that a semester grade for "speed" will be determined from their performance and that this grade will be averaged into their final grades.

It is hoped that these exercises will prove to be of value in actually assisting the student to draw more rapidly. I have had several students who are excellent draftsmen but who performed so slowly that their value to an employer would be doubtful. They were convinced that they could not draw more rapidly and maintain high quality. Perhaps these exercises and the revisions of them will help overcome this psychological handicap.

In these days when one scarcely has time to think, speed is a vital consideration. Competition will soon be more keen than ever before. In so far as industry is concerned, the drafting room will have to be the starting point of increased efficiency and rapidity of accomplishment to meet this situation. If we are to do all we can for our engineering students, who for the most part will be engineering-draftsmen for some time after graduation, I believe that a concrete effort to teach speed in engineering drawing is worth some time and thought.

Report of

MID WINTER MEETING

Engineering Drawing Division

The midwinter meeting of the Drawing Division of the ASEE was held at the Brooklyn Polytechnic Institute, Brooklyn, New York, on Saturday, February 1 at 10 a.m.

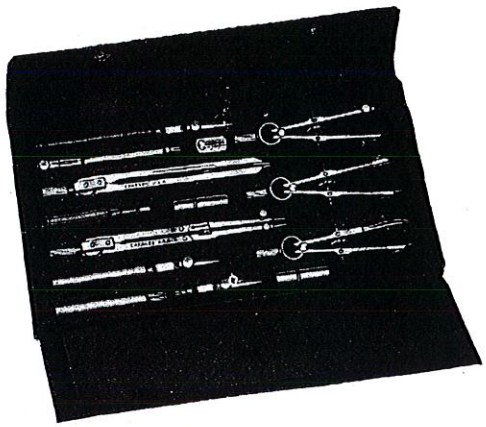
The morning session featured a talk by Dr. Otto Klitgord of the Institute of Applied Arts and Sciences in Brooklyn on the Technical Institute movement, a few words by Professor Ming of the Brooklyn Polytechnic Institute on his work on ESMDT courses and a report by Professor Harry M. McCully of Carnegie Institute of Technology on the work of the Standards Committee. Professor Rule reported on the committees appointed on the recommendation of the St. Louis Summer School. The morning session was followed by a luncheon, at which the entire group were the guests of President Rogers of the Brooklyn Polytechnic Institute.

The afternoon session was featured by a paper by Mr. Steven A. Coons of the Chance Vought Aircraft Corporation on the Application of Graphical Methods to Aircraft Design. This was an unusually interesting paper repeated from the fall meeting of the New England Division of the ASEE. The paper started a lengthy discussion. This was followed by a meeting of the Executive Committee of the Drawing Division.

The attendance was in excess of forty. The chief topic of open discussion was the possibilities of increasing our emphasis on graphical methods and graphical research. It was tentatively decided by the Executive Committee to make this topic the major theme at the Minneapolis meeting.

17

NEW-POST WAR CHARVOZ PRECISION DRAWING SETS



Charvoz No. 877 Drawing Set

SCHOLASTIC SETS To meet the post war needs of students in Technical Schools and Engineering Colleges.

PROFESSIONAL SETS To satisfy the exacting requirements of the Professional Draftsman, the Architect and the Engineer.

EACH SET A nice, appearing, highly polished, well balanced precision built set, attractively designed by Charvoz engineers. Produced at our Charvoz factories under high manufacturing standards and rigid methods of inspection.

EACH INSTRUMENT A sturdy well balanced precision instrument built for accuracy, perfect performance and life long service. Mechanically perfect and expertly constructed to make possible the finest precision work.

ALL SETS Nicely fitted in neat, compact, leatherette cases lined with velveteen. Each set neatly boxed in a new type, attractive, streamlined sturdy carton on which is clearly indicated the sfyle and stock number.

Charvoz-Roos Corporation

101 FIFTH AVENUE **NEW YORK, N. Y.**

INTERNATIONAL TEXTBOOK COMPANY

Scranton 9, Pennsylvania

To Readers of the JOURNAL OF ENGINEERING DRAWING:

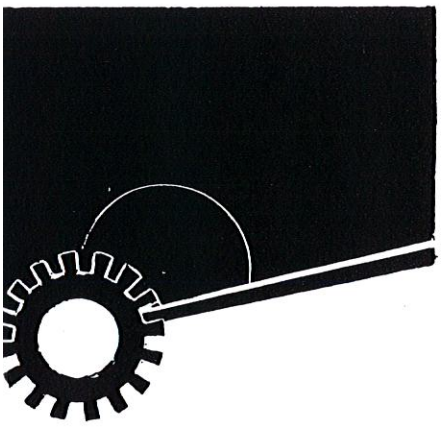
We want you to know more about two of our textbooks which continue in steady adoptions in college courses because they meet specific training preparation requirements for industry today: Maleev's MACHINE DESIGN and Hall and Kiley's PATTERN DESIGN.

An important addition to the recently revised edition of MACHINE DESIGN is data on screws with ball nuts, which are growing rapidly in importance particularly in automobile and aircraft design. The book covers concepts, definitions and fundamentals on which design calculations must be based and fully stresses the value and importance of modern engineering research. Listed at $5.00, it contains 590 pages, 6 x 9, with 460 illustrations.

PATTERN DESIGN, because of consistent demand, has just been released in a new printing. With ample illustrations, this book offers experience in manipulating hand and machine tools, studying and designing patterns and a series of special problems that involve the construction and interpretation of mechanical drawings. Containing 193 pages, $5\frac{1}{4}$ x $8\frac{1}{4}$, and 227 illustrations, this book is listed at $2.50.

We shall be pleased to mail you descriptive literature more fully explaining the merits of these timely works; or let us mail you examination copies on approval. May we hear from you?

Yours sincerely,

Lawrence W. Tice

Lawrence W. Tice, Manager
College Department