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JOURNAL OF ENGINEERING DRAWING

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S P E E

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JOURNAL OF ENGINEERING DRAWING

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VOL. 8, NO. 3 NOVEMBER, 1944 SERIES NO. 24

CONTENTS

FRONTPIECE: Illustrated by a former editor, Professor Fred W. Slantz, Lafayette College, Easton, Pa. Verse after the original by Grace Noll Crowell; any similarity to donkeys or drivers living or dead purely coincidental . . . . Page 3

THE EDITOR'S PAGE: YOUNG PEOPLE RETURN TO SCHOOL, and a message from the new chairman with progressive plans for the Drawing Division . . . . Page 4

TEACHING WELDING SYMBOLS: By Edward J. Dowling, S. J., University of Detroit . . . . Page 7

MINUTES OF MEETING of Committee to formulate National Efficiency Tests in Engineering Drawing, Cincinnati -- June 23, 1944. . . . . Page 13

SYMPOSIUM OF MEETINGS AND RESULTS of the Committee to Formulate National Efficiency Tests in Drawing . . . . Page 14

THE DEVELOPMENT AND USE OF STEREOGRAPHS FOR TEACHING DESCRIPTIVE GEOMETRY: By John T. Rule, Massachusetts Institute of Technology. Page 18

TOPICS DISCUSSED AT THE 1930 AND 1936 DRAWING SUMMER SCHOOLS. . . . Page 19

MINUTES OF ANNUAL MEETING: Cincinnati, June 1944 . . . . Page 21

PRODUCTION ILLUSTRATION: By Orrin W. Potter, University of Minnesota. . . . . Page 22

BIBLIOGRAPHY COMMITTEE REPORT: By H. H. Fenwick, University of Louisville . . . . Page 25

PROJECTIONS: Current events. . . . . Page 27

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

Overloaded Drawing

The donkey is a curious beast.
He is not lazy in the least.
The thing he does in self-defense
Proves that he has far better sense
Than many human beings. He
Will work away industriously;
But overload him – he will stop,
His tail a-quirk, his ears a-flop,
He props his heels and nothing can
Induce him to move on again.

I wish I had his native wit:
The sense to stop when I should quit,
The sense to wait until the load
Is within reason, and the road
Looks better to my tired eyes,
Avoid tough grades and exercise
Sound judgment, when a fellow tries...
The donkey may be very wise!

The Editor's Page

During those periods of prosperity as in the period America has enjoyed since 1939, high-wages offer a greater incentive to the high school student and college undergraduate than the aspects of higher education. Certainly the labor situation has been grave and in many respects more important to the well-being of our country than mass education. We in the educational field believe, however, that as many students as feasible should be retained to promote the educational standards after the present emergency has ceased to exist.

Our greatest problem will confront us when the war is over and there is an opportunity for the eligible student to return to college. Many prominent people have stressed the thought that many, perhaps too many, of those in this classification will become attached to their present position and will have very little desire to return. Too, many young people after they have felt the responsibility of earning money often accept the other responsibilities that go with it, such as, marriage and may not afford to return to their college work.

Our democracy and present high level of education can be maintained only as long as we have a large percentage of people who deeply appreciate the fact that our freedom depends upon our enlightened citizenship and strive toward that objective; the objective of higher education.

Drawing teachers come in contact with engineering students during their first semester in college and have an excellent opportunity for guidance of young people. By encouraging them to finish their education and explaining the advantages you reach many other young people through this medium.

In your contacts in the class room, in social clubs, in church and with friends, keep in mind the slogan, RETURN TO SCHOOL.

Millions of young people have had their education interrupted by the war. Our government is concerned to the extent that they have provided a way for financial assistance to encourage them to complete their former plans. In this our government realizes that an enlightened citizenship is insurance for a democracy founded on the principles set forth in our constitution.

As citizens and teachers in a great commonwealth, it is a privilege and duty to call to the attention of young people and returning service men and women their opportunity and obligation to RETURN TO SCHOOL in order to be prepared for maximum service as citizens.

* * * * * * *

Professor R. R. Worsencroft, editor of the Journal of Engineering Drawing for the past three years, has very ably edited the Journal. This is confirmed by several people's comments found under PROJECTIONS in this issue. Professor Worsencroft has again scored by preparing a series of helpful hints for the editor. In addition, he was gracious enough to spend several hours with the editor and other members of the publication committee going over the operation, editing, managing and circulation of the Journal. For his help and that of Professor Arnold, Advertising Manager and Professor Wood, Circulation Manager and Treasurer, the editor is indebted.

The publication committee invites your suggestions and help in order that we may in part continue the fine work of previous Publication Committees.

Finally, the editor expresses appreciation for the assistance of his colleagues, Professors McGuire, Ransdell, Brock and Martin, in preparing the material for this issue of the Journal.

A MESSAGE FROM THE NEW CHAIRMAN

During the annual meeting of the S. P. E. E. this year a request was made and permission granted to hold a third Engineering Drawing Summer School; this school to be conducted on a similar basis to those held in Pittsburgh in 1930 and in Madison in 1936. It is believed by many that such advancements have been made in the application of Engineering Drawing and Descriptive Geometry in the engineering profession and in industry that the teaching of these subjects should be studied and re-evaluated. It is with this in mind, by the Chairman of the Division of Engineering Drawing and Descriptive Geometry of the S.P.E.E., that such a request was made and upon this idea the summer school is to be conducted.

THE SUMMER SCHOOL

The task before us consists of finding the answer to a simple question of five parts: What? Who? When? Where? and How?; What shall be taught?, Who will teach it?, When will it be taught?, Where will it be taught?, and How will the expenses be met?

Answers to the above questions will require careful consideration for the school to be a success. Letters have been sent to the Deans of Engineering and Heads of Engineering Drawing Departments of all member schools of the Society. Certain information was requested and from the answers that have been received there is much interest and enthusiam for the school. A persual of the T-square Page from 1928 and reference to the Journal of Engineering Drawing since 1936 may stimulate suggestions and ideas.

Your chairman asks that you be prompt in returning the blanks with your suggestions and recommendations. Others who are interested in drawing and descriptive geometry who may receive notice through the Journals of Engineering Drawing and Engineering Education will certainly be cooperating if they will present their ideas which will contribute to the advancement of Engineering Education in general and Engineering Drawing and Descriptive Geometry in particular.

For several years, the midyear meeting of the Executive Committee was held in conjunction with a midyear conference to which all persons interested in teaching and applications of Engineering Drawing were invited. Because a second meeting of the Executive Committee to consider final plans for the summer school is needed this year, it is believed advisable to arrange a one-day conference at Detroit in February or March, 1945 and invite other interested persons from that area to attend.

PROPOSALS FOR THE YEAR'S WORK

In planning for the year there are a number of proposals that seem to have merit and deemed worthy of including within the scope of the work of the Drawing Division. We invite your comments and suggestions regarding the items brought forth.

I. To further sell Engineering Drawing to other groups of educators, it is planned to hold joint sessions with the Division of Deans and Administrators, and the Committee for Personal Development (Guidance).

II. To establish or have established a bulletin similar to the Civil Engineering Bulletin for drawing. Information reveals that certain publishers of engineering texts are publishing the Civil Engineering Bulletin and that they are receptive to the publishing of the Journal of Engineering Drawing on a similar basis. The circulation would include all teachers of drawing, whether in high schools, trade schools or technical institutes, etc. Such an arrangement, properly established so as to safeguard the interests of the Division, should extend the influence of the Division immeasurably.

III. To establish a Committee on Education and Extension whose object would be to promote among the teaching sub-divisions of individual institutions the importance of drawing in the whole engineering curriculum and the contributions which it can make to the accomplishment in subsequent individual courses and to the quality of the complete engineering program. It would be the function of this committee to prepare material on how the Engineering Drawing Department should fit into the scheme of Engineering Education. Further it would assist and make suggestions, when called upon, as to how local drawing departments could plan meetings with other engineering departments of their own institution for a discussion of the place of Engineering Drawing in the various curricula, with the possibility of inviting leaders in the field from other institutions to speak.

And in addition, as a thought for consideration, it is suggested that drawing departments ask the cooperation of all teachers of subsequent courses in which drawing is used to submit to a committee of the local drawing department, a sample of the work of each student, which if unsatisfactory, would require the performance of additional work under the direction of the drawing department before the student could graduate. This same idea is in operation for English in many institutions.

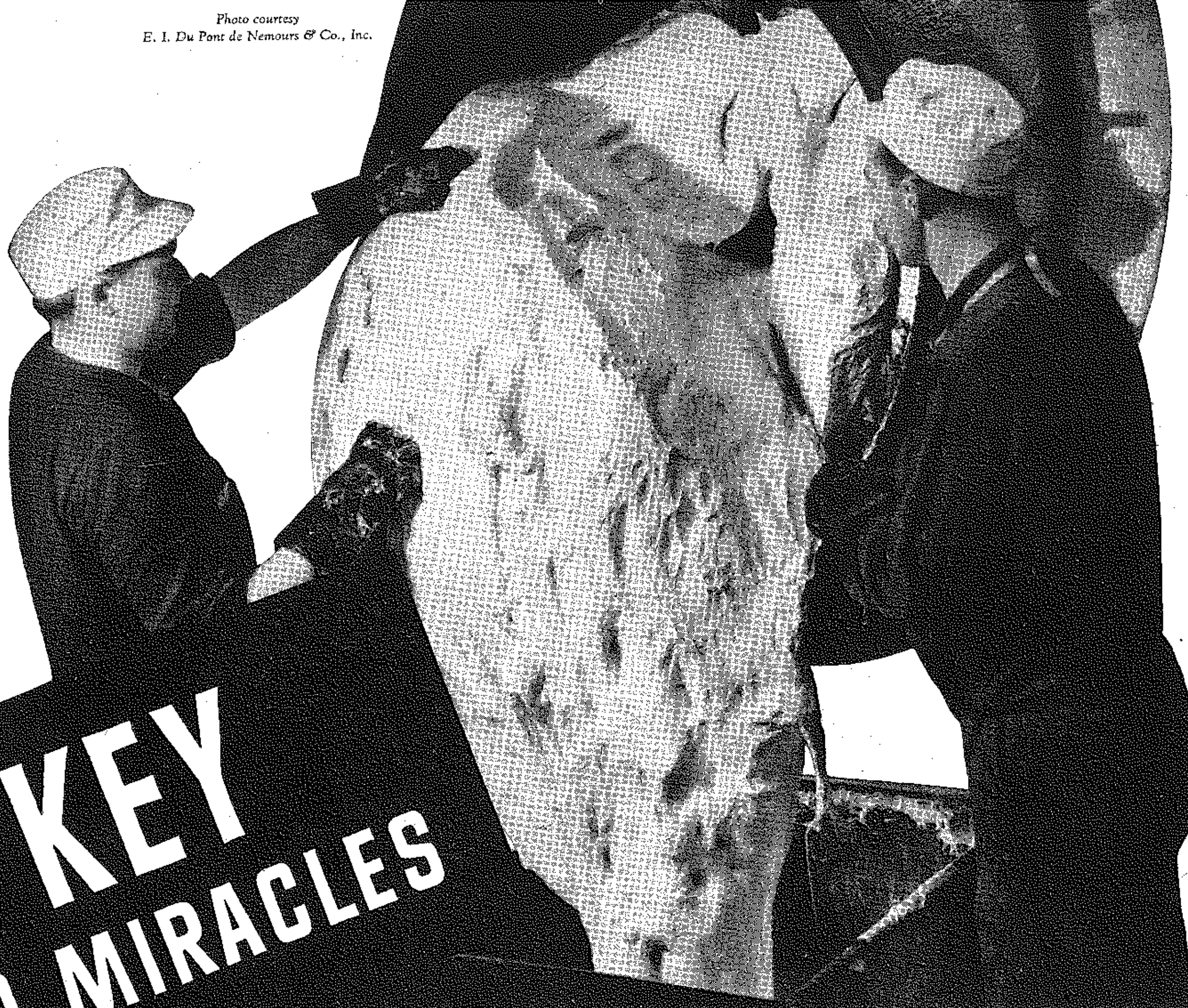
IV. Objective type tests in engineering drawing have been in use for many years by a few members of the Division who were able to convert their colleagues to the value of these methods. It awaited the development of excellent tests of this type in "OUR" field by the ECPD, the U.S. Armed Forces Institute, and other agencies to stimulate the Division to some constructive action.

The completion of the tests being formulated by Dr. Clair V. Mann's committee will be an added contribution to the field of testing and provide means for measuring objectively, and in a manner which can be scored mechanically, all phases of drawing except those where an evaluation of techniques such as quality of line work, and quality of lettering is desired. The completion of the job cannot be accomplished by the committee alone but will require the cooperation of many members of the Division to administer the vertical units of the test on a trial basis so that the final test may measure up to required standards.

V. Since its inception in 1928, the Division has been an effective Agency in

(Continued on page 12)

Photo courtesy
E. I. Du Pont de Nemours & Co., Inc.



KEY TO MIRACLES

. . . in chemistry or in the classroom

● Amazing as it is that the doughy mass of synthetic rubber shown "pouring" from a polymerization kettle is made from coal, air and water, there is another fact about it of far greater significance. The *possibility* of making neoprene and nylon and the sulpha drugs and a host of other modern-day wonders from common coal has always existed. But the *actuality* had to await the coming of someone who knew the key to the riddle, and how to use the key.

So the possibility of making human "miracles" out of commonplace mankind has always had to await the appearance of a chance-turned key or of individuals who knew the key and how to use it. Men do *not* differ from one another sufficiently to account for the *great* difference in their achievements. Some get onto the right track early, and success becomes a matter of following the path to its end. Others get off the track and never find their way back.

What is the secret of getting on the right track? Honest examination must reveal that it's done largely when men are boys, malleable and plastic . . . that it is a question of setting the right boyish habits . . . that it's a question of surrounding these boys with the proper influences. For example, when a boy first comes to drafting class, he is in a receptive frame of mind. He is on the threshold of induction into adult activity, adult thought, adult values. Will the influences that he meets pull him with their attraction or repel him? Will he be given a set of drawing instruments that through their quality and value speak of the momentousness of the occasion, or will he have an inferior, makeshift set that says this work is a mere continuation of childish make-believe? Psychologists know that boys respond in kind; "reaction equals action." To say that economy has any part in the purchase of these tools for creative activity, heightened standards, discrimination between good and shoddy, is to miss the entire lesson of experience as it applies to the growing lad.

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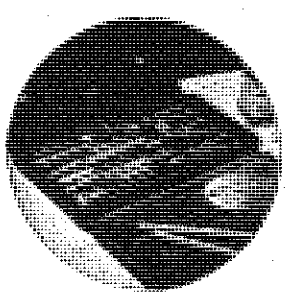

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TEACHING WELDING SYMBOLS

by

EDWARD J. DOWLING, S.J.
Instructor in Engineering Drawing
University of Detroit

In these days of stepped-up production many processes and methods have undergone extensive changes and vast improvements. Probably no process has come into its own more fully than welding, since welding makes for speedier work and requires less manpower than riveting, or bolting, or any of the older joining processes. Furthermore, welding has made possible the fabrication of many structures which formerly had to be cast.

It would seem, however, that despite this notable increase in the importance of welding little has been done to enable our students of engineering, and especially those of engineering drawing, to acquire a working knowledge of the present day unified and practical means of designating welding processes on drawings. We are indebted to industry, particularly to corporations like the Lincoln Electric Company for taking the lead in producing an integrated and readable system of welding symbols. Today we need this unified system of expression, for no longer is welding in its various phases left only to the craftsman to be done however he sees fit, but it is now the task of the engineer, who, foreseeing all the possibilities and consequences of welding, can design and specify exactly what ought to be done.

Textbooks, in their treatment of this matter, are, with few exceptions, brief, theoretical, and none to clear to the students. This situation is unfortunate and presents a problem which we believe requires immediate solution, since welding is now so widely used. Any draftsman or designer will sooner or later have to contend with welding symbols, and he ought to be informed on how to express his solution of the welding problems in an understandable manner.

We have given considerable time and thought to this problem of the presentation of the use of welding symbols in drawing to engineering students in a manner complete enough to be useful and at the same time simple and clear enough to be understood by the average intelligent person. The discussion which follows is the result of our effort to present this complex system of symbols in a meaningful and orderly way. The most frequently used symbols are shown according to the latest standards, and the illustrated examples are sufficiently varied to cover the ordinary cases.

Welding

Welding is a process of joining two pieces of metal by fusion or melting so that the two pieces become one. Welding is not the same as soldering or brazing where two pieces are joined, yet still remain essentially two.

For fusion heat is required. This heat may be provided by the combustion of gas, either hydrogen, acetylene, or commercial gas. It is important that the gas used in welding, whatever kind of gas that may be, yields a product of combustion which is chemically inert. For a chemically active product of combustion will unite with the metals being welded, and either impede the process, or weaken those metals, or weaken the weld itself.

Another source of the fusion heat is provided by electricity. The danger of oxidation, inherent sometimes in electrical welding, must be controlled by covering the rods with a proper coating. There are two electrical processes in general usage, arc welding and resistance welding. In the arc process heat is given by the electrical arc which can be formed between the electrode and the metal to be welded. Resistance welding is founded on the known fact that the resistance of any conductor to electrical current is greatest at the ends or joints where the area of contact is limited and where there is a reduction or pressure contact. Hence, if a sufficient current is passed through two adjacent pieces of metal, they will fuse or weld at the point of greatest resistance, namely at their point of contact.

Sheet Metals

Thin sheets of any metal are easily welded by one of the following processes:

1. Heat each piece and join while the pieces are melted.
2. Heat and supply molten material.
3. Crimp or fold the edges  and press the crimps together and melt these down simultaneously.

Heavy Metals

Heavier sheet material, and anything more than one quarter of an inch in thickness is difficult to heat through evenly; hence, such stock cannot be welded while the joints to be welded retain their normal shape. Such materials must be cut away or "scarfed" to allow an effective weld to be made. There are many possible shapes and combinations of scarfs, four of which are very common and are shown at the top of the following page.

(1) The "J" Scarf Weld

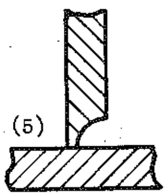
(2) The "U" Scarf (Two "J" Scarfs)

(3) The Bevel Scarf

(4) The "V" Scarf (Two Bevel Scarfs)

Scarf Welds

The welds used to join pieces scarfed in this manner are called scarf welds. Of the four shown, the "J" scarf is more acceptable for very heavy work because it permits the electrode to be inserted deeply without requiring so wide an opening as to weaken the structure. There are many other combinations of scarfs and of placement of pieces. We show a few here:



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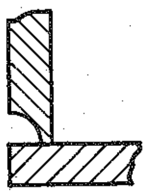

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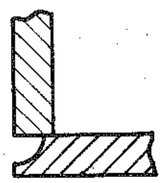

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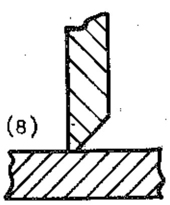

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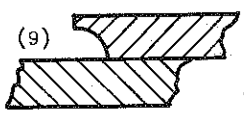

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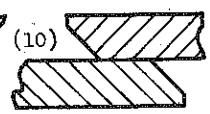
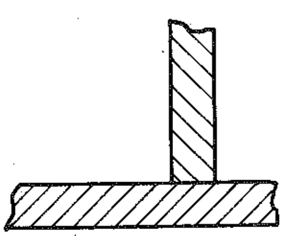


(10)

In designating scarf welds the preceding set of symbols is used. First of all the weld symbol is drawn, if possible or convenient, to the edge view of the pieces. If the drawings can be shown in section at the place of welding, so much the better. For the sake of clarity we are showing the cross hatching of the sectioned examples drawn in opposite directions. However, it is the custom in some industries to show the cross hatching of the two pieces in the same direction, thereby signifying that after the welding is completed the are now one, no longer two.

The scarfs for the welding are not shown in the view of the basic metals themselves.



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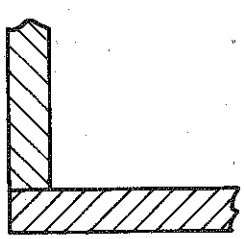
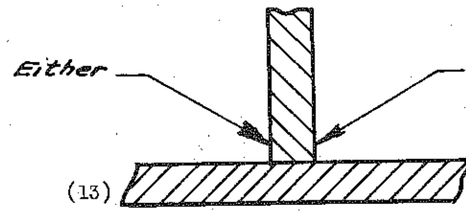


(12)

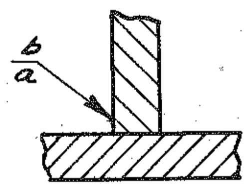
Leaders

A leader is drawn to a point on ONE or the OTHER of the pieces to be welded, near the weld itself. The arrow can be drawn to either side, for reasons to be explained shortly.



(13)

In many cases only one piece will be scarfed or otherwise prepared for the weld specified. In all such cases the arrow must clearly point to THAT piece, not to the other piece, nor to the middle of the juncture between the two. From the back of this leader one more line is drawn either vertically or horizontally in relation to the whole drawing.



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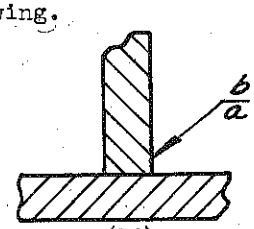

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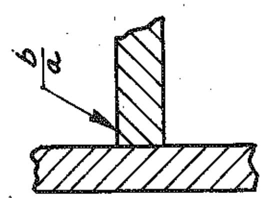

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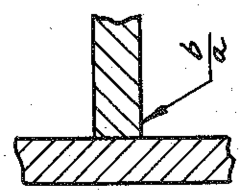

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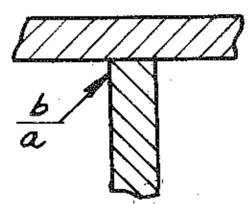

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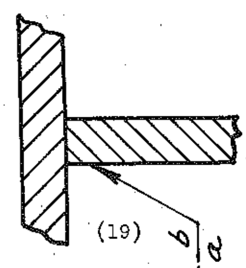
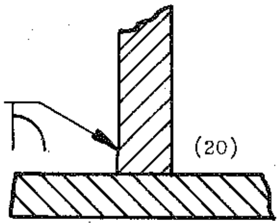


(19)

Thus, in figures (14), (15), and (18) the "arrow" side of the leader is the lower side; in figures (16), (17), and (19), it is on the right side. Any symbols placed on the "arrow" side of the leader means that the weld must be made on the same side of the structure as are the arrow and its note. If the weld is to be made on the side of the structure opposite to the leader and arrow, then the symbols are placed on the "other" side of the leader.

In the examples shown above (figures (14)-(19)) the side marked "a" is the "arrow" side and the side marked "b" is the "other" side. Thus, if a "J" scarf weld is to be made on the left side of a joint AND the leader is made on the same side, the designation will be as shown below: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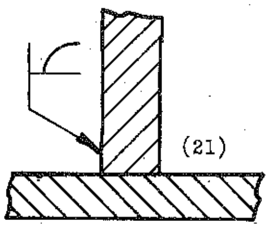
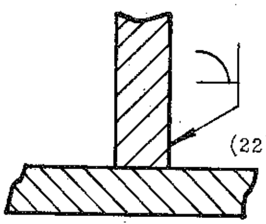

(21)

Either figure (20) or (21) is correct since in both cases the symbol (⊦ for the scarf weld in this case) is on the "arrow" side of the leader.

If, because of the nature of the drawing, it is more convenient to put the leader on the right side, say, and yet wish to designate the same weld on the left side, then the symbol (⊦) is merely put on the "other" side (above or to the left) of the leader, thus: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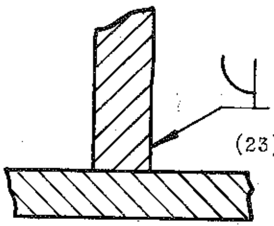
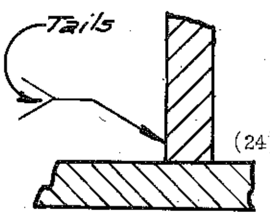

(23)

If special or unusual kinds of welds are to be used in a single joint, the leader has tails.



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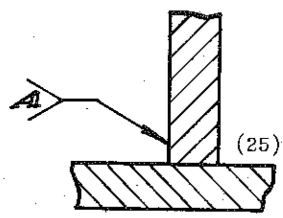
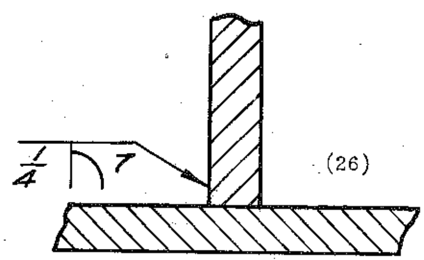


(25)

These tails usually enclose a letter, say "A", which means that the welder is to follow "Schedule A" which is a certain known formula usually localized or peculiar to a shop or industry. This schedule, too, will show things which cannot be expressed by symbol.

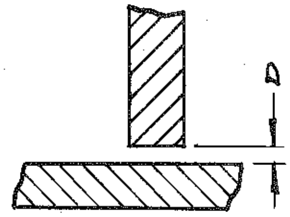
The length of the weld and the depth of the scarf are indicated thus:



(26)

which signifies a "J" scarf weld, seven inches long, and with a scarf one quarter of an inch deep, to be done on the left side of the joint.

If, instead of a contact weld, the pieces are to be welded apart, then the distance bust be indicated in the symbol: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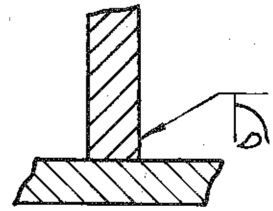
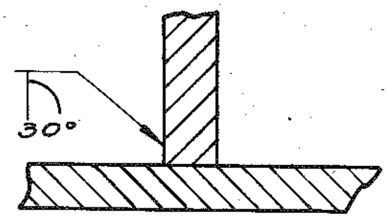

(28) As Symbolized

If a bevel weld is to be used instead of a "J" scarf weld, the symbol is changed from (⊦) to (|\), all other designations remaining the same. The angles of the bevel weld and the "J" scarf weld are standard and not noted ordinarily. If, however, welds of an unusual angle are specified, this is noted above or below the symbol of the weld, thus:

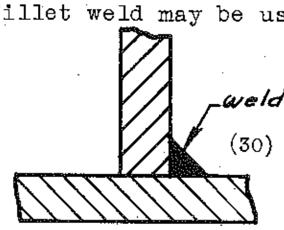


(29)

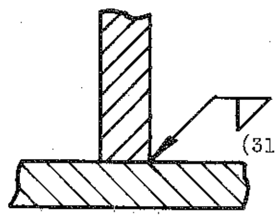
Signifying a "J" scarf weld of thirty degrees on the left side of the upright piece.

Fillet Welds

Thus far we have discussed scarf welds which are inside or between pieces. It may be desirable to weld outside the pieces. If so, a fillet weld may be used.

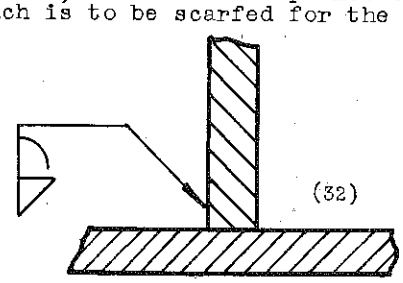


(30)


(31)

The symbol for a fillet weld is (▽) or (⊿). It is important to note that in cases where the fillet weld is used alone, the arrow must point not to one or the other pieces, but to the joint.

Sometimes both a scarf weld and a fillet weld are used together, in which case both symbols are used, and the arrow points to that piece which is to be scarfed for the weld.


(32)

This indicates that a "J" scarf weld and a fillet weld are to be used on the left side. The "J" scarf here is indicated as on the upright piece, not on the base, hence, note where the arrow points.

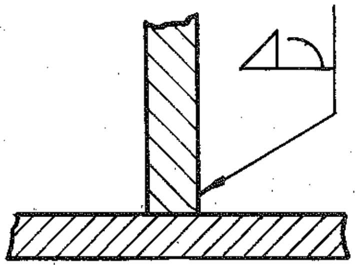
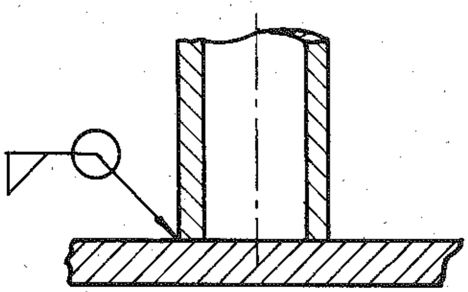

(33)

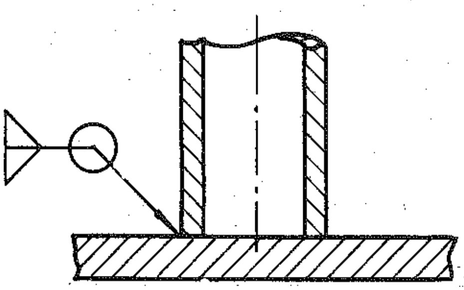
Figure (33) indicates a "J" scarf weld and a fillet weld on the same left side, the "J" scarf again being cut out of the upright piece.

In the case of a circular piece being welded to a flat piece, and in similar situations, the weld may be required all around the circumference. Thus, if a column or pipe is to be welded to a base or a flat piece, and the weld is to be carried all around on the outside with, say, a fillet weld, the designation would look like this:


(34)

The circle at the corner of the leader is the added symbol for "all the way around" weld. The weld is on the outside; therefore, the symbol is on the "arrow" side of the leader.

If both the inside and outside are to be fillet welded all around, the designation would be as follows:

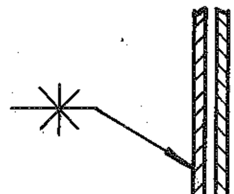

(35)

In this case the inside of the cylinder is the "other" side, hence, the symbol is above the leader. A scarf weld might also have been called for here. It would be designated by its proper symbol (|) plus the circle. In this case the arrow would point to the piece to be scarfed.

Resistance Welding

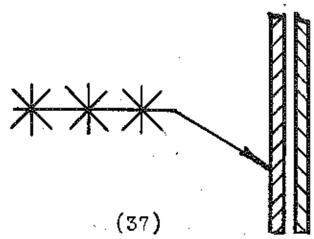
Resistance welding symbols are less involved. There is no "arrow" side or "other" side on the leader.

Spot welding is made by the placement of two electrodes in line on the opposite sides of two adjoining pieces, usually of sheet metal. It is highly important that the resistance be greatest between the pieces themselves and not between each piece and one of the electrodes. With this precaution taken, a current is passed through, and the resistance is greatest at the gap or point of contact of the pieces and the weld is made there. The symbol for a spot weld is an aserisk (*) drawn through the leader, thus:

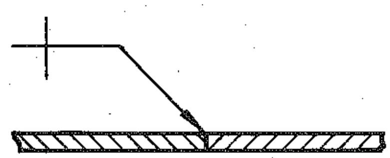

(36)

This signifies a spot weld between the two sheets.

A continuous weld is made by moving the two sheets between a pair of electrodes set in line, or by using rotary electrodes moving exactly opposite each other with the two sheets between them. A continuous weld is essentially a series or spot welds, and it is symbolized by series of asterisks, usually three, on the leader.


(37)

A butt weld is an edge to edge joining of two pieces. These pieces or sheets are actually the electrodes here, and as the resistance is greatest at the joint, they will fuse there first. Pressure is exerted to force the edges together as they melt, thus leaving a rough, raised surface at the weld. The symbol for such a weld is a straight line perpendicular to the leader, and through it.

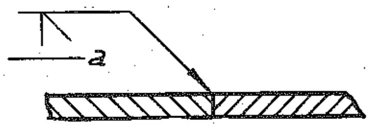

(38)

The length of the butt weld will vary, obviously with the length of the materials to be joined.

Finishing

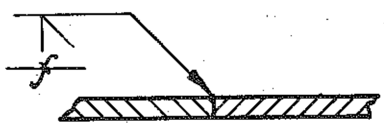
It must be remembered that all welds are more or less rough surfaces which may need to be finished. There are symbols to indicate this finish when it is necessary, and the symbols have the usual significance regarding the "arrow" side and "other" side in regard to scarf welds. Any finish symbols given refer ONLY TO THE WELD and not to the adjacent base metals.

If the weld is to be made flush roughly, say by flattening or scraping while still soft, but not by any mechanical finishing or polishing process, this is symbolized by a line drawn parallel to the leader outside the symbol. Thus, if we desire a bevel weld to be made flush, we denote it thus. The rough finished symbol is the line marked "a" in the drawing.



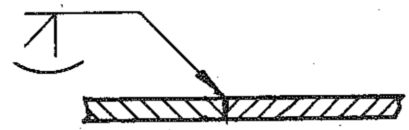
(39)

If a finish strictly so called is wanted on the flush surface, then the standard finish mark (f) is drawn through the flush symbol, or any local user's special mark is used:



(40)

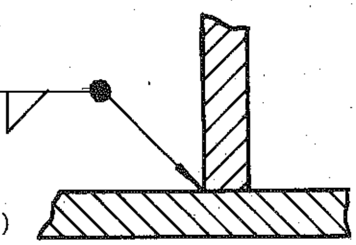
If the weld is to be finished but with a bead raised above the surface of the pieces, then a curved line replaces the straight line.



(41)

Field Welds

When it is convenient or necessary to make a weld at assembly, or in a place other than the shop, a special field weld symbol is used. Pieces or parts may have to be shipped, or moved long distances and it may be handy to have them in more or less knowndown form. Such as these would better be welded at their destination than beforehand. When this is to be done, a solid spot or disc is shown at the turn of the leader, indicating a field weld.



(42)

* * * * * * *

In conclusion, the writer wishes to acknowledge his indebtedness to Professors Uicker, Gerardi and Crossley of the Faculty of Engineering at the University of Detroit for their assistance in the preparation of this paper.

(Continued from page 5)

promoting the interest of drawing and related subjects because of or in spite of the lack of a "constitution" to systemize its activities. Since assuming the Chairmanship of the Division, I can appreciate the value to the officers, of a document which would outline their duties. I propose to appoint a Constitutional Committee and ask the Division to accept or reject their recommendations. It might strengthen the work of the Division if a consitution could be formulated and adopted.

Two of the original seven members who lead the Drawing Division at the time of its formation are no longer engaged in teaching and several more will, in a few years, step aside for others to take their places. The Drawing Division is going to need young and dynamic leadership in the years ahead in order for the division to accept to the fullest, its responsibility to engineering education and to itself. One of the prime functions of the coming summer school will be to discover who among the younger teachers possesses the originality, the initiative and the aggresiveness to assume the leadership of the Division and broaden the effectiveness of the work which, thus far, has contributed so much to the educational progress of its members and to the development of sound engineering education in general. The success of the summer school will be in proportion to the number who participate actively in planning and carrying out the program. The reward may not be measurable in dollars and cents but it will be there never-the-less, in the inner satisfaction that comes from earnest effort followed by worthwhile accomplishment.

Justus Rising, Chairman
Drawing Division of S.P.E.E.
Purdue University

MINUTES OF MEETING OF COMMITTEE TO FORMULATE NATIONAL EFFICIENCY TESTS IN ENGINEERING DRAWING

Cincinnati, Ohio - June 21, 1944

Present: Clair V. Mann, Chairman - Missouri School of Mines, Rolla, Mo.
Thomas E. French - Ohio State
J. Lawrence Hill - University of Rochester
H. M. McCully - Carnegie Institute of Technology
Justus Rising - Purdue University
H. C. Spencer - Illinois Institute of Technology
W. E. Street - Texas A. & M. College
C. L. Svensen - Professional Engineer, proxied for by Street
K. W. Vaughn - Carnegie Foundation
Chas. J. Vierck - Ohio State

Meeting was called to order at 10:30 A.M.

Mann discussed the minutes of the Purdue Meeting April 21, 22, 1944 and briefed the field that tests are to cover.

Hill explained the purposes of the tests which are: (a) To determine if ESMWT Students should be given college credit. (b) To determine if ASTP drawing should be given college credit. (c) To determine if credit should be given for Armed Forces Institute courses in Drawing. (d) To determine if credit should be given for high school drawing.

Rising, Hill and Vierck presented tests on orthographic projection for consideration of the committee and these were approved in general.

Dr. Vaughn gave many helpful suggestions pertaining to the kind of problems that are best suited for Drawing tests.

The committee voted to add multiple choice orthographic projection questions. Time to be devoted to these questions not to exceed ten minutes. McCully and Street to work up these questions.

The committee voted to add surface and edge orthographic projection questions. Rising and Spencer to work up these questions.

It was agreed that members of the committee present would each work up one or more of the vertical sections of the Drawing test and have 500 copies mimeographed at their institution and place these in the hands of Dr. Vaughn of the Carnegie Foundation for distribution and validating of questions.

The vertical units of the test were divided as follows: and the person or persons name following tests to work up that section of the test.

1. Use of instruments and applied Geometry - Hill, Time: 35 minutes
2. Lettering - Mann, Time: 35 minutes
3. Orthographic projection - Street, Time: 35 minutes
4. Isometric and Oblique projection - Spencer, Time: 35 minutes
5. Auxiliary and Sectional views - Graney, Time: 35 minutes
6. Dimensioning - Vierck and Russ, Time: 35 minutes
7. Working drawings and shop practices - Vierck and Russ, Time: 35 minutes
8. Screw threads and bolts - Rising, Time: 35 minutes

Standard I.B.M. answer sheets are to be used. The above tests are to be prepared in tentative form and placed in the hands of the editing committee composed of Rising, Graney, and Vierck by October 1, 1944. This committee will edit in final form and return to the person preparing the examination, who will cut and run 500 copies of each sheet in his vertical test and these are to be placed in the hands of Dr. K. W. Vaughn, Carnegie Foundation, 437 West 59th Street, New York, New York by December 1, 1944.

All sheets are to be run on $8\frac{1}{2}$ x 11 paper.

Professor Thomas E. French was selected to work up a cover sheet and style sheet for these examinations.

Professor McCully agreed to assume the responsibility of securing financial aid to promote these tests and the funds to be placed in Dr. Vaughn's care.

It was agreed that Mann and McCully would contact ten schools to try out the tests and it was assumed that those present and who are helping cut the examinations would try them out in their Institutions for validating purposes.

Moved by Rising and seconded by Spencer that J. Lawrence Hill present the work of the committee to the Drawing Division Meeting of the S.P.E.E., Friday evening, June 23, 1944. Approved.

Moved by Street and seconded by French that Professor J. M. Russ of the University of Iowa be added to the committee. Approved.

Dr. K. W. Vaughn agreed to distribute scores and tabulate the results for validating purposes of the Drawing tests.

W. E. STREET,
Secretary for the Meeting

SYMPOSIUM OF MEETINGS AND RESULTS of the COMMITTEE TO FORMULATE NATIONAL EFFICIENCY TESTS IN ENGINEERING DRAWING

Division of Engineering Drawing and Descriptive Geometry

Cincinnati, Ohio - June 23, 1944

by

J. Lawrence Hill, Jr.
Associate Professor Mechanical Engineering - University of Rochester

In making the report of the Test Committee, as is my part in the program, I should like to say that the committee has already reported, at least in part. Our plan was to have Dr. Vaughn discuss the basic principles of testing, followed by Dr. Graney giving some concrete examples of various kinds of problems or objective questions that might be used.

From these two talks, we hoped you might become intrigued with the possibilities of using objective tests in your normal class room procedures and would come to appreciate their real significance and usefulness. We anticipated also, that these two presentations would be a fitting introduction to the very brief statement of what your Test Committee has done so far. Before making this statement and asking for your approval, I should like to summarize for you, as best I can, the highlights of the two preceding speaker's discussions.

You have heard Dr. Vaughn state that one of the fundamental principles of making a test is to know first what it is you want to find out or measure. That holds true for your class room tests as well as for any nationwide standardized test. He also differentiated between objective and subjective tests and has stated that one of the chief advantages of the former is that it eliminates errors in judgment of correction. It also permits comparative study of answers year by year and section by section at any given time.

Another advantage lies in the speed and ease of correction, which for large classes three days of acceleration is worth consideration.

Dr. Vaughn also has made it clear that no test made by an outside agency can do as well for an institution as one made by that school for itself. I am glad that he emphasized this fact, for it should be understood that the Division's test, about which I shall comment briefly in a moment, is not intended in any way to replace your own examinations.

We had hoped that you would get from this meeting some new ideas and might become actively interested with the possibilities of using objective tests in your class room. They are no panacea for all your testing woes, but they can help you in numerous ways.

Let me illustrate with two situations from our recent experiences at the University of Rochester wherein objective type examinations in Engineering Drawing were of particular value. Last July, just about a year ago, there were registered in our Drawing classes nearly 600 Navy V-12 students, about eight times as many as we had ever had in civilian days. During the rather hectic days of registration more than 100 students were registered for a section where the room capacity was only 40. This was duplicated in several instances with the net result that seven classes totalling about 200 men were subsequently given during the evening hours of 7:00 to 9:50. This was in itself bad enough but when the final examination time rolled around in late October, the registrar's office decreed that all examinations would be given in one or more of three places, no one of which was a drafting room. The use of drafting equipment was entirely impossible, but we were fortunate in having used objective type examinations before and so were able to build a final exam that very adequately served the purpose. Sketching was resorted to instead of instrument drawings. By using special answer blanks for most of the questions, we were able to score the six hundred in a relatively short time.

The second situation occurred during this past term when one of our instructors seemed to be less exacting in the quality of work demanded of his students. In spite of tactful and diplomatic suggestions given, the class still remained far behind the others in quality and performance. We figured that the midterm examination could be so designed that this particular class would be placed in its true relative position with the other sections, at least on part of the examination. By a careful and judicious selection of questions, this was done with the result that the instructor recognized his own short comings and promptly took steps to remedy the situation. Everybody, including the students, benefited by this experience, which could not have been accomplished by the usual essay or problem type of examinations alone.

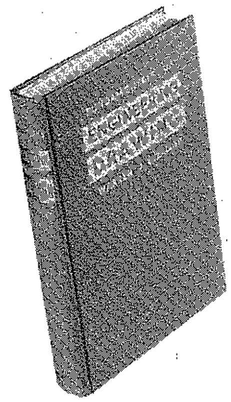
Dr. Graney has shown you on the screen a variety of kinds of questions that can be made objective. These were deliberately chosen from various areas of engineering drawing study and are in addition to questions involving multiple choice answers of words or phrases. Both he and Dr. Vaughn have indicated that true-false questions are the least reliable of any that might be developed. Dr. Graney also defined for us the two terms, "reliability" and "validity". The latter term

(Continued on page 17)

• FUNDAMENTALS OF ENGINEERING DRAWING

By WARREN J. LUZADDER

Associate Professor of Engineering Drawing, Purdue University



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Special emphasis has been placed on Dimensioning — Developments and Intersections — Machine and Welding Drawings — subjects which are not adequately treated in most texts now in the field and which are of great importance in today's War Training courses in Engineering Drawing.

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is applied to the degree with which a test or test item really measures what it purports to measure. The term "reliability" refers to the degree of consistency with which the same item or test measures a particular trait. Reliability may also be applied to the consistency with which we as instructors will grade the same question or problem on all papers, or that several of us will grade alike on one paper, statistical measures of reliability can be determined in a number of ways, but in all, the higher the value, the better the question is for separating and spreading the good from the poorer students.

Well, so much for the resume' and now a brief statement of what your test committee has done. Early in the year, Dr. Mann, the chairman, met in Chicago with Professors Rising, McCulley and Spencer and there talked over the general duties and responsibilities of the committee. This was followed by a two day meeting in April at Purdue University of a larger number of committee members including Dr. Mann of Missouri School of Mines, Professor Thomas of Ohio University, Professors Rising and Graney of Purdue, Professor Vierck of Ohio State and myself. Professor Street of Texas A. & M. College could not come, but sent some sample tests and materials and Professor Arnold of Purdue served as proxy for him.

After considerable preliminary discussion it was agreed that the committee could best prepare a comprehensive test in engineering drawing by developing first a series of unit tests graded as to difficulty. The ultimate objective of the Division's test would be to serve a three-fold purpose: one, as a means of classifying incoming students for the purpose of sectioning in accord with prior knowledge and ability; two, to determine the level of entrance (or possible exemption) of former ASTP, ESMWT or returning service men who have had prior college work in engineering drawing and three, to serve as a general achievement test for students who have completed a college course in engineering drawing. In no sense of the word is it intended to have this test serve as a substitute for your own final examinations, but could be used as a means of comparing the results of your teaching with other schools of similar size and comparable student body.

The proposed test is not intended to duplicate the efforts of Dr. Vaughn and the ECPD - Carnegie Foundation testing program. That is primarily for prediction of probable success in engineering, where as ours is designed for measurement of first year achievement. What overlapping there may be is unavoidable and of no serious consequence.

At the Purdue meeting of the Committee, a selection of material (by chapter headings of text books) to be covered was decided upon with which for the moment you are probably not too concerned. This material was further grouped into so-called units of testing, one of which deals with the principles and practices of orthographic projection. A test covering this unit has been prepared, which in its entirety will probably take about thirty-five minutes to administer. Five or six other units are to be developed, each taking about the same time to give. The best items, subsequently determined by statistical analysis, will be taken from each unit to make a composite or comprehensive test which, covering the entire field as we have defined it, should take about two hours for administering.

Dr. Vaughn and the Carnegie Foundation have graciously agreed to help us in validating our test items. To do this, we shall need the cooperation of many engineering schools and college drawing departments. It is expected that by January 1945 we shall have all six or seven units ready for actual use. If you agree to cooperate, and have let us say 140 students in your drawing classes at that time, you will be sent 20 copies each of the seven units. These you will be asked to pass out at random and since each unit is designed for only 35 or 40 minutes, the whole test can be given in that length of time. These efforts, duplicated in other schools, we hope will result in at least 500 students taking each of the seven unit tests, or 3500 in all. This should provide sufficient responses for adequate statistical analysis of each item. From these results, the final form of the comprehensive examination will be developed. This too will have to be constantly refined and rebuilt, but that is yet another problem.

Now, in order that the whole report may be put to you for discussion, I move Mr. Chairman that the Division here assembled formally approves the work and efforts of the Test Committee to date and authorizes them to proceed with the necessary steps to validate the items and to prepare a final test form. (This was passed without a dissenting vote).

(Continued from page 19)

drawing courses be made to serve as material for orientation, and for professional application? (l) Testing material, its purpose, types and uses (in a broad educational sense). (m) Class room teaching methods and special devices, (n) Laboratory methods and special devices, (o) Use of special equipment, (p) Films as an instructional medium and for correlation purposes.

THE DEVELOPMENT AND USE OF STEREOGRAPHS FOR TEACHING DESCRIPTIVE GEOMETRY

by

John T. Rule
Associate Professor of Engineering Drawing and Descriptive Geometry
Massachusetts Institute of Technology - Cambridge, Mass.

Descriptive Geometry might be defined as the representation on a two dimension surface of three dimensional objects and the solution of problems concerning them. The problem of conversion from three dimensions to two or vice versa is the constant problem.

Many systems for doing this are in use for different purposes. The basic system is orthographic and all drawings in other systems are actually constructed by the use of orthographic. The other systems are in general employed for pictorial purposes, that is, for achieving a three dimensional visual reality. The basic effort is to create a retinal image which shall approach the retinal image that would be seen if the object itself were viewed.

But no single flat drawing can really achieve this, first because one view can never accurately describe an object, the location of points in the direction away from the eye being always indeterminate. In perspective depth in this direction is determined by inference. Second, normal vision is three-dimensional, this three dimensionality being entirely dependent on the fact that the retinal images of any object in the two eyes are different. When we view a single drawing the retinal images are identical and thus no depth is apparent.

It seems quite natural, therefore, that a pictorial system which actually creates a three dimensional image in the eyes should be much more powerful pictorially than any other possible system.

Stereoscope drawing is a system of two-view drawing to be classified with perspective as a pictorial system. It is in fact nothing more than double perspective. It creates different retinal images in the two eyes which lead to a true three dimensional image. The reality is so great that these images actually become disassociated from the drawing surface and float in space. Everyone viewing a stereograph has the tendency to reach out and touch the image, though he knows there is nothing really there.

Now this is obviously a powerful tool in developing space concepts, for they can actually be shown in space. Furthermore, it is particularly adopted to the teaching of Descriptive Geometry. The slides shown here are composed of two parts, the space image of the problem under consideration and the flat drawing of the problem as it should appear on the students drawing paper. Both are viewed at the same time. The student can mentally fold the drawing paper into the planes of the space image and accurately perceive the relationships involved. He has, in effect, a space model of his drawing, the model being transparent to reveal all the lines and having on it all the letters and symbols as they appear on his drawing.

The use of this tool is still in its preliminary stages. At M.I.T. we are using it cautiously. The most common objection to its use has been that its great reality makes visualization too easy for the student so that he may become dependent on the stereograph to help him with his problems. Our experience has been that the contrary is the case. Once he has really learned how to associate the flat drawing with the space image he is able to visualize for himself much more rapidly. Learning to visualize seems to a certain degree a sudden process. That is, a student may fail to visualize for a considerable time and then suddenly "get-the-trick" after which he has very little difficulty. The problem is to "get him over the first hump". Experience with stereographs indicates that this is exactly what they do, for many students show a tendency to use them for a short while and then to find that they see the propositions clearly without them.

The development of stereographs is an interesting process. For projection from latern slides a size screen and a viewing distance is assumed. This establishes the position of the two eyes. The screen then becomes the picture plane and the eyes two station points for two perspectives of the object. The object is made to be of a size to fill the screen and is placed in general with its front or rear point in coincidence with the screen dependent on whether the image is to appear in back or in front of the screen.

The two drawings are then nothing more than two ordinary perspectives drawn to any convenient scale for the whole system.

The difficulties encountered are primary problems of accuracy. Suppose we are making drawings for a six foot screen to be viewed from 12 feet, all drawn to 1/3 scale so that each of our drawings will be about two feet wide. On this basis an error of .007 of an inch in locating one of the two images of a point will lead to a 1 inch error in the depth of that point. If a line makes a 15° angle with the horizontal, a lateral error in locating the line of less than .002 of an inch will make an error of 1 inch in the depth of that line.

This necessity for accuracy practically rules out the possibility of projecting both perspectives individually. The best results are obtained by projecting one perspective and developing the second by actually measuring the necessary displacements of each point to yield the proper depth for that point in the stereoscopic image. Rapid methods for doing this can easily be developed.

The same problem of accuracy makes paper shrinkage very annoying. Either a non-shrinking or a uniformly shrinking surface must be used. Furthermore it is practically impossible to draft to the required accuracy. Consequently drawings must be checked under a stereoscope and lines and points shifted until they appear at the required depth in the actual stereo image. This correction must be done as the final step after the drawing is inked for photographing. An ink line is not a pleasant thing to have to move a hundredth of an inch. One drawing may require the shifting of a number of lines.

The answer to these problems has been the use of frosted cellulose acetate as a drawing surface and of black scotch tape as a bottle of ink.

The acetate is an ideal tracing surface - tape may be placed on it and removed without damage to either the tape or the acetate. Scotch tape can be cut extremely thin and is well suited to curve-work. In fact its assets may be listed as follows:

1. Tracing time may be reduced to about 1/3 of that using ink.
2. A line may be erased instantaneously.
3. All lines are of uniform width.
4. All corners are sharp.
5. Uniform photographic density is assured.
6. No blotches are possible.

For the purposes of stereoscopic drawings both the acetate and the tape have proved to be ideal. The possibilities of their use in other fields is certainly worth investigating.

Three drawings are made for each stereograph. This yields three pairs of interoculars, - one pair is used for small stereoscopic prints, the other two pair for different size screens. It is obvious that a pair must be reduced or enlarged to a size where the two station points become $2\frac{1}{2}$ inches apart, or the distance between the eyes. Thus if a two foot drawing is to be reduced to a six inch print, the station points must be considerably further apart than the eyes. On the other hand, if the same drawings are to be enlarged to a six foot screen, the station points must be closer together than the eyes. This dictates that the size of the resultant picture must in general be known before a stereograph is begun. A rather wide latitude is possible, but it is very easy to show slides made for a six foot screen and have them too deep or unviewable for variable screens.

The vectographic process by which the slides are made is a new one in photography. It is the first really satisfactory stereoscopic projection process in that it requires no special equipment other than an aluminized screen and viewers. The polarization of the images occurs in the slide itself. It is reasonably cheap and capable of quantity production. It thus makes the use of three-dimensional visual aids a feasible proposition.

TOPICS DISCUSSED AT THE 1930 AND 1936 DRAWING SUMMER SCHOOLS

A. The Pittsburgh outline contained the following topics:

(a) Orientation of Freshmen to Engineering; (b) Relationship of the Engineering Drawing courses to the Engineering Curriculum; (c) Objectives of courses in Drawing and Descriptive Geometry; (d) Standards for Drawing and Drafting Room Practice; (e) Content of an Engineering Drawing course; (f) Content of a Descriptive Geometry course; (g) Sectioning students on the basis of ability; (h) Aptitude tests and their use in sectioning students; (i) Use of Recitation in teaching Drawing; (j) Problem question: Source, presentation, laboratory methods; (k) Engineering College preparation for the industrial drafting room; (l) Use of Recitation in Descriptive Geometry; (m) Use of laboratory period in Descriptive Geometry; (n) Demonstration classes in Engineering Drawing and Descriptive Geometry; (o) Organization and administration of a drawing department; (p) Responsibility of the drawing teacher; (q) Development of a course in engineering drawing; (r) History of the Development of graphical representation; (s) Examinations and tests of achievement; (t) Drawing room design, equipment and appliances; (u) Committee reports.

B. The Madison program contained the following topics:

(a) What training in Graphics does industry require of the young engineer? (1) Electrical Engineering, (2) Mechanical Engineering, (3) Civil Engineering, (4) Other Branches. (b) What type of training in Freshman Graphics is important to progress in the remaining period of engineering education? (1) Electrical Engineering, (2) Mechanical Engineering, (3) Civil Engineering, (4) Other Branches. (c) What qualities and special training are important to drawing teachers? (d) How best to meet the objectives of speed and skill in drawing courses. (e) Educational and Cultural objectives in drawing courses. (f) Should instruction in Graphics be carried beyond the Freshman year? (g) Present day needs in the freshman drawing course. (h) Present day needs in freshman course in Descriptive Geometry. (i) To what extent are the teaching problems in high school and college curricula dependent or independent of each other in the field of drawing? (j) Do we need to teach the graphic language to engineering students? (k) Can

(Continued on page 17)

MINUTES OF ANNUAL MEETING

THE DIVISION OF ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY
Society for the Promotion of Engineering Education
Cincinnati, Ohio - June 22-25, 1944

Opening Conference, Thursday June 22, 2:00 P.M.

Professor W. E. Farnham, Chairman, presided, forty-four members and guests present. In the absence of Professor Tozer, Professor W. J. Luzadder was appointed acting secretary and after making a few general remarks, the chairman introduced Professor B. M. Aldrich of Oklahoma A and M College who spoke on "The Isometric Approach to Descriptive Geometry".

The chairman thanked Professor Aldrich and then introduced Professor John T. Rule of the Massachusetts Institute of Technology who presented a paper on "Three Dimensional Drawings". Professor Rule commented in general before projecting a set of slides made to teach descriptive geometry. At the end of the discussion, Professor Rule explained and demonstrated the process of production of three dimensional slides and prints.

Sample prints were fastened to the walls of the room for inspection by division members and envelopes with sample slides and viewers were passed to each member of the audience.

Professor Rising announced the preliminary outline for the Friday evening conference on Engineering Drawing Tests. In order to avoid interfering in any way with this program, Professor Farnham announced that the business meeting and election of officers would be conducted as part of the dinner meeting Thursday evening.

Professor C. V. Mann suggested that a committee be appointed to discuss methods of teaching Descriptive Geometry. In discussing this Professor Porter remarked that no attempt should be made to standardize a particular method of teaching descriptive geometry, but we should be open minded to receive all new methods of presentation. He suggested that first an attempt be made to standardize descriptive geometry nomenclature.

Professor Mann moved that the Drawing Division set up a committee for the year 1944-45 to study, with a view to subsequent standardization, the notations and nomenclature for descriptive geometry and to report at the next annual meeting of the Division. This was duly seconded and carried without a dissenting vote. No action was taken on Dr. Mann's earlier suggestion of teaching methods.

The meeting ended with a general discussion of the use of visual aids for teaching descriptive geometry.

Dinner Meeting, Thursday June 22, 6:30 P.M.

The Annual Division Dinner was attended by 50 members and guests. Professor C. B. Hoffman, Chief Engineer and Technical Adviser of Sperti, Incorporated, of Cincinnati, gave an interesting illustrated talk, "The Earth Belched Forth Fire". This was concerned with the spectacular formation and eruption of Paracutin, Mexico's most recent volcano.

Following his talk, opportunity was afforded to ask questions, which many of the Division did. Professor Farnham then introduced Professor H. M. McCully, chairman of the nominating committee, who presented the following proposed slate of officers of the Division for 1944-1945:

Chairman - Justus Rising, Purdue University

Secretary - J. Lawrence Hill, Jr., The University of Rochester

Retiring Chairman - Walter Farnham, Tufts College. Replacing R. P. Hoelscher

Ivan L. Hill, Illinois Institute of Technology for term of 5 years replacing R. W. French. Other members of committee are:

F. M. Porter - University of Illinois - 4 years

E. C. Willey - Oregon State College - 3 years

G. M. Phelps - Rensselaer Polytechnic Institute - 2 years

F. A. Heacock - Princeton University - 1 year

Journal of Engineering Drawing

W. E. Street, Agricultural and Mechanical College of Texas - Editor

J. N. Wood, Kansas State College - Business Manager

J. N. Arnold, Purdue University - Advertising Manager

Editor of T-Square Page

H. C. Grant, University of Wisconsin at Milwaukee

It was regularly moved, seconded and subsequently carried that nominations be closed followed by a duly seconded motion to accept the slate as proposed. This was carried without a dissenting vote.

Friday, June 23, 8:00 P.M.

About 50 Division members attended this session presided over by the new chairman, Professor Rising. He introduced Dr. Kenneth W. Vaughn of the Carnegie Institute who spoke

(Continued on page 24)

PRODUCTION ILLUSTRATION

by

ORRIN W. POTTER
Assistant Professor of Engineering Drawing and Descriptive Geometry
University of Minnesota

There is an old saying "There is nothing new under the sun". Production Illustration is a new name for an old type of drawing. This name was coined by the aeronautical industry and as the name implies it may be defined as a pictorial drawing used to facilitate production. The use of pictorial drawings is not new, they have been used for many years by the architect, for Patent Drawings, for advertising and catalogue illustrations, and to a limited extent for shop drawings. There are records showing that many of the well known artists furnished pictorial sketches which were used in the construction of some of the famous historical structures. Leonardo da Vinci (1452-1519) was one of the most famous artist engineers. Pictorial drawings were also used to aid war production by England in World War I. The aeronautical industry in this country revived the use of the pictorial drawing for production purposes but its use has been rapidly spreading to other industries.

The war production program has greatly emphasized the importance of drawings in industry. Before production can proceed smoothly numerous drawings are necessary showing shape, size, material, and shop processes and procedures. Mass production would be practically impossible without them. Drawing has often been referred to as "the language of the engineer" and the war program has certainly reaffirmed this. The shortage of draftsmen, in many cases, has greatly hampered production. To help this situation an intensive training program to train draftsmen was set up at the beginning of the war emergency period. It is estimated that in the past three years well over 100,000 persons have received training under this program and yet the demand for draftsmen continues. Many more persons received training in drafting than in any other war training course. Here at Minnesota in the past three years up to January 1944, 49 courses have been conducted in engineering drawing with 1067 students under the war training program of the ESMWT (Engineering, Science and Management War Training). This is in addition to the regular drawing courses given in the colleges, highschools, and vocational schools. Many of the persons who took these courses were shop workers who felt the need for a better understanding of drawings in their work but by far the greater majority have found employment as draftsmen. Many women received training under this program.

The aeronautical industry was one of the hardest pressed for the need of draftsmen. Many of these companies had art departments where artists were employed to make drawings for advertising and catalogue illustrations, but under the war program the need for advertising was at a minimum and someone conceived the idea of using the artist to help the engineering draftsmen make the much needed drawings for the shop. The artist was not familiar with the conventional engineering drawing or the various engineering details of manufacture but he could make pictorial drawings. Under the supervision of the engineering department it was found that he could make pictorial drawings which could be used in a number of places to facilitate production. This proved so successful that the country was combed for commercial artists and now thousands of them are being used for this purpose. Engineering draftsmen, in general, were not familiar with pictorial drawing and few of them had the time or the inclination to learn how to make them. It has been found, however, that both the engineering draftsman and the artist can be used to make this type of drawing with a little training and experience. Some companies prefer the regular engineering draftsman, some the artist but many of them are using both.

There are two reasons why the Production Illustration has met with such favor. It is more easily understood than the conventional engineering drawing and second it can be made more quickly. It has been especially helpful to the thousands of unskilled workers now in the war industries who never before worked in a manufacturing plant. They can easily read these drawings with a minimum of preliminary instructions. Pictorial drawings showing certain information as to shop processes or procedures, in many cases, serve the purpose even better than the conventional orthographic drawing and have the advantage that they take considerably less time to make.

There is no danger, however, that the Production Illustration will replace the orthographic drawing completely; it will be used only to supplement it. There are many problems requiring accuracy of measurement and true shapes where orthographic drawing must be used. Some such problems are the laying out of true shape patterns for developed surfaces and templates, surface intersections, lofting, and the like. Also the dimensioned detail drawing, especially for complicated shapes, are best made in orthographic as pictorial drawings are very difficult to dimension clearly. The pictorial drawing lends itself best for transmitting information for shop operations and procedures rather than for the details of shape and size description.

Some of the principle uses to which the Production Illustration has been put are as follows:

1. Assembly drawings (exploded assemblies) for the assembly line.
2. Assembly drawings (exploded assemblies) for maintenance and repair crews.
3. Assembly drawings (exploded assemblies) for erection crews.
4. Drawings, showing alterations as used by the aeroplane modification plants.
5. Design development drawings.
6. Production Breakdown Illustrations.
7. Detail shop drawings showing shop operations.
8. Detail pictorial drawings for submission to contractors for bidding purposes.

The most extensively used drawing of this type is the pictorial assembly called the "exploded assembly". This is a drawing of an assembly taken apart but with the parts so arranged that anyone can easily see how they go together. It has greatly facilitated assembly line production even for those who are familiar with orthographic drawings. The exploded assembly has also been of great value to maintenance and repair crews. They have been furnished by the war department to be sent with war equipment of all kinds going to the fighting fronts for use by the ground crews. The printed instructions may be given in different languages, if necessary, depending on where they are going, but the same drawing is used regardless of who is to use it. The exploded assembly is also used to give instructions for the assembly and installation of machinery and equipment which must be assembled at the point of use rather than in the factory. In other words the information necessary for the assembly or the taking of a machine apart for any purpose is best given by means of a Production Illustration drawing.

The alteration drawing as used in the aeroplane modification plants are principally Production Illustrations. These plants were set up by the government in a number of places throughout the country where various changes on aeroplanes can be made which have been found necessary due to experiences gained in combat duty or where installations of new features that have been developed thru research can be made or where a ship may be fitted for certain climatic conditions or a specific task. In this way changes can be made without interfering with the assembly line production at the factory. This work is always rush and it has been found that the Production Illustration type of drawing serves the purpose best.

In the development stage of design many ideas have to be explored and frequent changes are made before the final design has been set. The Production Illustration has been found very useful here because it lends itself so easily and quickly to alterations.

One of the big jobs in any manufacturing plant is the production planning. The size of the manufacturing units, how they are to be made and handled, and the equipment and tools needed must be determined. Production Breakdown Illustrations are pictorial drawings used for this purpose after the design has been decided upon without waiting for the completion of the detail working drawings of the various parts. This has made it possible to get new designs into production much faster than formerly.

Pictorial shop drawings showing shop operations such as machining, bending, forming, riveting, welding, etc. have been used for some time to a limited extent but the war program has greatly expanded this use.

One of the problems of the War Production Board has been to make use of as much of the country's available production facilities as possible and thus reduce the building of new plants and the expansion of others. In transmitting information to the small shop operator, pictorial drawings have been used in a number of instances and they have proven very helpful.

As manufacturers become more familiar with the Production Illustration and as more persons are trained to make them more uses will no doubt be found for this type of drawing.

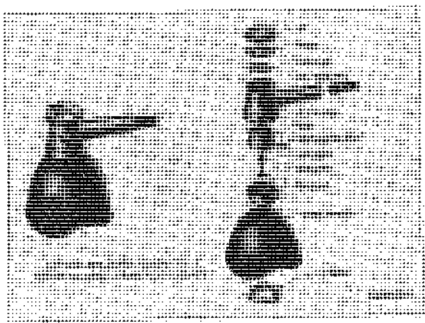
Here at Minnesota we have been following the development in this field and last summer the first course in Production Illustration was given for the employees of the Northwest Airlines under the ESMWT war training program. The details of the course were worked out and administered by the author and Mr. Ivan Doseff. Mr. Doseff has extensive training and experience as a commercial artist and has been on the teaching staff of the Institute of Technology for a number of years. The combination of an artist and an engineer working together made an ideal combination for a course such as Production Illustration which makes use of both art and engineering. The results obtained thus far have been very gratifying.

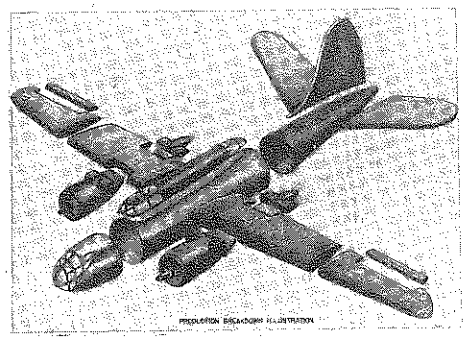
Following is an outline of the course in Production Illustration now being conducted at the University of Minnesota.

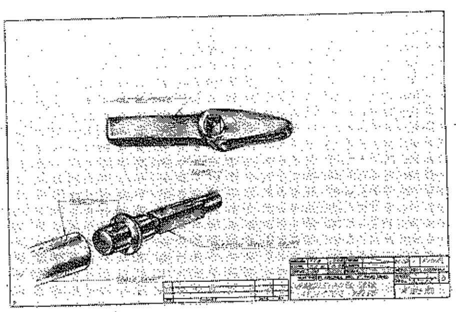
1. Isometric, mechanical and freehand.
2. Oblique, mechanical and freehand.
3. Axonometric, mechanical and freehand.
4. Perspective, mechanical and freehand.
5. Freehand sketching from models.
6. Exploded assemblies.
7. Production Breakdown Illustrations.

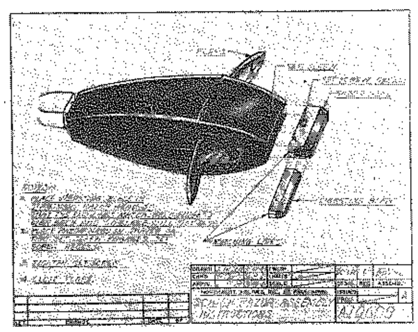
Various types of shading will be used throughout the course. Particular stress is made on freehand work on vellum.

Very little training in the making of pictorial drawings has been included in the curriculum of our engineering schools. This has been partly due to the limited time available in the drawing courses but probably mainly due to the fact the value of pictorial drawing for engineering purposes has been overlooked. Now that the war program has reaffirmed the importance of drawings in general and also demonstrated the usefulness of pictorial drawings some consideration should be given to finding a place for pictorial drawing in the curriculum. The ability to make pictorial sketches would certainly make a useful tool for the engineer.









Courtesy of the Northwest Airlines, Inc.

(Continued from page 21)

on the Basic and fundamental principles of testing. His talk was followed by a presentation by Professor M. R. Graney of Purdue University of various kinds of objective type examination questions that can be used in engineering drawing.

The highlights of these two papers were summarized by Professor J. L. Hill, Jr. of the University of Rochester, who also presented the report of the National Drawing Test Committee.

It was regularly moved and seconded that "The Division here assembled formally approves the work and efforts of the Test Committee to date and authorizes them to proceed with the necessary steps to validate the items and to prepare a final test form."

This was passed without a dissenting vote.

(A copy of the summary of the meeting is attached hereto for record).

Meeting adjourned 10:45 P.M.

REPORT OF THE BIBLIOGRAPHY COMMITTEE

PROFESSOR H. H. FENWICK
University of Louisville
(For the period May 1944-November 1944)

Author	Title	Edition	Publisher	Year	Pages	Price
Davis, D.J. & Goen, C.H.	Aircraft Mechanical Drawing	1	McGraw-Hill	1944		$
Greitzer, Samuel L.	Elementary Topography & Map Reading	1	McGraw-Hill	1944	157	1.60
Johnson, W.H. & Newkirk, L.V.	Modern Drafting	1	MacMillan	1944	197	2.50
Liming, R.A.	Practical Analytic Geometry with Applications to Aircraft	1	MacMillan	1944	277	4.50
Lobeck, A.K. & Wentworth, J.T.	Military Maps & Air Photographs	1	McGraw-Hill	1944	256	3.50
Nicholson, F. & Jones, F.	Blueprint Reading	1	VanNostrand	1944	141	2.25
Quier, K.E.	Engineering Drafting Probs.	1	Harper & Bros	1944	96	2.50
Roberts, W.E.	Beginning Mechanical Drawing	Rev.	Manual Arts	1943	111	1.80
Sloane, R.C. & Montz, J.M.	Elements at Topographic Drawing	2	McGraw-Hill	1943	251	3.00

MAGAZINE ARTICLES

Altenberg, G.W. - Training a Ship Draftsman in 6 weeks - Marine Engineering, 49:182-4 Mr 1944.

Blueprints that will pass muster - Comp. Air. Mag., 66:41-6 Ja 1944.

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Chicago Plumbing Contractors Assoc. - Draw it isometrically,- Dom. Eng., 163:76 Mr 1944.

Elberty, R.S. - Standard symbols facilitate circuit design; hydraulic control diagrams - Machine design, 16:97-9 My 1944.

Graphical construction of parabola through 3 points - Eng. N., 132:492 Ap-6 1944.

Hartley, E.M. & Liming, R.A. - Lofting problems of stream line bodies - Aero Digest, 43: Oct, Nov, Dec 1943.

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Gonzales, J. & Couse, W.P. - Simplified procedure devised for scaling perspective drawings - Product Eng., 15:409-13 Je 1944.

Kowal, W.J. & Paolucci, D.J. - Training draftswomen for emergency work - Machine Design, 16:95-8 Je 1944.

Lee, C.E. - Map making by primitive people - Special Lib., 35:79-83 Mr 1944.

MacDonal, J.A. - Marked blueprints aid toolroom - Am. Mach., 88:90 F-3, 1944.

Martin, Glen L. Co. - Trimetric projections facilitated by new tools; use of axonograph - Steel, 114:72 My 29, 1944.

Martin, H.C. - Graphical aids for designer and draftsman - Aero Digest, 43:219 D 1943.

Miles, T. - Template reproduction methods - Iron Age, 153:52-5 My 4, 1944.

New system of triangulation - Sheet Metal Worker, 34:53 D 1943.

Parks, H.E. - Shadowgraphs simplify pictorial drafting - Mach. Design, 16:129-30 Je 1944.

Pikington, H.E. - Dizzy diagramatics save time new system sketches with distorted ellipses - Power, 88:177-8 Mr 1944.

Scott, W. - Square root by graph and construction - Sheet Metal Worker, 35:60 My 1944.

Sheet metal books since 1880 - Sheet Metal Worker, 35:89-80 Ja 1944.

Silberman, J. - How to illustrate an annual report; statistical data in graphic form - J. Account, 76:479-83 D 1943.

Webster-Brinkley Co. - Isometric drawings help new workers and old hands - Steel, 114:116 Ja 26, 1944.

PROJECTIONS

Professor Ralph S. Paffenbarger has been appointed Chairman of the Department of Engineering Drawing at The Ohio State University succeeding Professor Robert Meiklejohn, who was Acting Chairman for two years following the retirement of Professor Thomas E. French.

Professor Paffenbarger has three degrees from Ohio State University, Bachelor of Electrical Engineering, Bachelor of Industrial Engineering and Master of Science.

He taught two years in the Chillicothe High School and was an engineer with the Ohio Fuel Gas Company two more years before coming to the Ohio State staff in 1919. He served as a Lieutenant in the Infantry during World War I. He is a member of the American Legion, the American Association for the Advancement of Science and has been active for several years in the Drawing Division of S.P.E.E. He has held a full professorship since 1936.

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Professor F. R. E. Crossley, instructor in Engineering Drawing, University of Detroit has resigned to take a position as Assistant Professor of Mechanical Engineering at Yale University.

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Professor S. B. Elrod and a staff consisting of Professor F. H. Thompson and Instructors M. H. Bolds and C. O. Mock of the Engineering Drawing staff of Purdue University are taining 110 Curtiss-Wright girls. The course consists of 15 drafting hours a week. Another program paralleling this one started October 1, 1944 requiring the services of two new additional teachers. These classes run six months and are under Professor H. F. Owen, Drawing Division Head.

INDUSTRIAL APPLICATION OF DESCRIPTIVE GEOMETRY

Professor J. Gerardi, Director of Engineering Drawing, University of Detroit, accepted a position as a stress engineer with the Nash Kelvinator Company in Detroit last summer. He works on helicopters and states, "believe me, we use descriptive geometry not only in drawing but also in design and stress analysis." Professor Gerardi is still directing the Engineering Drawing of Detroit University. Although working twelve hours a day he has a working arrangement whereby he can take off time for University duties.

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Carl L. Svensen, President of the National Council of State Boards of Engineering Examiners, gave his presidential address before the assembly during their meeting October 28 to 31 in Lexington, Kentucky. Svensen is Member-Secretary of the Texas State Board of Registration for Professional Engineers.

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Professor J. N. Arnold of the Engineering Drawing Department of Purdue University and a staff composed of Instructors Glen Halik and L. W. Thomas are teaching drafting to a group of 88 R.C.A. girls. They spend 20 hours a week in drafting for a period of six months.

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Lt. (jg) Edd L. McDonald, U.S.N.R., Acting Associate Professor of ASTP drafting, Agricultural and Mechanical College of Texas from November 1943 to February 1944 is on active duty with the Navy. He went into the Navy February 1, 1944 and was stationed in the East several months before taking up his duties as a gunnery officer on the A.P.A. President Monroe.

Word has been received of the death of Professor Thomas E. French on November 2, 1944. Tribute will be paid in a later issue of the Journal.

The annual meeting of the Society for The Promotion of Engineering Education will be held in St. Louis, Missouri June 21-24, 1945. Make your plans to attend and receive inspiration and learn about what is being done in other institutions.

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Professor Harold F. Meyer, of Aurora (West) High School, Aurora, Illinois writes that he feels the Journal of Engineering Drawing is versatile and that Professor R. R. Worsencroft, editor for the past three years, has made a very creditable production of the magazine. He states, "I have enjoyed reading the section where names, positions and localities are listed."

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Professor O. L. Duffin of Technical High, Springfield, Mass. writes "the journal is outstanding." The credit belongs to the former editor.

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Professor T. E. Curran, Principal of Troup Junior High School states, "It has been suggested that the Journal of Engineering Drawing would have greater value for us if it contained some material on secondary level for Junior and Senior high schools."

This is a good suggestion and the editor would like to have names of people and topics for such articles.

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Interested in a radio correspondence course in Engineering Drawing? If so, tune in WBAA - 920 on your dial, Purdue University's School of the Air, 5:15 P.M. Tuesday and Thursday and hear Professor Justus Rising impart "The Engineer's Language" via the radio waves. Sixteen weeks on Engineering Drawing, GE-11c which started September 19, 1944. The course is a combination radio and correspondence study. The students are expected to tune in for two 15 minute broadcasts and complete five hours of laboratory work each week.

We understand that his radio voice is very good.

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Professor Norman J. Pitt, East Technical High School, Cleveland 4, Ohio has this to say about the Journal, "I enjoy the Journal of Engineering Drawing very much. Each issue has new ideas of value."

Professor C. E. Rowe of The University of Texas has been made Assistant Dean of Engineering. He will continue to do some teaching in Engineering Drawing and Descriptive Geometry. Professor Rowe graduated from the University of Colorado in 1900 with a B. S. in C. E., receiving an E. M. degree from the Colorado School of Mines in 1902. His practical experience includes mining and railroad surveying, designing and construction and professional engineering practice in Colorado. During World War I he did airplane designing for the Packard Motor Car Company.

Professor Rowe is author of "Engineering Descriptive Geometry" and the Bulletin, "Basic Models for Engineering Drawing and Descriptive Geometry". He has one of the finest array of models to be found anywhere.

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Professor Henry D. Welty, Central High School, Akron 4, Ohio, wishes the Journal to publish an article on one point perspective. Drawing teachers, who do you suggest to write such an article? The May issue of the Journal of this year carried two interesting articles on perspective.

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Professor V. D. Hales, Head of the Engineering Drawing Department of Fenn College writes, "I have always enjoyed receiving the Journal of Engineering Drawing and I believe that it is very helpful and informative to those of us who are teaching in this field."

Professor Hales, like many other drawing teachers, is interested in drafting tests. Considerable space is devoted to the testing committee reports and minutes in this issue of the Journal.

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The Engineering Drawing Department of Texas A. & M. College enjoyed a profitable two day visit from Dr. Kenneth W. Vaughn of the Carnegie Foundation for the Advancement of Teaching in early October. A dinner was given in his honor and the evening was devoted to a discussion on how to build and validate drawing examinations. During his visit Dr. Vaughn spoke to the faculty of the college on testing in Engineering Education and to the Heads of Engineering Departments on the administrative advantages of examinations.

Professor Paul S. Wheeler of Central High School, Bartlesville, Okla. would like to know what industry expects the Engineering Drawing courses in college to give students. Reference to the following articles in the Journal of Engineering Drawing will help answer this question:

1. "Quinine" by Professor A. S. Levens in the December 1936 issue of the Journal records the results of a limited survey to help formulate an answer to the question, what training in graphics does industry require of young engineers?

2. "Present Day Drafting Requirement of Industry" by Werner L. Serger, Engineer for Gisholt Machine Company, page 2 of the February 1942 Journal.

If these papers are not available they may be had from the editor for cost of reproduction.

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Professor Warren J. Luzadder of the Engineering Drawing Department of Purdue University visited colleges and universities in Michigan during October.

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Professor Harry Billman, Kiser School, Dayton, Ohio is interested in an article on the teaching of dimensioning including tolerances, etc.

On page 7 of the November 1939 Journal is an article on dimensioning breaking the part up into type forms. This paper is discussed on page 10 of the same issue, of the Journal of Engineering Drawing by Professor H. C. Hesse, the University of Virginia under the title "Size Description". Another discussion of the paper was published in the February 1940 Journal, page 2 by Professor Ralph T. Northup of Wayne University.

"Student Checking and Dimensioning of Detail Drawings" will be found on page 8 of the February 1942 Journal by Professor A. Jackson of Queen's University, Kingston, Ontario.

"Size Description" is discussed by Professor John M. Russ of The University of Iowa in the May 1937 Journal.

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Professor J. N. Wood, Circulation Manager, Journal of Engineering Drawing, reports the present subscription list is bigger than at any time in the past. Send in your 1945 dues to Professor Wood if you have not already done so and invite others to become subscribers.

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Professor Frank Zozorha of Lafayette College has transferred to the Engineering Drawing Department of Purdue University.

Professor Thomas E. French and daughter, Janet, of Ohio State enjoyed a pleasant vacation in the New England States this past summer.

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The editor needs help and requests that the Heads of Engineering Drawing Departments or the person in charge either act as a reporter of news for the Journal of Engineering Drawing or appoint some member of their department to report news items such as appear under projections, etc. Many have signified a definite interest in personal news briefs and it is through your cooperation that such items are made available. Tell us what you are doing and share with others your ideas. News should be in the editors possession December 25 for the February issue, March 25 for the May issue, and September 25 for the November issue of the Journal.

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Professor H. M. McCully, Head of the Engineering Drawing Department, Carnegie Institute of Technology visited his son, who is in the Armed Services, on the West Coast last spring. While in California he made extensive studies of the aircraft industry.

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Professor Clair V. Mann, Head of the Engineering Drawing Department, Missouri School of Mines and Metallurgy who prepared a history for his home county recently, enjoyed an extended vacation following the S.P.E.E. meeting in Cincinnati last summer delving into the history of the first family to settle around Rolla, Missouri.

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Professor L. E. Stark of the Engineering Drawing Department of Texas A. & M. College resigned effective October 1, 1944 to go into private business. His position has been filled by Mr. B. M. Galloway, a Texas A. & M. graduate, who spent several years with the Magnolia Refinery.

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Mr. Gale E. Thompson of the Engineering Department of North American Aviation Corporation has accepted a position in the Engineering Drawing Department of the University of Texas.

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Professor F. M. Porter of the University of Illinois has accepted the Chairmanship of the Descriptive Geometry Nomenclature and Notation Committee authorized at the Cincinnati Drawing Division meeting in June. He is thoroughly familiar with this work having made a similar study in 1933 for thirty leading Descriptive Geometry textbooks. Be prepared to make suggestions for a simple yet definite and inclusive set of notations for Descriptive Geometry.