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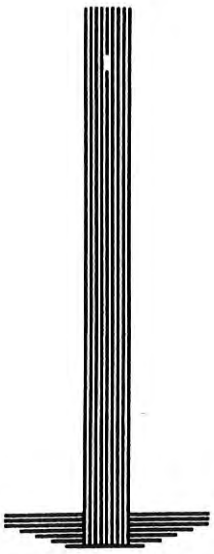
JOURNAL OF ENGINEERING DRAWING



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THE DIVISION OF ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY
S P E E

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

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CONTENTS

PUBLISHED BY THE DIVISION OF ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

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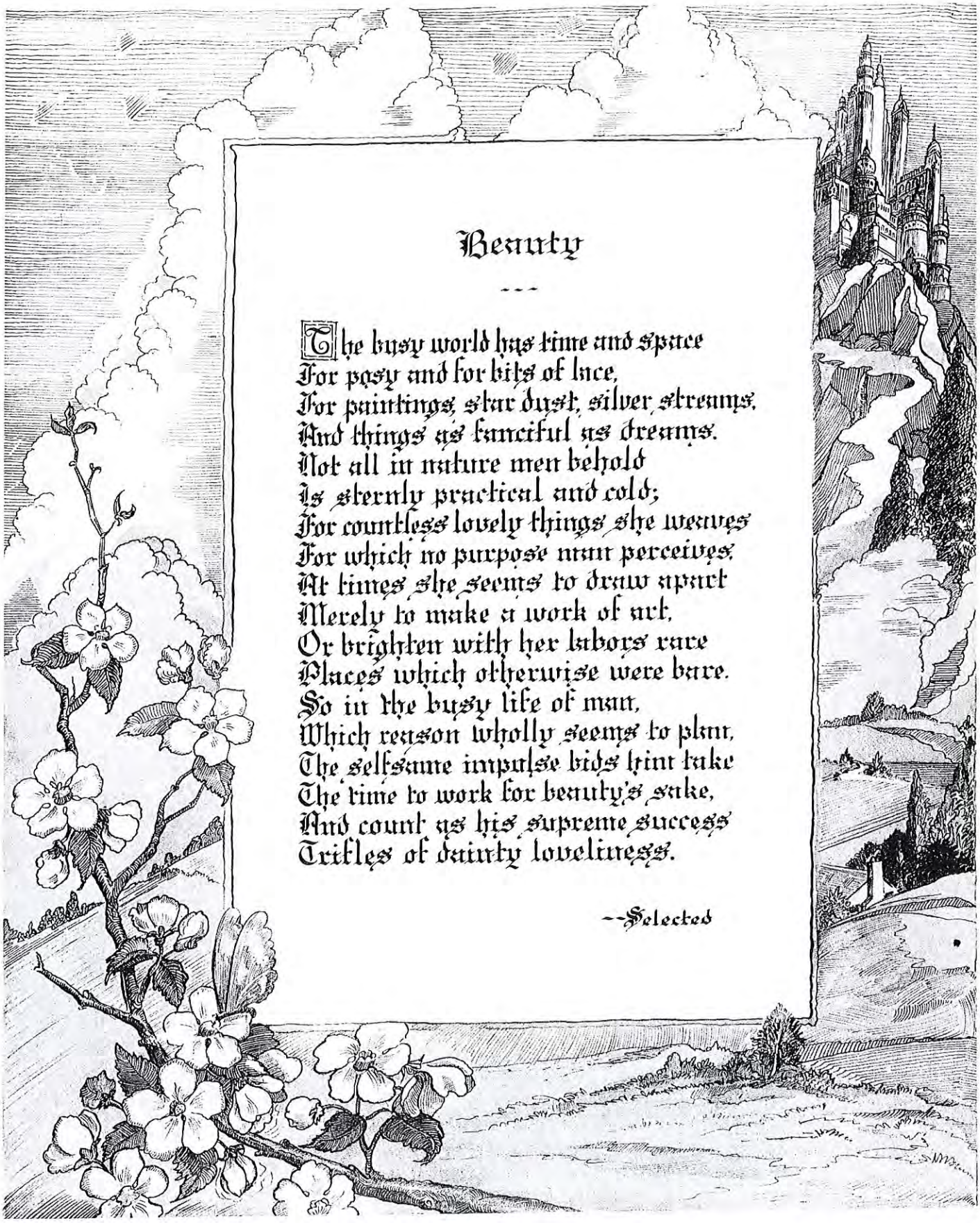

Beauty

The busy world has time and space
For posy and for bits of lace,
For paintings, star dust, silver streams,
And things as fanciful as dreams.
Not all in nature men behold
Is sternly practical and cold;
For countless lovely things she weaves
For which no purpose man perceives.
At times she seems to draw apart
Merely to make a work of art,
Or brighten with her labors rare
Places which otherwise were bare.
So in the busy life of man,
Which reason wholly seems to plan,
The selfsame impulse bids him take
The time to work for beauty's sake,
And count as his supreme success
Trifles of dainty loveliness.

—Selected

The Editor's Page

"FORWARD, THE DRAWING DIVISION!"

Guest Editor
C. V. Mann, Chairman,
Drawing Division of S. P. E. E.

Several interesting and valuable lines of activity for the Drawing Division were suggested and agreed upon at the meeting of the Executive Committee, held in Chicago, February 17, 1940.

The first of these is the plan to hold mid-year Drawing Division conferences in the Chicago-Detroit metropolitan area each year. These conferences would include in their membership not only those who are college teachers of engineering drawing and descriptive geometry, but also interested persons, particularly those in the field of teaching high school graphics, and those who are engineers in industry who have an interest in graphics. Next year's mid-year conference is already being looked forward to with high interest.

Of course the main divisional meeting at the University of California (Berkeley) holds first place among events immediately ahead. One thorough-going conference session, together with a divisional evening dinner -- addressed by some eminent engineer -- and a later noonday luncheon business session will be the features. Only one conference session was planned in order that drawing teachers collectively might have the opportunity of attending one of the several conferences on engineering.

Perhaps the most important activity this year planned by the Executive Committee is a national study of the teaching of engineering drawing and descriptive geometry. This is to be all-inclusive in so far as that can be arranged. The study is to include the teaching of drawing in high schools, in vocational and trade schools, in junior and senior colleges, and even within the organization of various industries and engineering enterprises.

In some way the Drawing Division hopes to make arrangements for a research fund of approximately $2500.00. It is possible that a "hook-up" can be made with the Federal Office of Education, through cooperation of which the publication of a suitable bulletin, including the results of the study, might be arranged.

One of the very interesting features of the Chicago conference was a paper read by Mr. H. D. Campbell, listing the unit goals, or achievements, which might be expected of the student who had pursued drawing through the courses in Machine Drafting. What would you, the reader, think the student who had progressed this far should know and be able to do? Do you agree with the objectives so ably described in this issue of the Journal, by Professor Arm of Purdue?

The suggestion is made that the Drawing Division attempt to produce a satisfactory syllabus covering the entire field of engineering drawing. The Division is not so sure that such a syllabus, covering descriptive geometry, can be prepared, because of differences of opinion that exists among teachers of descriptive geometry who, on the one hand speak of their methods as "fundamental" and on the other hand speak of them as "direct". The writer of this editorial is of the opinion that no situation within the Drawing Division calls more for careful study and reduction of teaching ideas, notations, and so forth, to a common denominator, than does descriptive geometry. When all of the arguments are in, there is a basic unity in the descriptive geometry field which is being obscured by all this controversy over fundamental and modernistic methods of teaching. There can be, and should be, a correlation between the work of the Drawing and the Mathematical departments which it is easily possible to demonstrate to the student. The writer feels that the teachers of descriptive geometry, by their lack of unity as to method of teaching, are providing the very loophole which is being used by teachers in the upper years to minimize the time devoted to descriptive geometry, or even to eliminate it from the curriculum. This is surely a situation which requires a remedy.

Another situation which certainly must have interest, and might cause some concern among college teachers of engineering drawing, is the undoubted fact that numbers of the teachers of drawing in trade and high schools are doing a most excellent job. We are tempted even to say that some of the high school teaching is superior to some of the engineering college teaching. What is the trend? Are engineering drawing and descriptive geometry being taught more and more in the high schools, vocational schools, junior colleges, and even in the teachers colleges? On the evidence at hand we think the answer must be an emphatic "Yes". Does this then mean that the engineering profession is giving over the teaching of engineering (in the form of engineering drawing and descriptive geometry) in some cases directly to the colleges of education, or teachers colleges, and in other cases giving it over to the teachers who have been prepared in such colleges of education? If such is the fact, what becomes of the philosophy, voiced in meetings of engineering teachers, by some engineering educator who has nothing but contempt for the college of education, that "nothing good ever came out of the college of education"? Is, or is not, the drawing that we are teaching real engineering? Should it be taught to our engineering college students with a definite engineering flavor? If it should, then what about accrediting those students who come to the engineering college after having had courses in drawing under non-engineering teachers who received their training in the college of education?

If drawing and descriptive geometry are not the essence of engineering, then it should be possible to carry on practical engineering work without the aid of engineering drawings. Let us put away, tear up, eliminate all of the drawings such as are commonly made for contracting and construction purposes on engineering works and projects. How shall we then proceed with the engineering construction on the project? It must be obvious that engineering drawing is of the essence of engineering.

AIMS OF A MODERN COURSE IN APPLIED DESCRIPTIVE GEOMETRY

By
Harold B. Howe
Associate Professor of Engineering Drawing
Rensselaer Polytechnic Institute

Throughout various phases of the past from the time of the early Egyptians through the 15th century period of the ideas and inventions of Leonardo Da Vinci, geometry played its part in the achievements of mankind. It was not, however, until toward the end of the 18th century when Gaspard Monge, a French engineer, first made it known that a new kind of geometry could be used to advantage in designing fortifications, that the subject known as Descriptive Geometry came into being. For some time the scope of this discovery was kept as a military secret.

Apparently, from the claims of its originator, it must have been used formerly as a practical subject. However, I presume after years of thought and resourcefulness the students of Geometry and Mathematics discovered that it held great possibilities for the developing of the mind. Thus many theoretical problems were devised which required varying amounts of reasoning in their solution. The problems were not set up in their simplest form and made to be solved in the one space quadrant, but were confused, perhaps intentionally, by the use of all four angles of projection. The inclined planes were represented by their intersections with these quadrant dividing surfaces, and by means of revolving and projecting, the true size of angles could be shown and other desired values obtained.

Undoubtedly, the treatment of problems of this sort developed the power to visualize and plan solutions. The weakness of this system, as we have found it, was in its unwieldly adaptability to the very reason for its creation - to help solve practical problems.

A number of years ago, fortunately, some of our teachers of this stimulating subject again saw the need which it might serve, the solution of problems of a practical nature, and books were written stressing this important phase of the subject. This department used a text of this type for some years in teaching Descriptive Geometry. Some students could grasp the thrill of solving practical problems by these theoretical methods, but many struggled rather vaguely in their attempts to apply this theory to the practical. Students who had graduated, when asked if they ever used this subject in their daily work, intimated that they had not recognized it.

It seemed to us that our problem was to make them see where this subject did apply, so in the drawing room problems we found that it was necessary to deviate from the four-quadrant, trace-of-plane system in favor of what one of the more recent textbook writers calls the Direct Method. This change in method produced improved student interest, and we could see an opportunity for making Descriptive Geometry serve a much broader purpose in the engineering student's education.

Not long after this, several texts were published using this so-called Direct Method of solution and at that time both our theory and drawing courses were reorganized to more adequately include the application field.

It is apparent that the measure of this change in system is not in the percentage of men passed or in the median of marks attained. The human element involved makes the comparison by marks alone confusing. However, the improved attitude of the student toward the subject while taking it, the numerous citing of examples of its use by young graduates back for reunion, the arousing of teacher interest in accumulating good problems from practice, and the enthusiasm incited in the presentation of the subject, all indicate that better results are being obtained by the use of this newer, integrated system of theory and its application.

Undoubtedly one of the chief values in studying and applying Descriptive Geometry lies in its adaptability to the development of visualization. Visualization does not confine itself to the realm of scientific endeavor. Although we with technical attributes may realize our need of more of it, obviously it is most essential to all the concepts of mankind. It is evident that some have more, let us say, natural power than others, and many have surprisingly little. But, if by any means we can arouse that which is dormant or encourage that which already has its boots on, we should make the effort. Certainly the successful individual is the one who, by looking ahead, may visualize the danger or the opportunity and prepare for it.

Why, may we ask, is this subject (Descriptive Geometry) which in its theoretical form of the past was disliked by many and taken as a tonic, now in its more practical form so interesting and adaptable for developing this power to see what we look at and plan what we seek? There are numerous reasons. First, the scope of the subject matter is flexible. A wide range of engineering problems

assures a student and teacher interest which is a large half of the successful consideration of any subject. Second, the integration of fundamental theory directly with its interesting applications is conducive to desire for more knowledge. Third, the application problems involved are accessible to student inspection, both in reality and in picture form, and arouse in him the curiosity to apply the theory of analysis to other situations which previously were seen only by the eye and not by the mind.

Due to the position that this visualizing type of development has in the curriculum, namely in the early years when of necessity much time of the student is devoted to the study of fundamentals, these application problems have a strong appeal to the student who is anxious to start studying engineering.

I do not mean to imply that training in visualization is limited to this type of course, but rather that this training broadens the scope of engineering problems and alleviates the tendency to parrot-fashion design and plan, and helps to supply a better understanding in the obviously more complicated situations encountered in the later courses.

Aside from the visualization training in viewing objects or projects from advantageous positions, the analyzing of methods of procedure in the solution of problems, and the training received in the methods of procedure, we have, by the use of Descriptive Geometry, a graphical means of measuring angles, lengths and stresses. We study the development and intersection of surfaces, and receive training in the orthographic expression of the more complicated industrial space problems.

In clarifying the procedure involved in the solution of complicated graphical problems, we might think of the analogy between it and a mathematical problem solution. In the graphical solution, an analysis of the given conditions and an understanding of the desired result, followed by careful planning of a logical procedure of solution, will give a result where the graphical answer is evident. Likewise, the mathematical solution of a complicated calculus problem may be carefully analyzed and broken down into simpler forms which are easier to solve.

Descriptive Geometry in the present applied form has a wide range of service in the developing of the young engineer because of the broadening of engineering interest, the appeal to the student, and the consideration of the type of situations which deal with engineering projects. However, just a series of problems would defeat the purpose of the course. A continual integration of the fundamentals, with the analyzing and planning of their applications, build a foundation on which an intelligent superstructure of the more advanced space and even social problems may be added.

In conclusion, with due consideration to the practical usefulness of Descriptive Geometry, I wish to stress the fact that we are fortunate in finding in this subject the opportunity for arousing and strengthening the mental concepts called visualization. This, it must be acknowledged, is a most important asset in forming and directing our future actions.

Note: This paper was read as a part of the program presented by the Department of Engineering Drawing at a departmental advisory committee meeting held at Rensselaer Polytechnic Institute, Troy, New York on April 6, 1940. This advisory committee was composed of representatives of industry, high school faculty members, trustees and graduates of the Institute, and heads of the degree-granting departments. This was one of the departmental meetings which are being conducted for furthering the aims and duties of the Institute.

H. B. H.
May 1940

A Brief of TEACHING MACHINE DRAWING IN A SECONDARY SCHOOL TO MEET INDUSTRIAL NEEDS

By
H. D. Campbell,
Morton High School, Cicero, Ill.

The Morton Schools serve a district populated largely by factory workers. Because very few of the high school graduates went away to college, vocational industrial courses, including drawing, were instituted in 1923 and a junior college was established in the following year.

To prevent the development of an industrial peasantry, it was decided to prepare vocational students for entry either into industry or into pre-engineering college courses. The curriculum includes, therefore, four years of English, three years of mathematics, three years of natural science, and two years of

social science as well as four years of shopwork and drawing.

The first year of shopwork is devoted to industrial-arts courses given for the purposes of guidance. Freshmen who plan to elect vocational drawing take two semesters of related work in their sophomore year - pattern making and machine shop. During their junior and senior years they spend three clock hours a day in the drafting room.

The first step in planning this two year course was to make an analysis of the subject to determine what a graduate should know and be able to do. Each student is given a copy and periodically checks his progress.

One of the early problems concerned drafting practices which were less standardized then than today. During the years 1927 to 1932 questionnaires covering one hundred and twenty-five controversial points were sent to three hundred firms engaged in the principal manufacturing activities throughout the United States. Two hundred and twenty-three firms in all cooperated in this survey which has been of great value in making our instruction practical.

Our method of instruction is based on the design of simple machines, tools, and equipment which are later made in the shops. Students in their fourth semester act as squad leaders, designers, and checkers and supervise detailers and tracers who are third and second semester students respectively.

Customary methods of instruction are employed in the first semester in teaching fundamentals and in developing technique. When it is found (in checking their analyses) that advanced students, due to the nature of the projects upon which they have worked, have had no instruction in certain of the learning units (cams, gears, or developments, for example) they are taken off production work and given individual instruction in these units.

Graduates who enter industry can continue their education locally while they work either in the adult evening school or in evening classes in the junior college. Tool design, production methods, and strength of materials are offered in the former while descriptive geometry, as well as College mathematics and science, is available in the latter.

The results of this combination of general and vocational education has been most gratifying. A recent survey of all graduates in the last five years shows that 52% are working as draftsmen, 17½% are in work related to their trade, 17½% are in college, 10% are in unrelated work, and 3% are unemployed.

ADMINISTRATION AND TEACHING

By
H. C. T. Eggers
Professor of Engineering Drawing,
University of Minnesota

This paper attempts to answer four specific questions which were assigned as topics for discussion at the drawing division meeting of the North Mid-West section held at Iowa City, Iowa, October 20 and 21, 1939. The opinions expressed here are the writer's own and probably do not coincide exactly with those of others interested in the same problem. However, they are presented here for what they are worth with the expectation that they may serve to stimulate discussion in problems of mutual interest to teachers of Engineering Drawing.

1. What should be the nature of tests and examinations: Objective, Problem, Essay, Oral?

Before attempting to answer this question let us first divide it into two parts, namely:

First: What is the best type of examination to an individual student or to a small group of students?

Second: What is the best type of examination to a large group such as is present in the average-size drawing class?

I have had the experience (as perhaps we all have) of observing a student who through concentrated study has so prepared himself that he is able to work out most any problem that he is given in such a subject as Descriptive Geometry without knowing the most fundamental things about the subject. In other words, he can work problems but he doesn't know why or wherefor. He has memorized operations instead of developing his reasoning process. Such a student can pass a course and forget it completely the next week. In fact it seems that his brain capacity is so low that he must clean house after each course in order to make room for the next one. Such a student would have little chance at passing an oral examination in the subject.

I always dislike to have a speaker say that at such and such an institution we do it this way because, unjust as it may be, I always feel he is implying that his school does it right and everybody else does it wrong. Let me say then that at a certain school with which I am acquainted I have heard that a student may petition for credit in a course without taking the work if he has prepared himself by private tutoring, by his own individual study, or by having taken the work in a so-called non-accredited institution. In such a situation the student is usually given an oral examination. If he satisfactorily passes that hurdle he is given a written examination. I am told that without exception every such student who has satisfactorily passed the oral part of the examination has had no difficulty in passing the written part.

To individuals or to small groups, therefore, I feel that the oral examination conveys more information to the examiner than any other type.

Let us now talk about the best examination to be given to larger groups where oral examinations are more or less impossible from an administrative standpoint. Personally, I don't pretend to pose as an expert on the subject of examinations. There is without question a great deal to be said for and against any particular form of examination. After all, the purpose of any examination is to determine how much the person examined knows about the subject. Any type, irrespective of its form, which answers this question must be classified as a good examination. Even the most enthusiastic starry-eyed expert will admit, if cornered, that no one type of examination is preferable to the exclusion of all others. One of my pet peeves is the expert who is so sold on one type that he will tie himself in knots in order to show the versatility of his method for meeting all possible situations and contingencies.

Such a subject as Descriptive Geometry adapts itself conveniently to the problem type of examination although it is possible to include some of both the objective and subjective form. In the case of other courses in the drawing department the objective type does not seem to fit in as well, although a little of this form may be used. The problem and subjective types seem to work out the best. If problems are short and selected so that they cover the fundamental elements, the problem type of examination should be adequate in my estimation to take care of at least 75% of our examination needs.

2. On what basis should the grading of drawings be placed?

a. Graded after checking and correction.

b. Graded on a deduction basis for errors.

c. Graded on the basis of acceptable or rejected.

The grade which a student receives on a drawing involves three things: completeness, accuracy, and appearance. The instructor can therefore give three grades on each drawing or he can combine them into one grade. If the problem is to be checked, returned to the student, and again handed in it will be necessary of course for the instructor to record some sort of a grade at the time he first returns the drawing. This might well serve as the grade for completeness. The grades for the other two items mentioned may be deferred until the plate is finally submitted.

There is a great deal to be said in favor of grading a plate on the basis of acceptable or rejected. The main thing is that it prevents a lot of arguments. Any instructor should be able to distinguish between work which is acceptable and that which is not. He should also be able successfully to defend his position if such a grade is questioned. Even with many years of experience an instructor's grades are more vulnerable to criticism when they are in "lettered" or numerical form. Since a grade in drawing must take account of such unmeasurable things as accuracy and appearance it is certainly not possible to say that a particular drawing should have a grade let us say of 73 in numeric form or even a grade of C in lettered form. The point I am trying to bring out is that the grade of 73 is really not 73 at all but possibly 73 ± 10%. A student, if at all bright, receiving such a grade, could find without much difficulty someone's plate apparently no better than his own, carrying a higher grade. For an instructor to try to defend his markings on the two sheets in question would be embarrassing to say the least. It is desirable, of course, for an instructor when he is making out the final grade for the course, to be able to list the students in his class according to their proficiency. He cannot do this with only + or - marks in his record book. I would have him put only + or - (accepted or rejected) marks on the sheets returned to the students, but would have him record an estimated numeric or lettered grade in his book. In other words, let us be honest with the students as well as with ourselves. While the individual recorded grades might be susceptible to errors of ± 10% the law of averages would insure that the grades over the entire course would reflect fairly accurately the student's ability.

3. Should all problem and drawing work be done under supervision?

This question requires so many qualifications that it is, of course, impossible to give a direct answer. Before starting on a discussion of this question let us first define the word "supervision." In the broadest sense of the word I would say, without qualification, that all drawing work should be done under supervision. However, as I interpret the question, I believe that "supervised work" is work done in the drafting room in the presence of the instructor.

Using the word then in its narrower sense I personally have always been in favor of a great deal of supervision in the teaching of drawing. However, I don't feel that all drawing work should be supervised or that such a situation would even be desirable. The student in a beginning course who is simultaneously faced with the task of manipulating a set of strange instruments as well as learning a new language, should have a great deal of personal supervision. Later, when the student's main problem is improving his technique through the repetition of working out problems, such rigid supervision is neither necessary nor desirable.

Whether work is done in the presence of the instructor or not, it most certainly should be done in the drafting room. Most any teacher in drawing knows that work in his course done outside the regular drafting room is usually unsatisfactory. Such work is generally done under poor lighting conditions, sometimes with makeshift instruments, and usually without the use of a satisfactory table. These conditions tend toward carelessness and the development of bad habits.

4. What are the relative values of problems completely laid out by the student and problems of the completion type as methods of teaching?

Throughout the past decade there have been many innovations in education and educational methods. During all this time the teaching of drawing has remained more or less static. Recently, however, those engaged in the teaching of drawing have witnessed a tremendous amount of activity in their province. Where formerly the field was dominated by one text we now have many excellent texts. Associated with many of these new texts we find so-called layout sheets containing problems of the completion type. Some people have become so enthused over these sheets that they seem to have lost all sense of proportion. To them, here at last, is the answer to all their difficulties. Maybe I am an old sour-puss but I just can't get all steamed up over such stereotyped problems. It is true that these problems are valuable for a first course in drawing for teaching a student to read that highly idiomatic language, Orthogonal Projection. In the cases of dimensioning and sectioning they fill a very great need, since they permit the solution of large numbers of problems in a limited time. They also permit the student to concentrate on one fundamental idea to the exclusion of others, which is valuable from an educational standpoint.

Without question then such problems are a valuable asset and serve a very useful purpose. However, when the student gets through school and into engineering practice he will be confronted with original problems which are not set up for him. It will be necessary for him to start with a blank sheet of paper. He will have to decide on size of drawing, scale, arrangement of views, and all other factors involved in producing not only a workable but also an attractive drawing. If our job is to prepare the students to meet successfully their problems of later life then certainly we will be derelict in our duties if our courses fail to provide tasks comparable to those which they will meet in practice. So let us use problems of the completion type but let us be careful that we don't exclude thereby, more valuable original practice, though it may require greater teaching ability to administer it properly.

WHAT CAN DRAWING DEPARTMENTS CONTRIBUTE TO TRAINING FOR DESIGN?

By
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Purdue University
Lafayette, Indiana

"Assuming that courses in Engineering Drawing are designed primarily for the purpose of preparing men for the study of the design courses, what type of material should these courses include?" This question, advanced by your Editor, had prompted the setting down of a few ideas on this subject by one who is teaching Machine Design to upper classmen.

In order that these remarks should not reflect the opinions of but one person, nor be interpreted to be a criticism of only one or a few drawing departments, we have consulted with others of our colleagues here at

Purdue University and at several other well-known schools of engineering. This article, therefore, represents opinions and observations of a number of men who have taught at a number of different institutions; the ideas presented seem to be the consensus of opinions formed as a result of rather widely varying teaching and industrial experiences.

It seems to us that there is not enough general agreement among teachers of Engineering Drawing as to what should be presented in their courses. Methods and procedures vary, and subject matter presented depends to a very great extent upon what the head of the department thinks the drawing course at his particular institution should be. Some graphics departments, like some shop departments, are still teaching a "manual training" type of course, while others have gone to the other extreme and are attempting to teach more engineering than drawing. Many, it is true, have reached a happy medium and are offering a good course, not only in engineering, but also in drawing.

We who teach Machine Design would be very happy if our students were to come to us having certain information and abilities which we summarize and later discuss below:

1. The ability to represent in the form of a technical sketch, clearly, quickly and neatly, an interpretation of a written or verbal statement describing an arrangement of mechanical parts or the proportions of a single part.

2. The ability to use standard drawing instruments and auxiliary drawing aids.

3. A thorough understanding of the standard drawing conventions.

4. An understanding of the principles of correct dimensioning and the practical reasons for these principles.

5. An ability to interpret Engineering Drawings correctly.

6. A skill in lettering.

7. An understanding of the fundamental fabricating and machining processes as these processes affect the drawings of some of the more common machine parts.

8. A reasonable degree of familiarity with the terminology of machinery.

9. An understanding of the principles of graphical representation of statistical material or engineering data by means of charts and graphs.

It seems to us that all the needs just mentioned should be included in every good course in Engineering Drawing. The material mentioned in Items 7 and 8 above is contained partly in the shop courses, but in the discussion which follows, we hope to indicate the contribution which drawing departments may make toward the student's understanding of machinery. We do not believe that we are being unreasonable in expecting that our colleagues in those departments should train their students in such a manner that they will be able to meet such requirements. Perhaps many of our readers might believe that we are asking drawing departments to accomplish too much in the time allotted to their courses. We agree that, in many schools, drawing time has been cut too severely. However, we cannot help but feel that all of our requirements could be met in the drawing course of average length. The writer has had intimate contact with one graphics department which for years has been successfully carrying on substantially this program in three two-credit hour courses, or a total of six class hours per semester for three semesters.

In the type of work which we do, one of the first and most important steps is to make a good technical sketch based on the information at hand. From this, most of our computations are made and the ultimate design is evolved. Furthermore, a good sketch enables one to check graphically the specifications of the problem and often it indicates the method of attack. This sketch may or may not be done free-hand, depending upon the type of problem being considered. Whether free-hand or not, the sketch should be intelligible to be read and interpreted correctly by anyone, even by one entirely unfamiliar with the details of the problem. It is our opinion that few of our students know how to make an acceptable sketch even of the most elementary type of problem. We do not advocate that all engineering freshmen be required to take a separate course in sketching or free-hand drawing, but we do believe that this type of training should be taught and required in all of the elementary courses in Engineering Drawing.

2. When we ask that each student have the ability to use standard drawing instruments and auxiliary drawing aids, we are not asking that he be trained in such a manner as to make him a finished draftsman. We are agreed, however, that he should be able to use his instruments properly and that he should have some conception of the functions and uses of the architect's and the engineer's scales as well as of the various irregular curves. How often do we see the student using his 10 scale to scale off the magnitude of a vector and then taking a paper and pencil to compute the required value, when he could have read

that value directly from his 30 scale. Also, need we mention the many times that we see a student making a drawing to a scale of, say, 3" = 1 ft., using his sixteenths scale and dividing all his dimensions mentally?

3. We would like to have the student know such things as the proper way to designate a cross-section, the conventional methods of showing center lines, dimension lines and section lines, and the standard methods of indicating screw threads, finished surfaces, chamfers and the like.

4, 5 and 6. We believe that these points are sufficiently clear so that they demand no further elaboration here.

7. An understanding of the effects of different production processes would necessarily involve material presented not only in Engineering Drawing, but also in shop courses. However, there is every good reason why work presented in both departments should be coordinated to the benefit of the student. Those of us who have spent considerable time in industrial practice, particularly in design, realize the great effect which different machining and fabricating processes have on the drawings of machine parts. In order to teach this material, it would be necessary that much of the drawing time be spent on detailing machine parts instead of the trick gadgets which are used in a number of drawing courses. Perhaps the use of such blocks and gadgets is desirable in the teaching of elementary projection, but we believe that the student would benefit if a considerable amount of time be spent on a study of the details of the simpler and more common machine parts.

8. We believe that any engineering student, when he is ready to begin the courses in Machine Design, should know precisely what is meant by such terms as gear, shaft, and crank and such features as bore, boss, hub, spotface and countersink, and that he should know how to show them properly on a drawing.

9. It has been our experience that most engineering students must be taught either in the first courses in Mechanical or Electrical Laboratory or in Mechanism the making of charts and graphs and the determination of proper scales for such charts and graphs. We believe that this type of training properly belongs in the courses in Engineering Drawing so that the student learns early in his career the value of this type of graphical representation, and how properly to present statistical material in this manner.

In addition to the topics and skills specified and explained above, there is a very important by-product of courses in Engineering Drawing which applies not only in our work in design, but contributes to the necessary training of the thinking processes of the embryo engineer. This by-product has to do with neatness in general and the orderly presentation of engineering data. In our opinion, a good course in Engineering Drawing, with its presentation of suitable lettering, practise in complete identification data, titles, tabulation, choice of suitable scale, and orderly arrangement, should instill in the student habits of logical, methodical thinking and presentation. This, it seems to us, should be one of the broad objectives of the teachers of these elementary courses.

Several years ago, the writer was privileged to attend a dinner meeting of the Engineering Drawing Section at the time of one of the annual meetings of the Society for the Promotion of Engineering Education. The main speaker at that time emphasized the opportunities which exist for the drawing departments to perform an extremely valuable service to the engineering profession as a whole, by starting the freshmen engineers properly in the technical studies of the profession. To this thesis we agree most heartily. Nowhere else in the engineering curriculum does such an excellent opportunity present itself. Most students have been inspired to select the study of engineering by some very definite motivating force. This force, in many cases, is somewhat artificial, but it is nevertheless real to the student. The glamour of aeronautical work, the supposedly unlimited opportunities in air-conditioning and in internal combustion engine work, and the mysteries of radio and television are among the agencies operating to attract an increasing number of students to our courses year after year. Because of these and other reasons, there has been kindled a spark of interest in engineering which, if properly handled, can be made to grow into a flame of desire for all things technical. For this reason, we believe that only the very best teachers should be assigned to the first engineering courses which students encounter. Many engineering college administrative officers apparently do not subscribe to this view, since one often finds the least experienced teachers assigned to the Departments of Engineering Drawing and to the Shop Laboratories. Also, for this same reason, the course content and the teaching methods employed should be alive and should tend to tie up as much as possible with the work of later courses, so that the interest of the student may be sustained until he begins the work of his major field, usually in his junior year. These first courses should also be designed to eliminate those who have received either the wrong type of guidance or no guidance at all and who should learn early in their college careers that they have erred in selecting a suitable course. In this connection, we do not advocate that drawing departments set

themselves up as testing agencies, to the detriment of their real purpose - the teaching of Engineering Drawing. There are a few such departments where relatively little time for teaching is available because of the time devoted to the testing program. We believe that this sort of program should be taken care of either by the Personnel Departments or by competent Psychological Clinics which should be in all modern schools. It seems to us that, after all, these are the people who have been trained to do this work and who are best able to interpret the results of reliable aptitude tests and other similar measuring devices.

Professor A. S. Levens, in his excellent paper entitled "The Effect of the Tendency to Reduce Engineering Drawing Time", printed in the January, 1940 issue of the JOURNAL OF ENGINEERING EDUCATION, raises a rather pertinent question. He asks, "And what of the 40% to 50% of entering freshmen who never graduate? What can they do if they drop out of school at the end of the sophomore year? What good has the training they received done them? What courses other than drawing give them a fair chance to enter the engineering field?"

We do not subscribe to the theory that the drawing courses should prepare these students who leave college by the end of the second year to secure positions in engineering offices as draftsmen. Many of these students leave because they are not fitted for engineering; the sooner they get into some other type of work for which they are more nearly suited, the better off they will be. The course should be laid out to prepare the 50% to 60% who go on to the work of the upperclass years for the more advanced courses in structural design, machine design and electrical design. In other words, all courses included in an engineering curriculum should be taught with the idea of their individual contributions to the preparation of the student for his professional career. In order properly to coordinate all the courses in the curriculum, there should be some mechanism in operation which would enable teachers to know what has been covered in prerequisite courses and what is desired by teachers in later work. Probably one of the best means of accomplishing this coordination is by an exchange of instructors among the Design Departments, the Departments of Engineering Drawing, and the Shops. Several years ago, due to an unexpectedly high enrollment in several of our courses in Machine Design, we borrowed the services of two of the more permanent members of our Engineering Drawing Department staff. During the semester spent with us they were able to make suggestions which proved extremely valuable to us in our work. On their return to their regular assignments, they made suggestions which have caused the adoption of several changes which will be of benefit to the students in preparation for our courses. The writer believes that there is too much of a tendency to specialize among teachers of engineering subjects, especially in the larger schools, and the general adoption of such a plan of exchanges of instructors within an institution not only would tend to coordinate the different courses, but would also broaden the viewpoints of the instructors as well. After all, we are all working toward the same objective - that of insuring proper training to our students so that they may take their places in engineering practice. Therefore, we believe that it would be of benefit to our students and to the profession if we should work together more closely in the future than we have in the past.

DESCRIPTIVE GEOMETRY RIDES AGAIN

By
Jasper Gerardi
Director, Engineering Drawing
University of Detroit

No course in the engineering curriculum has been tossed about as much as Descriptive Geometry. It held a place of dignity in days of Gaspard Monge when it was one of the military secrets of Napoleon's armies and it has toppled to the waste paper basket, if we believe the opinions expressed by some engineers, draftsmen, and, believe it or not, teachers of Engineering Drawing. Between these two extremes it has tried to survive. In some institutions of higher learning it enjoys its just place; in others it is a course to fill in or waste time. Some teachers of drawing devote their lives to imparting a better understanding of Descriptive Drawing; others, feeling that "too much time is spent on shape description", begin to eliminate many of the important principles of the course until it is so eviscerated that it becomes an easy prey to the curriculum maker looking for a place to insert some other course.

But why all this controversy? Descriptive Geometry is a course taught to men who some day will be engineers. The engineer is responsible for the completion of a project. He is responsible for the proper functioning of a machine or structure. Although he may

WHERE THE PATHS DIVIDE

Every educator knows that all students fall into two distinct groups... those who "can" and those who "can't". Sociologists find the same true of adult men. Some, it seems, are marked for success. Others, apparently, are doomed to mediocrity or downright failure despite seemingly equal opportunities.

What is this difference in men which sends some along the path to achievement and others down the dismal trail to disappointment? Usually it is a matter of *viewpoint*. Whether the student of today becomes a draftsman, doctor, salesman or mechanic in the world of tomorrow, his ability to discern between the good and the shoddy, his feeling for true craftsmanship, his reverence or indifference for ideals, will be major factors in his success.

"Viewpoint" is not a catalogued subject in any curriculum. Yet it has its place in every intelligent educator's teaching. It is taught by example or it isn't impressed on the youthful mind at all. It often finds its first expression in an instructor's attitude toward drawing instruments. When he shows genuine concern in their quality... in their accuracy... *in the maker's name*

College statistics show that faulty viewpoint is responsible for more failures than indolence. This, in itself, indicates the importance of the instructor's attitude in the earlier formative years of schooling.

on the instruments his pupils use, he has grasped a golden opportunity to create a correct "viewpoint" where the paths between success and failure divide.

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not do any of the drafting work, it is his responsibility to hire men who can do the work he specifies. The engineer expects draftsmen in his employ to know how to solve the unusual problems of drafting. If the draftsman cannot work these unusual problems then the engineer is expected to set up the problem in such a way, that the draftsman can complete it. The solution of these problems, then, becomes the responsibility of the engineer.

A person doing routine work in a drafting room may not realize the importance of Descriptive Geometry; as a matter of fact, he may not know that every time he makes a drawing he is solving a problem by applying some of the principles of Descriptive Geometry. This same person will also find it difficult to make, understand, or read a complicated drawing, because he has not had the proper training in visualization, a training which Descriptive Geometry is preeminently capable of giving. Visualization can best be taught at a time when the mind is flexible. Hence, the reason for the insertion of Descriptive Geometry in the Freshman or Sophomore Engineering curriculum.

Visualization is like a catalytic agent in the brain. It stimulates the power to think logically. Thinking is the hardest job we do. Is this, perhaps, the reason that Descriptive Geometry is unpopular with students and others?

Teachers of Engineering Drawing may find of interest the following quotations from a letter the writer received from Mr. A. R. Stevenson, Jr. of the General Electric Company who is in charge of training programs for graduate engineers.

"Out of the hundreds of men we employ every year we try to select approximately ten men who, we hope, have the spark of ingenuity and inventiveness. We try to develop any spark of this kind which may exist, by every means in our power, circulating the men to work with outstanding scientists, ingenious inventors, development engineers, etc."

"It was suggested that we teach Descriptive Geometry with the idea that it would stimulate the visual imagination in the hope that improving the visual imagination would improve a man's ingenuity."

Mr. Stevenson then states the contents of the course which is given to the students of the General Electric Company and continues:

"Both the instructors and the students were enthused over this course."

"In teaching Descriptive Geometry we go at it from an engineering fundamental standpoint, making sure that the fellows really understand what they are doing and that they are not committing to memory a series of meaningless rules."

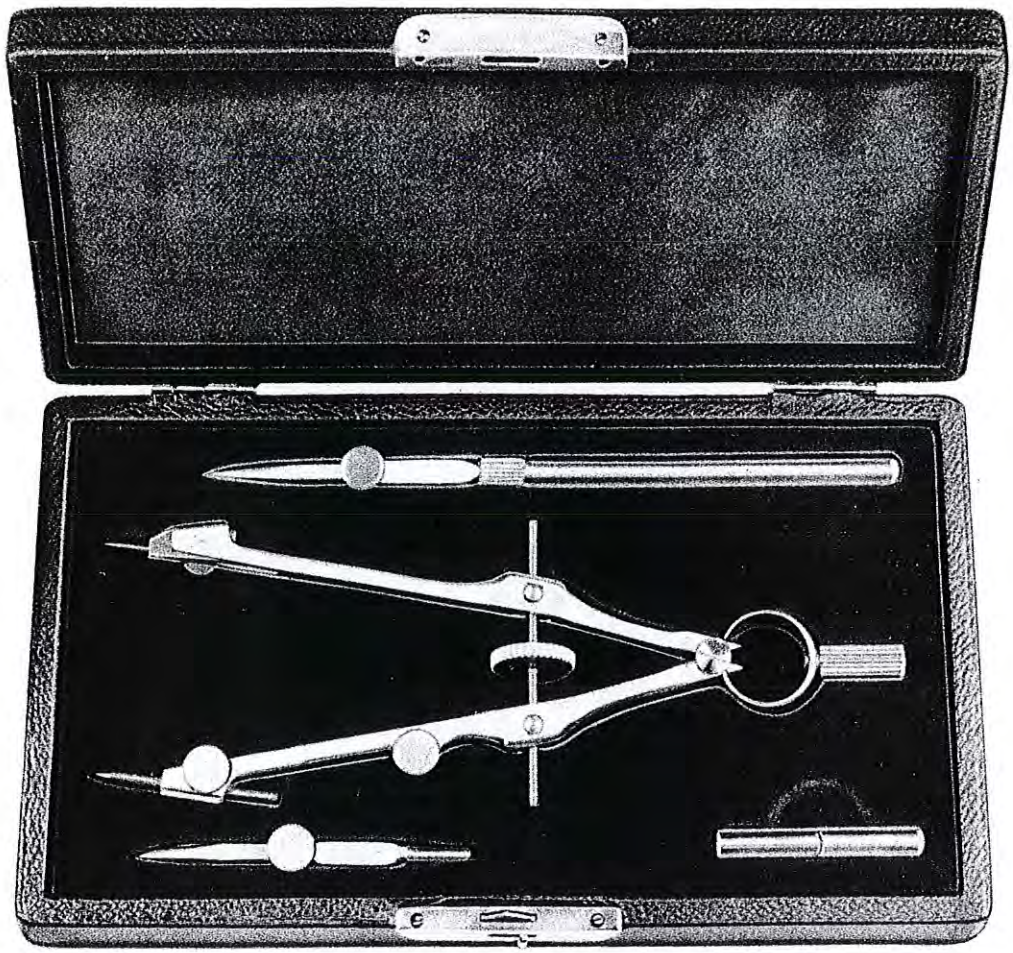
An orchid to Mr. Stevenson! Here is a leader in the field for engineering and engineering education who recognizes the value of a course in Descriptive Geometry and gives Descriptive Geometry the job of developing the visual imagination of our future leading engineers. We teachers of Descriptive Geometry will do well to apply Mr. Stevenson's methods to our students and seriously take his suggestion: "Make sure that the fellows really understand what they are doing.

James T. Larkins, Jr. of Pennsylvania State College has just produced a text that he titles: "Descriptive Geometry", nothing more or less. In the preface he states that no attempt has been made to cover the whole field of the subject. Result: one of the clearest and most interesting presentations that has ever been published.

Each topic is introduced by simple discussion of what it is all about, the student is told why the subject under consideration is presented; the sequence is logical.

Mere memorizing is discouraged. Short cuts and mechanical solutions serve no useful purpose in such courses as this text is intended to supplement.

In short, since this subject is of practical worth to Engineers only after they understand and know how to use the fundamentals, the text rigidly confines itself to those fundamentals. Prentice-Hall has done a first rate job in printing this book in fresh modern type. The illustrations are excellent.



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ADVANTAGES OF SUPERVISED DRAWING PERIODS

By
Prof. O. W. Potter
Dept. Engineering Drawing
University of Minnesota

The objectives of any drawing course in the engineering schools might be stated as follows:

1. To develop in the student a certain degree of skill in lettering and the making of complete engineering drawings.

2. To develop the ability to read and interpret the technical drawings of others, that is to think in three dimensions.

3. To familiarize the student with manufacturing processes and engineering nomenclature.

The problem confronting all drawing departments is how best to attain these objectives in the relatively short time allotted to drawing courses. The total time scheduled for drawing courses in many schools is only about 200 hours. Out of this must be taken time for lectures and quizzes leaving perhaps 175 actual working hours. In an engineering drafting room this would be equivalent to about five weeks' intensive time. Industry has often criticized the ability of engineering graduates to make good drawings but what do they accomplish in training on a single specialty in five weeks in their own drafting room? This does mean, however, that very careful planning is necessary to utilize best the time available.

Because of the limited amount of time available, drawing departments have planned their courses to include varying amounts of outside work, that is, work not directly supervised. They have felt that this is necessary in order to give the students the desired training. There are certain advantages and disadvantages to such a program.

It is pretty generally conceded that beginning students today come with less previous training in graphics than in years past. Many of the students have had no experience whatsoever in the use of drafting instruments. The beginner is awkward at the start in the handling of these tools, and the best way to teach him the proper use is to show him how, and to correct him when he uses them improperly. Most of us learn more quickly by being shown, rather than by being told how. The only way that this can be done is to have the student under the direct supervision of an instructor so that he can get individual attention. If a beginning student in drawing is required to make drawings unsupervised he is very apt to develop many wrong habits of practice.

The beginner makes many errors; lines will be omitted, visibility will be wrong, views will be misplaced, and many mistakes of ommission and commission will be made. Shall we allow the student to continue these errors and to submit drawings that are inaccurate and incomplete? Under direct supervision these errors can be checked and corrected as they occur, and the result will be a much improved technique and the student will have had the experience of correcting his own mistakes, which is much more impressive than to have them merely called to his attention or to be noted only by a grade without constructive criticism.

There are many short cuts that the student does not know and these can best be demonstrated as they occur. This not only saves the time of the student, but develops good habits of drafting. Many times there is a misunderstanding on the part of the student as to just what is required and unless the instructor is at hand to advise him, he may spend hours doing something that is not necessary at all. Some will say that with adequate written or oral instructions that it is better for the student to be on his own and learn to take instructions and follow them. That may be true to a certain extent, but never-the-less instructions are often not any too clear and the instructor may forget that this is the first experience for the student while for him it may be an old story. Too many instructions make the problem valueless. The fact remains that students do get confused many times as to just what is required of them. Under direct supervision this can be properly taken care of by timely guidance, which is the best form of teaching.

Where home work drawings are required the student must either have two sets of equipment or he must take his tools back and forth between the drafting room and home. This is unsatisfactory. It is hard on equipment, and drawings frequently become smeared and torn. It often happens that the student does not have the required tools at the right place at the right time, which promotes careless habits of drafting. Also working conditions in the students' room either at home or in the dormitory are usually not as good as in the drafting room. The lighting is apt to be poor and the drafting table some makeshift rickety affair like a card table. Under such

conditions good drawings can hardly be expected.

The program of most students is such that home work must be done in late afternoon or evening. This is the poorest time of the day to do drawing and is very hard on the student's eyes. Some may suggest that the regular drafting rooms be kept open all day and the student allowed to come in whenever he has free time. If the school has ample drafting room facilities so that this does not interfere with scheduled classes this may be done, but many schools are not so equipped.

Another undesirable feature of having a course planned to include both scheduled drafting room time and outside time, is that students have the tendency to loaf during the regular class time with the idea that they can catch up on outside time. If the student understands that the regular scheduled drafting room time is all the time he is going to be allowed, he is more apt to tend strictly to business and work harder than if he is given extra time.

Another condition which the student is constantly up against is the budgeting of his free time to his various courses, work, recreation, etc. It is very easy to make assignments for home work but too often too little thought is given to the time required to actually fulfill these assignments. Some teachers seem to take the attitude that their particular subject is the most important and the only one the student has. This pressure on the student means that something is going to be neglected and this might be the drawing assignment just as well as anything else. This condition puts an especial burden on the student who must do outside work to stay in school and there are many of them. This monopolizing of the student's time prevents him from participating in extra-curricula activities such as athletics, musical organizations, social groups, and the like. Some will say that the student is in college to get an education and should not dissipate his time on these unessentials. This is a questionable attitude as many of these activities are just as "educational" as required courses, in that they train in leadership, give the individual poise, and teach him how to mingle with and get along with others. Who has not known of an individual who was a class-room drudge who did nothing but routine work, who was a social misfit among his fellow students outside of the classroom? Participation in these extra-curricula activities can only be had while a student is in school and they offer certain cultural advantages that can be gotten in no other way. Engineering students have been accused of being too narrow and specialized, and lacking in cultural outlook. They therefore should not be deprived of participation in activities which offer broadening advantages. It is not necessary nor is it reasonable to require all the student's "free" time for scholastic work.

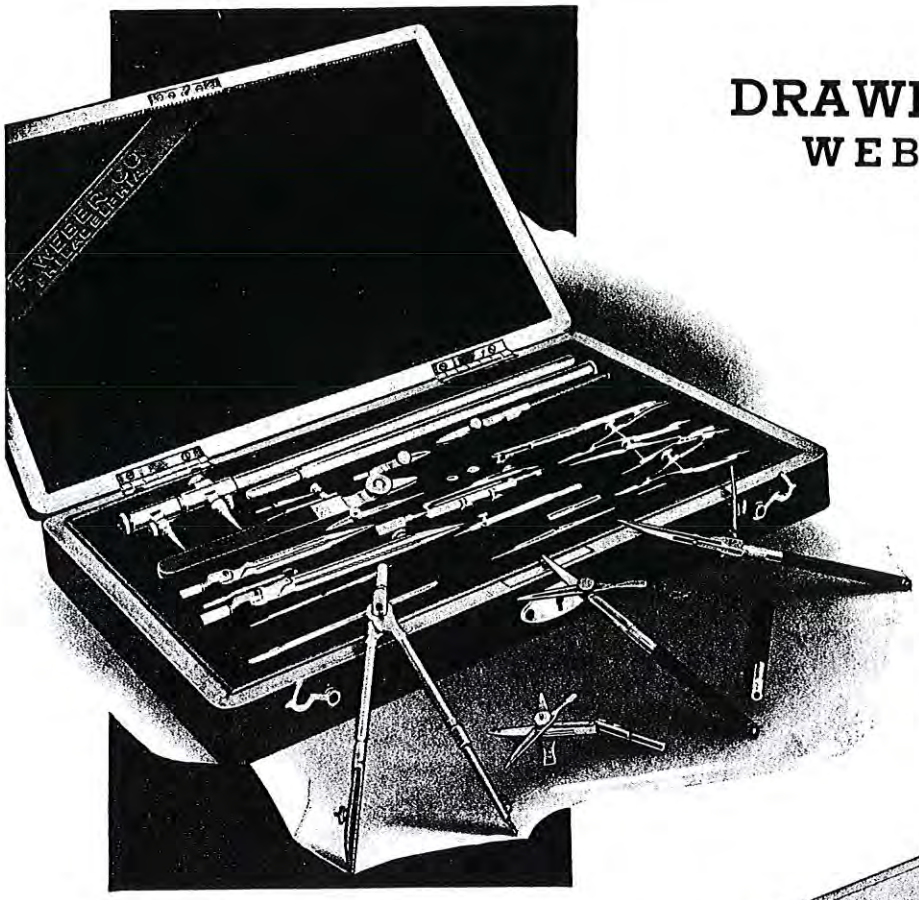
There is the problem of honesty. How do we know that the work done outside is the student's work? Especially when pressed for time, it is a real temptation to the student to hire someone else to do some of his tasks for him. We hear that there is more or less cheating going on and why offer another opportunity? If the drawing is all done in the drafting room under the supervision of an instructor this problem can be eliminated.

It is generally agreed that the only way for a student to develop good drafting technique is to go thru the process of making drawings, the more the better, and also the quickest way to learn to read drawings is to make them. Drawing departments cannot follow drawings thru the various manufacturing processes as industry does. The school trains the student by requiring him to make many drawings both mechanical and freehand, some from sketches, some from models, by using reading exercises, translations from pictorial to orthographic and vice-versa, and by demonstrating the application of geometry, mathematics, and descriptive geometry to engineering problems. All of this takes time and the tendency is to assign more and more outside work in order to cover the desired field. A carefully planned course under the direct supervision of an instructor is the best way to get the most done in the minimum time.

Another feature of supervised work is the reaction on the teacher. By close contact with the student he is better able to determine the student's weaknesses and to devise problems that will be best adapted to eliminating them. It greatly broadens his experience and makes the work more effective and interesting.

School administrations sometimes take the attitude that drawing is an unimportant subject and anybody can teach it. Frequent comments from industry would lead us to believe that they think good training in graphics is very important. From experience and observation the subject of graphics is not an easy subject to teach if it is done right.

The practice of having student assistants or fellows teaching drawing or supervising laboratory classes presents several objections. Such assistants are usually poorly trained in graphics and since this is only a side line for them their main interests are often elsewhere. This condition fails to arouse the interest of the student and it is definitely reflected in the quality of his work. To have such assistants function under a



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supervising instructor can work out satisfactorily. The assistant may remove some of the drudgery from the instructor by keeping records, filing, supervising quizzes, checking and the like, so that the supervising instructor can keep in closer touch with the students.

Some schools, especially junior colleges, often have instructors teaching drawing along with a number of other subjects. In many cases the main interest and training is along other lines. Under such conditions the training in graphics that the student acquires is very inadequate and reveals itself when the student gets into the senior college. In such schools it is quite general to have the major part of the work done unsupervised and many of the problems are often of the copy type. Under such conditions the student develops poor drafting habits, and is deficient in graphical understanding.

Various studies have shown that the great majority of the students who start an engineering course find their life's work in the field of engineering regardless of whether they finish their course and get a degree or not. Training in graphics has been especially valuable to these students. The most effective way to give the student a good background of training in graphics is to have him in a course directly under the supervision of a competent instructor at all times.

There are certain topics that may be assigned as outside work for students in drawing which require little if any actual drawing. The study of text assignments, reading exercises, freehand sketching, and lettering are some of the things that a student can do at home without involving the use of much equipment. This kind of outside work can be done without taking up an unreasonable amount of time and can be of great help in supplementing the regular work in class. After considering all these various conditions, supervised drawing classes offer the best means of training in graphics.

May 1940

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Summer Course in Graphics for High School Teachers

By
John T. Rule and Albert L. Coyne*

No standard course in the secondary school curriculum has greater variation in subject matter and method of teaching than Mechanical Drawing. No set of secondary school teachers has had less direct training in the theory of their subject than teachers of this subject. A very great majority have never studied the principles of graphic representation as a necessary foundation for the work which they are doing. They have, in general, acquired mechanical drawing because it was a necessary adjunct to another major activity - either woodworking, machine-shop or art. Their teaching is necessarily limited by their experience and has, consequently, a decided bias in the direction of the field through which they approach it. The high school teacher who has prepared himself to teach mechanical drawing as a fundamental course in all graphical representation, is practically non-existent. One who has had a course in descriptive geometry is a great rarity.

This is not a criticism of the high school teacher who often is forced to teach the subject though it is only secondarily related to his major interests or his major teaching field. It is, however, a direct reflection on the attitude of secondary school administrators to the fundamental important of graphical methods, an attitude which quite naturally cannot be changed by teachers who themselves do not understand this importance.

We have an average of 600 entering freshmen per year at the Institute. The great majority of these have had some drawing experience. We are, however, unable to make any considerable use of this beyond the initial advantage to the student of facility in handling tee-square and triangles. His information is almost invariably limited to specific factual knowledge with only a bare minimum of understanding of fundamental graphical processes. He will know how to make front, top and right side views as a rigid system with no thought that this is a very specific example of a general projective theory. He will know how to make an isometric drawing by rule of thumb but will not understand its derivation. He will know that dimensions are necessary to a working drawing

*Chairman Section of Drawing, M.I.T. and Drawing Teacher at Rindge Technical High School, Cambridge, Massachusetts.

but will not in any way correlate them to manufacturing processes. Consequently we must begin with him at the beginning, assume that he knows nothing and give a great deal of time to ground work or to breaking down bad habits already formed.

None of these students know, because their teachers did not know, that graphical representation is a fundamental subject in its own right in the same way that Mathematics and Physics are fundamental subjects and that in teaching its mastery its practical applications are of secondary, and not primary, importance. If the gap between high school and university practice is so great that the latter can make no use of the former, basic spade work to create a greater understanding between the two is vitally necessary.

Some five years ago there was formed a New England association of high school teachers of this subject for the purpose of elevating the status of the subject itself and of endeavoring to emphasize to school administrators the value of graphics as a vehicle of learning. Soon after the formation of this association, certain facts became evident. First, there was a considerable amount of confusion regarding what should be taught, thus there was little uniformity of emphasis on the various divisions of graphics; second, many of the more important parts of the subjects were untouched and apparently unfamiliar or totally unknown to the teachers; and lastly, that untrained teachers were numerous due, in a great degree, to the faulty understanding on the part of administrators. As expected, many teachers were found to be vocationally qualified in specialized machine drafting but had little of the general broad conception of graphics.

Spasmodic efforts by the Massachusetts State Department of Education had been made to correct these conditions. These had accomplished a certain amount of good, but due to lack of time and the very limited geographical appeal, it was thought the time opportune to make a more comprehensive effort to combine consideration of content of course and method of teaching by direct education, under the auspices of an outstanding educational institution. This plan, in its barest form, was placed before the Institute Drawing Department.

THE SUMMER COURSE IN GRAPHICS FOR SECONDARY SCHOOL TEACHERS given at the Institute was the direct result. In line with the above considerations it was established with the following objectives:

1. To acquaint the teacher with basic graphical theory by teaching projection as a general process for representing space objects and solving space problems and by teaching the technique of getting views in order to give greater mobility to representation.

2. To increase his respect for the subject and his confidence in its importance and thus to raise its level with respect to other secondary school subjects, also to give him material and background with which to improve the attitude of his administration toward his subject.

3. To give him at least a speaking acquaintance with the various specific techniques of practical importance, such as architectural, topographical and structural drawing, perspective and nomographic charts. This, of course, to be aimed definitely at breaking down his bias in favor of his particular approach.

4. To smooth out and unify over a period of years, the subject matter of secondary school drawing courses in order that the Institute itself may be freed in future years of the necessity of devoting valuable time to teaching fundamentals that might easily be acquired at lower levels.

The summer of 1939 was the first year of the course. Due to lack of intensive advertising the class was rather small. The conclusions reached are consequently subject to change as we have greater numbers from which to judge. Three hours a day from 9 to 12 for thirty days were scheduled. The first hour was devoted to a lecture and a general discussion of teaching methods, course content, high school administration problems and the like. The following two hours were spent in the drafting room and were devoted exclusively to teaching graphics. As we felt that the time put in and the work done would vary considerably, we divided the work into required problems and suggested problems, and kept the drafting rooms open all day for those who cared to devote extra time.

The following results are of interest:

1. The students were of a much higher level of intelligence and lower level of training, than we had anticipated. Their background and experience was even more diverse than we had expected. Only one had had a course in Descriptive Geometry. Mathematical ability was negligible.

2. Their desire to learn was much beyond our anticipation. We discovered immediately that practically the entire class intended to do everything we could give them. On the great majority of days a substantial majority worked until four or five o'clock. A canvas of the class at the end of the course indicated an average time for the whole class of eight

hours each, per day including evenings, was devoted to the course though only three were required. This certainly was a most illuminating fact. It does not speak well of the opportunities which the universities had previously offered these men.

3. We only partially expected the most outstanding and revealing fact of the entire course. This was that they knew less about and learned more from, the time devoted to orthographic projection than any other subject. With the exception of one student they quite definitely did not know how to obtain auxiliary views by any logical process! Furthermore they were fascinated by the ability to generalize orthographic projection into a three-view system by the use of reference lines and the direct method. Most of them felt that this ability, which should be fundamental with anyone teaching the subject at any level, was the most important thing they learned.

The fact that the great majority of teachers of the subject should not be acquainted with the basic process of getting views, is a revealing commentary on the attention that has been paid to their fundamental training. Ten days were devoted to this phase of the work carrying through to normal views of a plane.

4. As expected, each student was spottily acquainted with one or more of the specialized fields but none with all of them. They were most acquainted with working drawings - and were quite surprised that we devoted no time to them. Pictorial drawing, perspective and architectural drawing were understood in about that order. Conic sections and nomographic charts were least understood. Mathematical training was, in general, very limited. One of the most intelligent students in the class did not know how to plot a curve from its equation even for a straight line. However, he devoted two or three full days to the subject and rapidly became proficient. This is an interesting sidelight on training in this field when it is remembered that plotting curves is taught in first-year algebra. Unquestionably a great majority of his students must have known more about this graphical subject than he did.

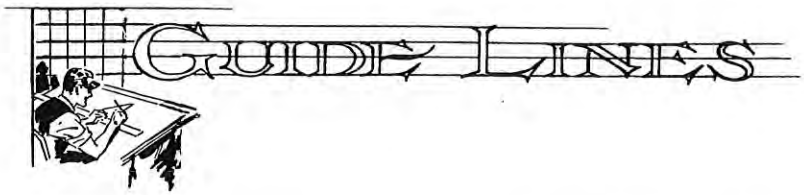
In this connection we definitely attempted to broaden the concept of the function of a high school drawing teacher by assuming that anything graphical was his legitimate field. Work on conic sections and nomographic charts was done with this in mind. We contended that knowledge of these fields and their introduction into high school courses would definitely increase the importance of the drawing teacher in the eyes of other departments, chiefly Physics and Mathematics. Nomographic charts were completely unknown and we experienced a great deal of difficulty with them, though we did succeed in showing their power as a tool for enabling students to solve mathematical formulae. We did know that where they had been introduced they had redounded greatly to the credit of the drawing teacher. We felt and still feel that this is the most neglected subject in the entire field of graphics.

5. Drawing technique was not good. Dull pencils and mediocre lettering were surprisingly prevalent.

No interim grades of any kind were given in this course. We expected a wide diversity of training and took the view point that the purpose of the course was to help each individual to develop himself as much as possible starting with the knowledge he already had. This proved a very successful procedure for it avoided personal sensitivity. We were also convinced by talking with the students who registered that one of the major reasons for the smallness of the class was the teacher's fear that his background was so feeble as to make him unable to comprehend the course material. Two or three who successfully took the course stated that they had almost decided against it because "I did not want to make a fool of myself". The implications of this attitue are quite important.

Some interesting features of the course are worth mentioning. Weekly lectures were given by outside speakers on related subjects. Professor McCully spoke on drawing instruments and materials. A lecture was given on "the administrator's point of view", and on stereoscopic drawing. Occasional trips were made to manufacturing plants, reports were made by the students themselves on their teaching problems. These reports were freely discussed in class. A library of text books collected from publishers to acquaint the students with the literature in the field was available at all times.

We await with interest the coming summer. We are emphasizing that any teacher of Mechanical Drawing in a secondary school can take the course regardless of his experience and that he need have no fears of his own inadequacy. If we again find that we gather a group of rather high intelligence and great anxiety to learn but of spotty training we shall begin to feel not only that the course may accomplish a great proportion of its objectives but that it is filling a real need which the Universities have heretofore neglected.

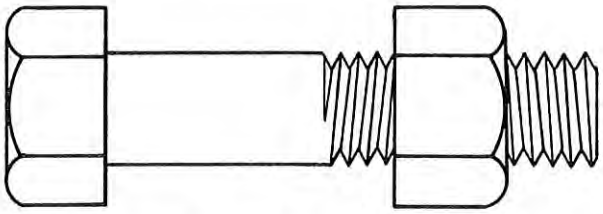


Quo Vadis? might well be the general theme for this edition of the Journal. Our guest editor indicates "forward" is our direction, but warns us that there is likely to be considerable shifting about of cargo and unrest among the crew, along the journey. Our contributors suggest a detailed manifest of our precious freight and a careful chart of our course, while there is general concern in defining our destination.

At a recent conference of science teachers it was discovered that the syllabi for courses in High School Physics were identical with those being taught in colleges. Does that imply that the quality of work that may be assimilated by boys of High School age is to be regarded in the same category with what may be expected of their more mature years in college?

If and when Engineering Drawing is so thin in quality that it can be relegated to the preparatory years, then the sooner we get it out of the college curriculum the better. Maintain quality or the word Engineering is meaningless.

F.W.S.



One engineering drawing student's idea of making threads on a bolt. Isn't it obvious that if right-hand threads are necessary for putting on the nut, left-hand ones are necessary for taking it off? Is this standard nerts?

Only a relatively small number of engineering students who take beginning drawing will ultimately find employment as engineers. Of these, still fewer will have to do with drawings either in the making or use.

What does engineering drawing have to contribute to the general education of the student which will be of benefit to him if he never looks at a drawing again? Does it have such values? If so, what are they?

R. P. Hoelscher

The Engineering School of Tufts College has established the Gardiner C. Anthony Scholarship in honor of former Dean Anthony, who was for many years dean of Tufts Engineering. This scholarship should be of particular interest to teachers of engineering drawing, as it is to be awarded principally on the basis of the candidate's knowledge and ability in mechanical drawing.

The competition for the scholarship is being conducted under the auspices of the New England Mechanical Drawing Association, and entrants are limited to students from secondary and preparatory schools of New England. They must be students graduating in June of the current year with sufficient credits to make them eligible to enter Tufts Engineering School in the Fall, and of high moral character and scholastic standing.

The competition consists of an examination in mechanical drawing made up of two parts: first, a written examination on questions taken from standard texts on this subject; second, completion within a specified time of a mechanical drawing of a simple mechanical device.

The scholarship is a substantial one, amounting to one full year's tuition ($300).

NEW BOOKS OF INTEREST TO TEACHERS OF DRAWING

COLLEGE ENGINEERING DRAWING by L. M. Sahag, Professor of Machine Design and Drawing, Alabama Polytechnic Institute; (John S. Swift Co., Inc. St. Louis). This text is a result of the authors many years industrial and teaching experience, and has been in use in his classes for the last six years. It includes all the necessary chapters which a great percentage of our colleges are able to cover in their first and second year courses. Each chapter contains many illustrations as well as text material.

ENGINEERING LETTERING by L. M. Sahag of Alabama Polytechnic Institute; (John S. Swift Co., Inc.). Contains thirty 8½x11 lettering plates with guide lines and model lettering on each plate; to be completed by the student. In addition, twenty pages of text on the theory of vertical and inclined lettering.

On February 17, 1940, a mid-winter meeting of the Drawing Division was sponsored by Armour Institute of Technology, Chicago, Ill. This was a one day meeting, and included a drawing conference in the afternoon, and a dinner meeting in the evening.

Chairman of the afternoon conference was Prof. J. M. Russ of the State University of Iowa. The speakers were Mr. H. D. Campbell of J. Sterling Morton High School of Chicago, whose subject was "Teaching Machine Drafting in Secondary Schools to Meet Industrial Needs", and Prof. Justus Rising of Purdue University, who spoke on "Machine Methods of Scoring Tests for Engineering Students". A round table discussion of the first paper was lead by Mr. R. N. Bryan, Asst. Chief Eng., Wisconsin Steel Works of the International Harvester Co. Prof. F. M. Porter spoke briefly on the "Journal of Engineering Drawing" and Prof. Stanley Hall of Illinois on the National Drawing Competition sponsored yearly by the Division.

Dr. Claire V. Mann, Missouri School of Mines and Metallurgy, and Chairman of the Division of Drawing, presided at the evening dinner meeting. President H. T. Heald of Armour gave the address of welcome. Prof. F. G. Higbee of the State University of Iowa talked on "The Past and Future of the Drawing Division". "The Importance of Engineering Drawing to the Chemical Engineering Graduate" was discussed by Dr. R. C. Kintner of Armour. Prof. T. E. French of Ohio State University gave a short address on engineering drawing, and Prof. H. C. Spencer of Texas A. & M. College, Secretary of the Division concluded the meeting with "A Preview of the California Meeting in June".

The Texas Section of the S. P. E. E. held its Ninth Annual Meeting on March 22 and 23, 1940 at the College of Mines and Metallurgy at El Paso, Texas. The Drawing Division was represented by a large number of teachers from many of the Texas Colleges of that section. Prof. C. E. Rowe of the University of Texas acted as Chairman of the Drawing Conference on Saturday. The paper of Prof. O. A. St. Clair of Texas Technological College, "Do our Drawing Courses Offer Training for Both Engineers and Industry" was read by Prof. C. C. Perryman also of that college. The general meeting was honored by the presence of Dean O. J. Ferguson, President of S. P. E. E.

C. E. Rowe

IMPORTANCE OF ENGINEERING DRAWING TO A CHEMICAL ENGINEER

By

Robert C. Kintner,
Armour Institute of Technology

NOTE: This is an extract of the paper read at the Engineering Conference, Engineers Club, Chicago in February 1940. The Editor apologizes for condensing the paper to less than 1/4 the original.

The Author described the introduction of Chemical Engineering into this country as a result of the World War. The first teachers of Chemical Engineering were industrial chemists.

It was only natural in those early days that teachers of Engineering Drawing and of chemical engineering should get together in the faculty club to discuss the amount and type of instruction that this new kind of engineer should receive.

You may imagine the struggles of the prewar chemists from liberal arts colleges to interpret blueprints in terms of actual machinery. The answer to the question of the engineering drawing teacher as to what is desired, was invariably to the effect that the chemical engineering student must "learn to read a blueprint."

Now, the ability to "read a blueprint" is not acquired by a single session of burning midnight oil. One must learn to read little blueprints first. And in order to read even a little blueprint, one must learn how the thing came into being. Hence the need for a teacher of engineering drawing, to help the prospective engineer acquired knowledge and and skill in the Graphic language, to letter so the other fellow can read the lettering, to tell a story so that some other workman can obtain a clear, unmistakable conception of the thoughts of the writer. In other words, the chemical engineer must learn and learn well, the common language by which all engineers, of every variety, communicate with each other with dispatch and precision.

Now let us jump some years of time to the year 1921. In that year the first acceptable textbook was published on the series of mechanical operations which we call the Unit Operations of Chemical Engineering. "Walker, Lewis and McAdams" became the name of a monument to the progress of our branch of engineering. It brought to the foreground the applications of physics and mathematics to the estimation of the size and type of machinery to do a given job in a chemical plant.

In the meantime a new race of chemical engineering teachers had appeared in our universities and colleges. These newer men, mostly instructors and assistant professors, had received their collegiate training in engineering curricula which included engineering drawing and descriptive geometry. They automatically demanded and received a higher standard of such work in student reports than they had turned in to their own professors some years previously.

The student must learn something of shop practice and how a certain machine part can or cannot be manufactured.

One of the most common remarks heard is that the chemical engineer isn't going to be a draftsman and therefore need not be as proficient in the art as a mechanical or civil engineering graduate. This is just plain, ordinary hokum. If we in the colleges were merely training draftsmen, we had better close our doors tomorrow. But every engineering graduate, whether he be an executive behind a shining desk, or a brand new graduate with an unscratched slide rule, will need to converse with his fellowmen on machinery and other material things. Now he will seldom have time or opportunity to sit at a drawing board with a set of instruments, complete with tee-square and ruling pen. One of the things for which I have always been profoundly grateful to Professor French is the long hours he made us spend in making sketches of various objects. Those sketches had all the elements of a finished drawing. I believe this ability to make a free-hand sketch which closely approximates an engineering drawing is one of the most precious possessions of any engineer. It is a tremendous addition to his vocabulary.

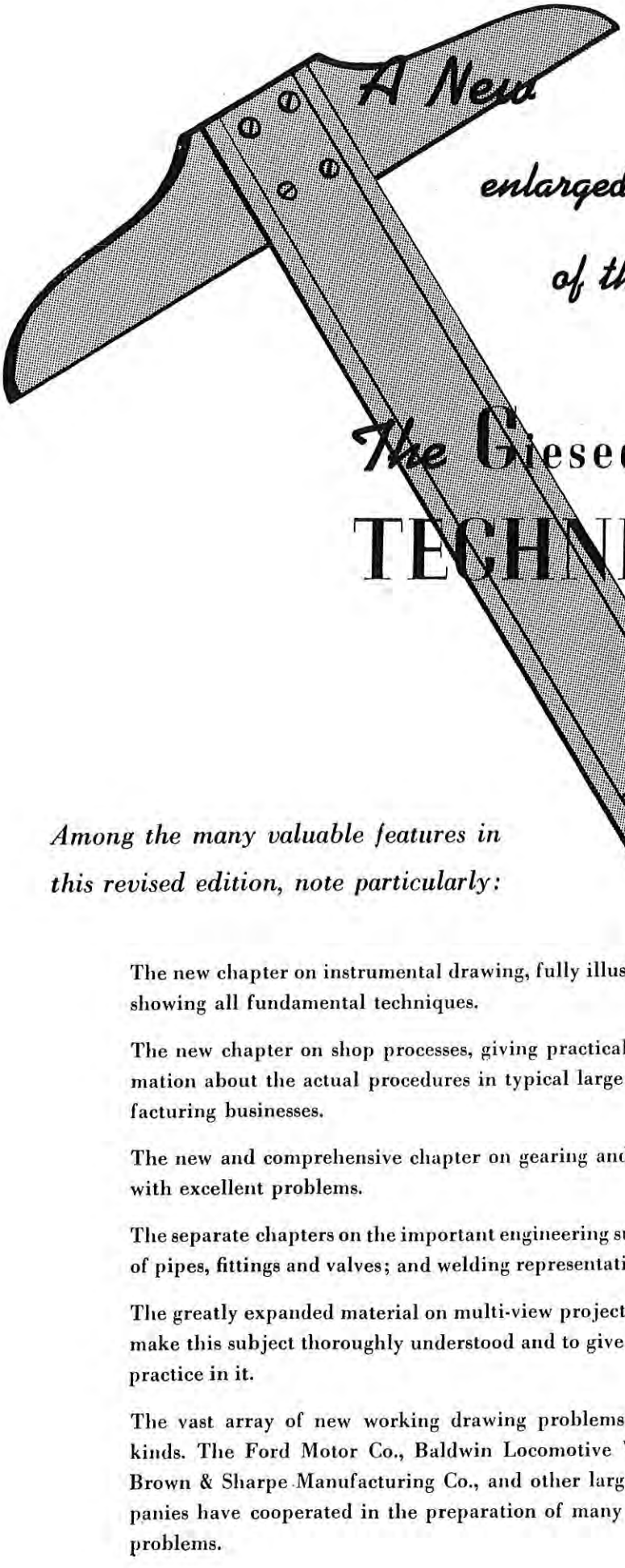
Some of you may have heard of the survey made some years ago at the Pennsylvania State College. Being a state institution with somewhat limited facilities, they wished to find some means of predicting the probable ability of a student to do acceptable work in the junior and senior years. After laboriously tabulating the grades of past students over a range of years it was concluded that drawing and descriptive geometry was the best criterion of the ability of a freshman or sophomore to make good as a junior or senior. Chemistry and mathematics were secondary in the prognostication of success.

The teachers of subjects outside the department of engineering drawing will always get a poor grade of workmanship so long as they accept it and it doesn't take the student long to learn who will or will not do so. If students were excused from using their mathematics for two years, we would be saying the same thing about that subject. Perhaps we who do not have to teach freshmen, escape your predicament only because our colleagues cannot check up on us.

1. The importance of engineering drawing to a chemical engineer is identical with its importance to any other brand of engineer. The engineer must simply learn the language of his profession. The ability to convey ideas is paramount and two indispensable tools for this are lettering and sketching.

2. You are doing an excellent job in your teaching of drawing but other engineering teachers do not follow up your efforts. The student is given a holiday of some two or three years in which to forget the things he learned and the skills he acquired. He should develop and improve this department of his career training.

3. Since, in the more advanced work, you would not dream of giving a mechanical engineering student a project on a high pressure, bubble cap distillation unit, why must some of you insist on giving a chemical engineering student a project involving a machine that he hopes he never hears of again? Let us get together to help each other help the student.



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