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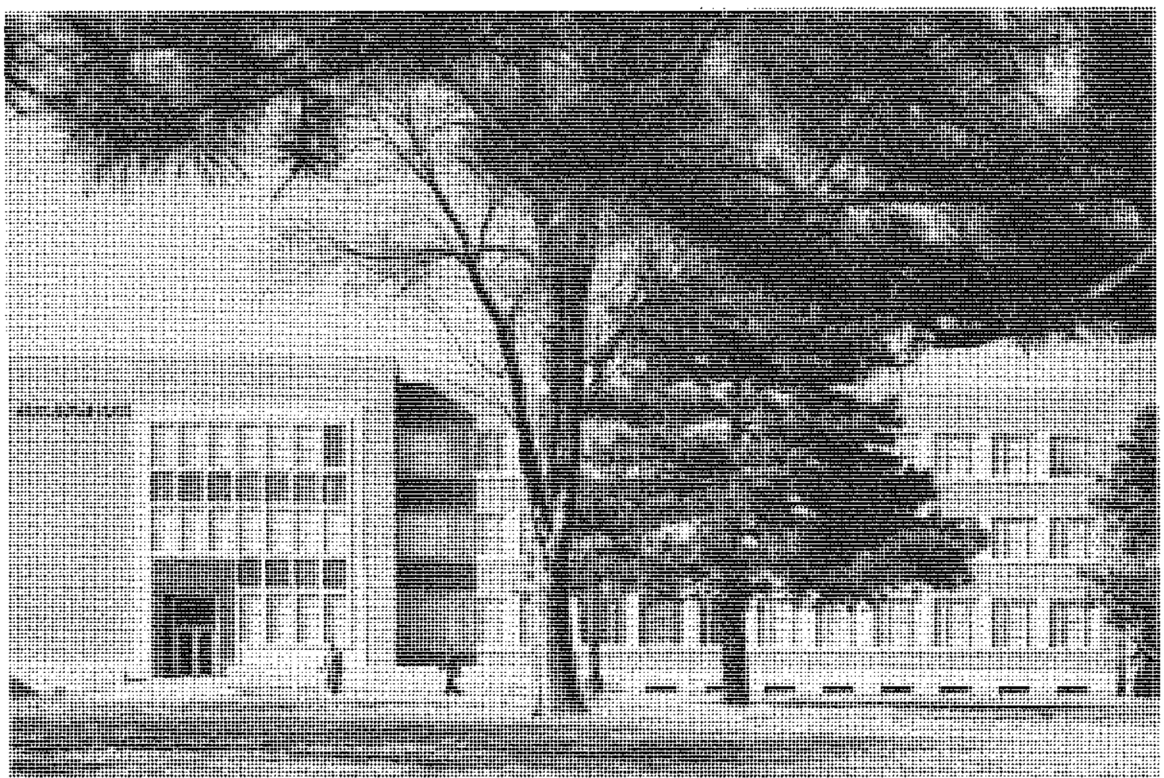

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CONTENTS

Page

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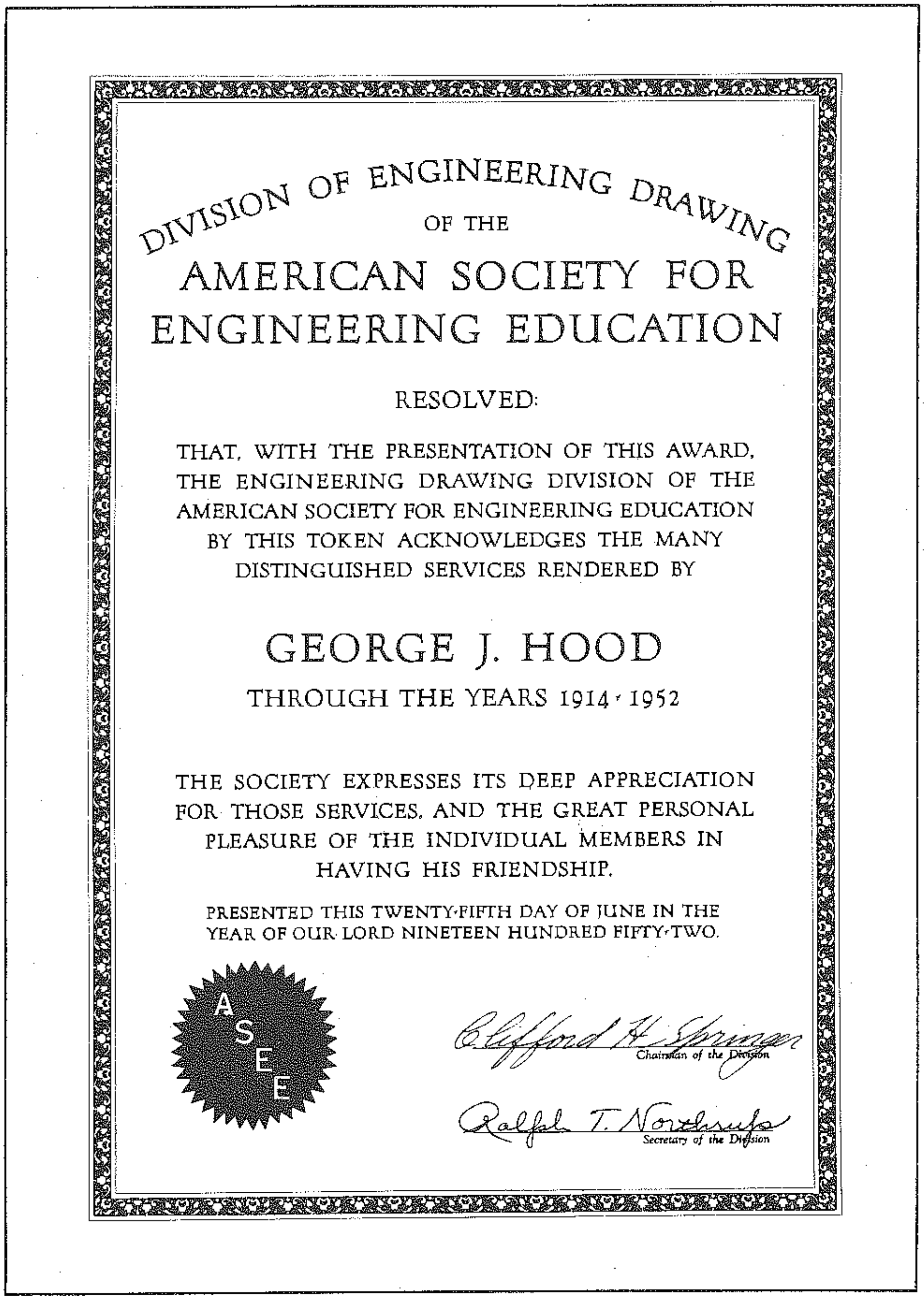

DIVISION OF ENGINEERING DRAWING
OF THE
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RESOLVED:

THAT, WITH THE PRESENTATION OF THIS AWARD, THE ENGINEERING DRAWING DIVISION OF THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION BY THIS TOKEN ACKNOWLEDGES THE MANY DISTINGUISHED SERVICES RENDERED BY

GEORGE J. HOOD
THROUGH THE YEARS 1914-1952

THE SOCIETY EXPRESSES ITS DEEP APPRECIATION FOR THOSE SERVICES, AND THE GREAT PERSONAL PLEASURE OF THE INDIVIDUAL MEMBERS IN HAVING HIS FRIENDSHIP.

PRESENTED THIS TWENTY-FIFTH DAY OF JUNE IN THE YEAR OF OUR LORD NINETEEN HUNDRED FIFTY-TWO.

ASEE

Clifford H. Springer
Chairman of the Division

Ralph T. Northrup
Secretary of the Division

JUST A FEW LINES

Dear Professor Luzadder:

I certainly am grateful to all of you of the Engineering Drawing Division for the honor conferred on me. This citation came as a great surprise to me. I feel that there must be others who are more deserving.

It would have been nice to have been at the Dartmouth Meeting to see all of you. I long have wanted to visit Dartmouth, and would have come had it not been a critical time in connection with the production of a new instrument that is just going on the market.

And yet, if I had been present when Professor Spencer read the reasons for the award, that might *not* have been a comfortable few minutes, and it would have made me blush; and the probable need to make a short speech would have been a considerable worry, since I never have learned to make even a short speech.

With best wishes to all,

Geo. J. Hood

Geo. J. Hood,
1505 Crescent Road,
Lawrence, Kansas.

LET'S FACE THE MUSIC

by

J. Gerardi

Chairman, Division Engineering Drawing (A.S.E.E.)

Those who have attended the recent meetings of the Drawing Division immediately recognize a perplexing atmosphere which seems to disturb our membership. Even the casual visitor discovers, before too long, that the drawing teachers are very much concerned about problems such as:

1. The misunderstanding which seems to exist between the engineers, educators and teachers as to the value of our present drawing courses in the engineering curricula.

2. The thoughts which have been expressed by some that drawing is of more importance to one branch of engineering than to another.

3. The problems concerning the amount of mathematics and other sciences which should be integrated into a course of graphics.

4. The assumption that drawing course contents have become static and that very few changes have been made within the past twenty-five years.

5. The impression which some of our friends in A.S.E.E. have that our drawing division feels that the world would come to an end if the slightest suggestion is made to de-emphasize lettering, use of instruments, geometric constructions, etc.

These and similar problems have had their fair share of discussion at our meetings and in all probability should be discussed further. But before we promote this activity, it might be wise to reflect for a moment on whether or not it is worthwhile.

At the convention last summer, Dean Hollister of Cornell University gave one of the most philosophical talks which has been presented before our division. Although his slides were selected to emphasize the methods used by architects to develop originality and creative thinking, several in the audience were more interested in the lettering and line work which appeared on the slides. Others seem to have thought that this was an opportunity to get an answer to the problem concerning the decreased time allotted to the teaching of drawing. It was evident from the discussion which followed that the problems which were mentioned at the beginning of this article are beginning to drown the best efforts of those who have a high regard for drawing courses and the Division's interests at heart.

These problems mentioned above must, of course, be resolved, but we cannot have them overshadow the more important projects which will enhance the prestige of the division.

As all of us know, the Engineers Council for Professional Development has asked A.S.E.E. to undertake an evaluation of engineering education. A committee with Dr. L. E. Grinter as chairman has been appointed to make the evaluation. The primary objective of this committee will be to determine why the basic pattern of engineering education has remained fixed and to determine whether new patterns of curricula are required to meet the rapid developments in science. One may hazard a guess that Dr. Grinter's report will not have only a profound influence on engineering curricula, but will also have a pronounced effect on the contents of technical courses.

Drawing courses will be no exception. They too must be geared to the more recent advances in science and technology. Because of the short supply of engineers, the number of graduates who will begin their careers at the drafting board will decrease. Not only will they be expected to apply their knowledge of mathematics and science to engineering developments, but they may be expected to supervise the work of draftsmen. Hence, it may be predicted that drawing courses may of necessity change their complexions. No longer will the description of drawing courses in University bulletins list lettering, use of instruments, geometric constructions, etc., but may emphasize items such as -- the study of shapes and form employing various materials to develop creative thinking, graphical solutions of engineering problems, supervision of draftsmen, etc. This change will not occur overnight, but we can expect something of this nature to develop in the near future.

Hence, let us "face the music", accept the challenge and direct our energies toward more efficient use of the time we have; let us revitalize our course content to such an extent that those whose courses have been curtailed may be given an opportunity to regain the necessary time to teach their courses properly.

The Drawing Division has served the A.S.E.E. for twenty-five years. Its activities and the resourcefulness of its members are well known. The many projects and studies which have been sponsored by the Division have been worthy of publication and have had a great influence in unifying course work with the demands of industry. No other Division of A.S.E.E. has a publication similar to the Journal of Engineering Drawing; moreover, our magazine enjoys world-wide circulation and has not shown a financial loss for the past fifteen years. These and other accomplishments of our Division are due to the initiative, loyalty and hard work of the men who founded and have led the Division.

In order to uphold the traditions of the past, and to encourage discussion, exchange of ideas, and active participation of our members, your officers this coming year, knowing that they can count on the excellent cooperation which has been given in the past, will initiate a program which will suggest a pattern of thinking along the following lines:

1. A critical review of the contents of present drawing courses and recommendations for the future.

2. A thorough study of the new requirements which the engineering profession will impose on graduates because of the short supply of engineers.

3. Divisional participation with Dr. Ginter's committee on evaluation of engineering education.

4. Methods of improving teaching and raising the level of instruction in graphics. Professor F. A. Heacock and his committee on advanced graphics has completed and published a report on "Graphical Methods for Solving Engineering Problems." This report will receive special attention.

The above suggestions are by no means fixed or final, and your chairman as well as your executive committee will welcome any suggestions which will improve the activities of the Division.

THE CONTRIBUTION OF ENGINEERING DRAWING IN AN ENGINEERING EDUCATIONAL PROGRAM

by

Professor Randolph P. Hoelscher

University of Illinois

The program we are engaged in today has been brought about by the strong trend in many of our schools to reduce the amount of time devoted to drawing and descriptive geometry. This process has gone so far in some places that it has become a matter of grave concern to the members of the Drawing Division.

We are concerned, not for our jobs, nor for the prestige of our positions, for all of us coul(move out of our present teaching work into industry without the loss of a day's pay and in most cases at salaries better than we now command. We, as well as deans, and teachers in the degree granting departments, are concerned about the total educational programs being given our students. All of us together are interested in giving our students the training which will best enable them to enter the profession and to develop into successful professional engineers.

Three principal groups are interested in what we do. First, our own teaching group, second, the employers of our product, and finally, the students themselves. It is to the latter that we owe the greatest responsibility, but we should not overlook the employer group who provide our students with the opportunity to become engineers. Many of them require their newly employed graduates to begin work on the drawing board because they believe that this is the best method for them to become thoroughly familiar with their business.

This trend toward the reduction of drawing time can be a wholesome thing if we, the members of the Drawing Division, accept it as a challenge to re-examine our work to see whether or not we are giving to the student the utmost value for the time he spends with us. It will make for a better program if we examine our course content, our teaching methods and our objectives to see whether or not they meet the needs of the vast majority of our students as they enter and develop careers in industrial practice.

On the other hand, there is no challenge toward creative educational work, if the time devoted to drawing is arbitrarily reduced without a careful consideration of the educational values to be obtained from it by the student as he takes the first steps toward entering an engineering career.

An apparently unfavorable attitude toward drawing has been developing since the time of the Mann Report almost thirty years ago. Some of you may recall the chart in that report showing the sequence and inter-relation of courses in the curricula. Drawing appeared in a little box by itself in the upper right hand corner with no connection to any other courses. In the present high level discussions of the curriculum, drawing and descriptive geometry are not mentioned at all. I refer to the Report of Adequacy and Standards of Engineering Education appearing in the January, 1952 issue of the Journal of Engineering Education. Here the subjects of the curriculum are divided into five groups as follows:-

1. Basic Science
2. Applied Science
3. Applied Engineering
4. Administrative and Managerial
5. General

Each group above was explained by examples but drawing was omitted here and throughout the report. Perhaps the omission is explained in the introduction which says, "Specific statements are often too limiting where taken literally and generalizations are often too vague."

This omission, however, has been tacitly interpreted by the administrators of degree granting departments as a signal for the reduction of time devoted to a subject which is not even worthy of mention in current discussion.

In handling the subject of drawing in the curriculum three courses of action seem possible.

1. Eliminate drawing and descriptive geometry altogether. This could be abrupt and immediate thus forcing the drawing teachers to take work in industry or it could be gradual, cutting off one credit hour every two years until the courses disappeared thus allowing the transfer of the drawing staff to other subjects as enrollments increase. This increase will come at a time when teachers are going to be very hard to find.

2. The time allottment can be reduced to an amount where no one with self-respect will be interested in teaching the subject. Even those assigned to do the job on a part time basis will give only reluctant attention to it. The results of such teaching will be totally inadequate. This seems to be the method currently chosen in some schools.

3. The course could be given an adequate amount of time and the staff stimulated to develop the full potentialities of the subject. As in other departments, the staff could be encouraged to develop the field of graphics by the recognition of elective courses of high calibre.

We, the members of the Drawing Division, believe the latter of these possibilities to be the best educational policy for reasons we shall endeavor to set forth.

AIMS OF ENGINEERING EDUCATION. As a background for our discussion let us review for a moment the aims of engineering education which have been recently stated and which I believe are generally accepted.

First, a definition of engineering as stated in "Careers in Engineering" published by the University of Illinois in 1951 - page 11:

> "Engineering is the art and science by which the properties of nature and the sources of power in nature are made useful to man".
>
> And --
>
> "An engineer is a person specifically trained and experienced in the use of materials, men and money so that these forces are put to the service of man".

Second, let us look at the late President Doherty's summary of undergraduate engineering education as published in Educational papers No. 1 of the Carnegie Press in 1950.

> "An undergraduate course in engineering should train students to *become* engineers and not train engineers; it should develop a foundation for later professional specialization, yet it should constitute at the same time a balanced education. It should thus be a bilateral program involving on the one side, the mastry of the fundamental principles of the physical and mathematical sciences and a *rigorous discipline in reasoning* in which these principles are applied to the analysis of problems, and on the other, the acquirement of a basic knowledge of English, History and the pertinent social sciences, and the application of such knowledge to social and economic problems. Thus the prime objective pervading and

unifying the whole should be the *development of the power of analysis and understanding* and the cultivation of a *scholarly attitude* and style".

Further on in this publication Dr. Doherty enumerates the five phases of the educational process.

"The first relates to the process of *acquiring factual* and *definite knowledge*".

"The second has to do with the type of reasoning in which the student is led, step by step through logical processes either by teacher or textbook" - - - .

"The third phase is the process of acquiring skill in manipulation." Slide rule manipulation, or algebraic manipulation for example.

The remaining two phases are not pertinent to our discussion.

One more item of background material needs to be added. This is taken from the Report of Committee on Adequacy and Standards of Engineering Education. Page 252, January 1952, issue of the Journal of Engineering Education.

"It certainly appears desirable that a major stress be placed upon those elements of the curriculum that will give the most continuous and lasting support to the graduate's professional life. Apart from the teaching of the professional attitude toward engineering and the instilling of the engineering and scientific method of attack upon problems, there are certain specific features of the curriculum that can be accepted as most essential."

"The first of these has to do with courses least likely to obsolesce."

Briefly then to have value in the curriculum a course must provide one or more of the following things:

1. Present valuable and definite knowledge.
2. Provide a basis for acquiring manipulation skills.
3. Develop the reasoning process or power of analysis.
4. Be of such a nature that it is not likely to become obsolete.

Before we can decide as to whether or not a course fulfills these requirements it is necessary for us to know something about the previous training and mental maturity of the student as he comes to us at the beginning of his freshman year. Only in this way can we bring out the contribution of drawing to engineering education. I speak from an experience of 34 years in a State University where we must take the students as they come. So far as previous education is concerned the following training is generally required for admission.

At present three years of high school English is commonly required not to mention grammar in the grade schools. In college then we require another year in rhetoric and in our engineering courses we are putting on pressure to compel the student to use good english in expressing his ideas.

Three years of mathematics is required and there is a growing tendency to demand college algebra and trigonometry for entrance. In college we are then adding additional mathematics.

One year of physics, or chemistry, or both, is recommended for entrance. In college we are tending to give more time to physics.

In drawing, however, the situation is quite different. The subject is not required for admission. Approximately 60 per cent of our entering students have had no drawing experience whatsoever. The remaining 40 per cent have had two years of drawing or less and mostly less. In college the trend is to reduce even further, the small amount of time now allotted to engineering drawing.

Here then we have the rather strange situation in which english as a means of expression is being emphasized while drawing, the universal language of the engineer, and the *only one* at all adequate to communicate designs for construction or manufacture is being minimized.

So far as mental maturity is concerned by far the greater part of our freshmen are quite young. They expect to be told, and in great detail, just what they are expected to do.

They are, in large measure, unable to read and understand the technical language of a drawing book or a descriptive geometry text. Their study habits in many cases are very poor or perhaps non-existent. Those of you who teach Juniors and Seniors should remember that you never see one-half to two-thirds of the boys with whom we work in the freshman year.

If, as we maintain, the time devoted to drawing in many schools is already inadequate and the small amount in others should not be reduced, the question then arises, what is being done in the drawing courses that merits consideration in an engineering curriculum.

WHAT IS DRAWING? Let us first note, then, what drawing is. Fundamentally it is the application of the geometry of space relations as represented primarily by orthographic projection. Other projection systems can be and are used for specific purposes but the type we are concerned with primarily is the orthographic or right angle system. It is therefore applied mathematics involving the use of theorems in plane, solid, descriptive and projective geometry. As such, it should be classified as applied science along with mechanics, thermodynamics and other courses of this kind.

For purposes of industrial use there must be added to this basic geometry many symbols and abbreviations to save valuable time. For construction and manufacturing there must be added dimensions and notes which in turn call for a knowledge of shop processes.

Referring then to Dr. Doherty's phases of engineering education we can see that engineering drawing fulfills the first of these phases, namely that of "acquiring factual and definite knowledge". May we elaborate on this for a few moments.

The representation of objects whether large or small with unmistakable meaning requires a precise knowledge of the theory of projection. This also calls for the exercise of good judgment in selecting the number and kind of views. Too many views are a waste of time in both drawing room and shop. First quadrant arrangement of views is fatal in production.

Further, factual and important knowledge such as standard practice and conventions is required to produce drawings of objects which can be manufactured. Some of these are as follows:

DIMENSIONING

We are teaching the student how to dimension his drawings since a bare shape description would be useless. Correct dimensioning is not a simple matter in modern mass production or even in "one time" jobs like building large machines, dams or bridges. It is not a matter of putting down every dimension you can think of. Datum or basic surfaces or lines must be selected which can be used in shop or field. This again requires the exercise of judgment. The student does not always have an adequate basis for judgment in some cases but he does acquire the basis for the exercise of good judgment in the simpler situations in the drawing course.

LIMIT DIMENSIONS

All modern machines, whether designed for mass production like automobiles, or one time jobs like huge milling machines, drills, etc., designed for one special purpose require careful tolerances if they are to function properly. Limit dimensioning is therefore required. This concept again requires reason and judgment as well as a knowledge of standard approved limits and where to find them.

SHOP PROCESSES

Dimensioning cannot be done properly without some knowledge of shop processes or construction methods and since shop courses have been practically eliminated or come too late in the curriculum the drawing course must include some instruction about shop processes. Not in the sense of setting up and operating a machine or to determine cutting speeds, but to show what can or cannot be done with the machines available. Modern dimensioning practice requires that parts be dimensioned according to the way they are to be made and inspected and not for the convenience of the engineer. This calls for imagination and requires the visualization of the shop man's problems and an exercise of good judgment. It is a waste of time and money to design or detail something that cannot be made or that is very costly to make.

COSTS

In the drawing course the student gets his first contact with the idea of costs; economics of a sound variety. He is made aware of the fact that designs must first of all, be of such a nature that they can be made and, second, that the parts can be made economically. An ounce of metal saved on a piece to be produced in hundred thousand lots saves an appreciable sum. A machining operation eliminated can save even more. Drafting time is also a cost factor. Useless views, unnecessary lines, and unnecessary dimensions are expensive in both the drafting room and shop.

TECHNICAL VOCABULARY

In the Drawing courses we begin the development of the students technical vocabulary of which he has practically none when he enters. He learns the meaning of shop terms such as drill, core, bore, mill, ream, etc., as well as the names of machines which perform these operations. He learns terms from other fields of engineering such as slope, grade, grade line, contour, clearance, pitch, batter, etc.

FREEHAND SKETCHING

Freehand sketching, whether of the multi-view orthographic type or pictorial form is useful to the engineer whether he is working on the board or in a supervisory capacity. Although every drawing department teaches freehand sketching this skill could be developed to great advantage in teaching the fundamental and simpler operations of orthographic projection. More work could be covered in problem solving while simultaneously developing sketching techniques. This phase of our work should be developed and used to a greater extent than most of us are doing at the present time.

SOURCES OF INFORMATION

In his contacts with drafting he learns about handbooks and standards of all kinds and where to find them. Without these standards modern production would be impossible.

GRAPHICAL REPRESENTATION OF FACTS

Many drawing courses now devote some time to the graphical presentation of facts, data or statistics as contrasted with the shape and size description of objects. We regard this as an important part of an engineers training.

A well made and complete chart is far better than a table of data from tests in field or laboratory. They are, or should be, used in laboratory reports in school and they are used extensively in engineering and research reports in industry. It seems just as valuable to have the ability to express test results in well made, meaningful charts, as it is to write about tests in pages and pages of english no matter how scholarly the style and diction.

Chart preparation, in compliance with A.S.A. Standards, can be taught in drawing courses, early in the curriculum, if time is available. If it is not given in the drawing course it must be taught later in departmental laboratory courses.

DESCRIPTIVE GEOMETRY

In the foregoing discussion I have included descriptive geometry as a part of engineering drawing. In some schools it is introduced concurrently with the work in drawing while in others it is offered as a separate course. Regardless of the method used in teaching, it may be well to discuss the changes which have taken place in the teaching of this subject.

Most administrators who graduated from 20 to 40 years ago probably had this subject presented to them by the Mongean or classical method. Taught in this manner descriptive geometry seemed to be purely a subject for méntal exercise with little or no relation to drawing or the problems of an engineering department. Problems were presented in any or all of the four quadrants and a difficult time was had by all.

It should be noted therefore, that most engineering schools have gone over to the auxiliary plane method of presentations with problems largely restricted to the third quadrant. This permits the solution of all space problems just as effectively as the older method and ties in with actual engineering industrial practice without a break.

One of the standard arguments presented for the teaching of descriptive geometry is that it develops the imagination and the ability to visualize problems in three dimensions. While this is true, the process really begins with logical reasoning. A problem must first be analyzed and a solution thought out. This is entirely a mental process. Pencil and paper are not required.

We have always trained our students to break their problems into two distinct phases, one the analysis, which we require to be written in good english, and, second the construction which is accomplished on the drawing board by the known rules of projection.

Once the construction has been finished complete visualization takes place. This visualization will be accurate in detail. There are no formulae in which numbers can be substituted. Each problem must be analyzed and worked out step by step.

Dr. Ernest F. W. Alexanderson, radio and television pioneer, who was recently awarded his 320th patent for inventions made during his 49 years with General Electric, has said, "algebra can be figured by routine rule while the solutions of geometry problems requires the use of imagination. The ability to solve geometry problems is the best intelligence test for creative engineering ability."

After this brief review of the work in modern engineering drawing may we point out first, that the course does fulfill adequately Dr. Doherty's requirement of developing analytical powers.

Second, that it fulfills the first of his steps in the educational process namely acquiring factual and definite knowledge. It is the only course in the freshman year having any direct engineering applications.

The instructors are engineers, many of them with years of engineering as well as teaching experience. Their lectures expressed in engineering terminology, are illustrated with examples from industrial practice.

Third, it begins the development of good common sense and judgment in a practical way.

This exercise of judgment is at the level of which the student is capable. No young engineer is expected to exercise judgment on a million dollar project until he has shown judgment on matters of smaller consequence. We do not expect the freshman to exercise the judgment of which a senior student might be capable but we do get them to think and make decisions. At the end of the course they are not asking for specific instructions for every detail but have started on the long road to making decisions of their own.

In addition, it should be noted that drawing is the universal language by which engineers communicate with each other and with the workmen in shop or field. It is just as essential that the graduate be as competent and scholarly in this graphic language as in English. It may be stated further that even though we are laying the foundation which will fit the man for the job he will have 25 years from now, there are 24 intervening years to be accounted for. Twenty-five years from now most of the current crop of graduates will not be on the drawing boards, neither will they be using the calculus, but they will still have to read drawings and approve them or approve contracts based upon them. As a side light it may be interesting to note that there are engineers working on the drawing board in design who are making 12 and 15 thousand dollars a year and quite a few are in the 10 thousand dollar bracket.

WORK HABITS

The Drawing Department in most large universities is the only department in the College of Engineering with which the student has contact. This department must and does help bridge the gap between high school and college work. In high school the capacity of the student for concentrated continuous work has rarely been used to any thing near his capacity. In the drawing department he must work at something near his capacity for two or three hours continuous intervals under the supervision of full time mature instructors.

His home work and his class work must be turned in on time if he is to receive full credit. He becomes aware of the fact that engineers work to a schedule, for example bids must be submitted on or before the time specified for opening them; contracts must be completed as specified. Alibis are not accepted.

In many schools the drawing department is the only one in which the student has direct personal contact with mature and experienced men. In mathematics, chemistry, physics, and rhetoric he is very likely to have graduate students, working as part time assistants, as his instructors or laboratory supervisors. Lectures delivered by a senior professor to large masses cannot be called direct contact.

Some elder drawing instructors may be in a rut (so are some teachers in other departments) but even so he does a better job of teaching than a graduate student whose major interest is his thesis, or a young inexperienced man even though he is a member of a degree granting department.

STUDENTS WHO DO NOT GRADUATE

Another factor which should not be overlooked when the position of engineering drawing in the curriculum is being considered is the contribution which it makes to the lives of those who do not complete the work for their baccalaureate degree. Those of us in tax supported institutions, and in particular in land grant colleges, should bear in mind the closing words of the Morrill Act which states its purpose in part as follows: "to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life"

It is well known that more than 50 per cent of those who enter our engineering colleges do not survive to graduate. Of all the courses studied in the freshman year and even in the sophomore year none has more immediate and permanent value than engineering drawing. The other courses require more advanced work to make them have anything more than cultural value. If drawing courses are cut to the point where they too are merely introductory, then the educational value of the first year or two consists chiefly of frustration.

On the other hand a reasonably adequate course in drawing, together with introductory courses in mathematics and physics will enable the student to engage as a beginner at the technician level of employment. Under these conditions we will have fulfilled our obligation to the state while at the same time we lay a better foundation for those who go on to higher scientific levels.

And now let us look for a moment at Dean Hollister's committee's requirement that material included in the curriculum shall be that which is least likely to obsolesce. Again I quote from a practicing engineer. Mr. A. F. Puchstein, consulting engineer for the Jeffrey Manufacturing Co., of Columbus, Ohio.

> "Before an idea takes form, or a structure or machine is built, informational data must be developed and presented in some way. The most feasible, useful, and inexpensive way is still, after centuries, the employment of sketches, diagrams, and drawings."
>
> Again --
>
> "For working out the shape of objects, visualizing natural phenomena or setting up a basis for calculation, graphics is simple and self-checking. For these purposes it has no competition and non appears in prospect".

Drawing is not likely to obsolesce, but it must not be assumed that it is entirely static. This society together with the A.S.M.E. are the sponsors for the American Standards Association Committee Y-14, American Standard Drafting Manual, of which I have the honor to be chairman. The revision of this standard has been going on since 1948 and will not be completed for another year or two. About 150 men from industry and out technical schools are working on 17 sub-committees. The industries are literally spending thousands of dollars on this project. If it were not valuable to them in their engineering departments they would not do it. If any high school boy could pick it up in a few months they would not need to bother about it. We therefore maintain that drawing, including descriptive geometry, is certainly one of the subjects not likely to become obsolete in the forseeable future.

Finally, I believe it would be a sound policy to follow Dr. Doherty's advise when we redesign our curricula for the purpose of getting more graduate work and the social-humanistic subjects into a four year program. Dr. Doherty says - "We must cut down on the now relatively over-emphasized part of the program to make room for the now under emphasized part. We must balance up. What cannot fit in the Junior year must be postponed to the Senior, and what cannot fit there will have to be postponed either to the post graduate or post college study, and to experience on the job."

This is just the opposite of what is taking place. Graduate work of a few years ago is being pushed down into the senior and junior years and drawing, college algebra and trigonometry are going out at the bottom. As one well known professor recently said to me - "Oh we are doing very well in the Junior year what I took as graduate work" and he is far from being an old man.

I would like to put in one more idea suggested by Dean Hollister's report. I quote, "Engineering education processes are most commonly of the problem type requiring but a single answer, with no latitude for judgment and no imaginativeness beyond the visualization of the circumstances of the problem. Programs in architecture far surpass those in engineering in this respect".

It would be well to follow this a step farther and see how the architects accomplish the development of imaginative abilities.

In their curriculum they require a minimum of mathematics, about nine semester hours, they take courses in physics requiring little mathematics beyond arithmetic and very simple algebra. Little or no chemistry is required. This makes room for courses in drawing, in art and design which occur in every semester of the five year curriculum.

How then do they design and construct large buildings. They are clever. They just hire a structural engineer to do the work they are not prepared to do or a heating and ventilating engineer to handle that phase of their work. But they do not admire the qualities of the men they hire and endeavor to make the young architects take all of the work required to make them competent in these fields. Frank Lloyd Wright in a public address some few years ago said, "An engineer is a necessary evil in an office just like a typewriter".

If as Dean Hollister has said the four year curriculum should be designed for the 80 per cent who are not interested in, nor perhaps competent for graduate study, why make expert mathematicians or research physicists of them.

Very close to 100 per cent of our engineering graduates are going to need drawing. Engineers without a need for a knowledge of drafting are about as common as physicians without a knowledge of physiology and anatomy.

If we want to develop the imaginative quality and the broad managerial vision of social and economic problems this will not be accomplished by more and more mathematics and science which tend to restrict rather than broaden the outlook on life's problems. The imaginative quality can be developed better on the drawing board than in any other single course. Problems in drawing and descriptive geometry permit more than one method of solution. Both imagination and judgment come into play even though there may be but one final answer.

One thing which every boy learns in drawing courses is that one view never tells the whole truth about any object. It always takes two views and sometimes more. This is a fundamental philosophy which can be applied to all of life's situations.

We trust therefore that those who are responsible for the re-design of engineering curricula will try to get another view before they jump to conclusions. Engineering drawing is fundamental in all engineering work and very useful for non-engineers. May I close with a quotation from the late President Eliot of Harvard who said in an address: - "I have recently examined all the courses offered by the University, and I found but one (the course of theology) in which a knowledge of drawing would not be of immediate value (and even here I think it might in some cases)".

"The power to draw is greatly needed in all the courses, and absolutely indispensable in some of them. A very large proportion of studies now train the memory, a very small portion train the power to see straight and do straight which is the basis of industrial skill."

METHODS OF DESCRIPTIVE GEOMETRY IN USE BY GEOLOGISTS[1]

by
Jerry S. Dobrovolny[2]
University of Illinois

In structural and other fields of geology the geologist is constantly concerned with the visualization of three dimensional situations and also with the solution of these problems by graphical methods. To increase his ability to think independently in three dimensions, and to enhance his flexibility in the solutions of the problems he encounters, the geologist should have a firm background in the principles of orthographic projection and in the methods of descriptive geometry.

Only recently has any attention been given by authors of structural geology text books to the solution of geological problems by graphical means. There is very little available literature in geology that deals with this problem. There are three texts that have been published in the last few years that more or less represent the total contribution in this particular field. These are "Structural Geology" by M. P. Billings; "Structural Geology" by C. M. Nevin; and "Field Geology" by F. H. Lahee.

Of these probably the best treatment of the descriptive geometry approach to the solution of the problems appears in the book by C. M. Nevin. Many of the methods outlined in these books are combinations of graphics and trigonometry. Other methods are based on the fundamental principles of descriptive geometry. However, the presentations have been so oversimplified by the omission of basic procedure or orthographic projection that the student without a good background in descriptive geometry has to resort to pure memory. On the basis of this, it is very essential that the geologists of today have a good basic course in descriptive geometry, preferably designed to deal with the solution of typical geological problems.

Some of the typical problems that a geologist is confronted with are the determination of the following: the strike and dip of planes representing faults, strata, coal deposits, etc.; the thickness of beds; the point where a line pierces a plane; the line of intersection between two planes; the angle between two planes; and the outcropping of strata on the earth's surface. There are also many other geological problems requiring three dimensional visualization.

THE THREE POINT PROBLEM

One of the most common problems that the geologist is confronted with is the so called "three point problem" where it is necessary to determine the attitude of a plane by determining its strike and the dip from the location of three points in a plane. The three points can be obtained from drilling data or by observing them outcropping on the earth's surface. A typical three point problem is as follows: Points A, B, and C, are points on the top of a bed of limestone. Point B lies N 30° E of A at a map distance of 400 feet. Point C lies N 45° W of A at a map distance of 400 feet. The elevations of the points are as follows: A = 900 feet, B = 680 feet; and C = 780 feet. It is required to find the strike and dip of the plane determined by the three points A, B, and C.

In Figure 1 there is pictured the descriptive geometry solution and also the solution as outlined by M. P. Billings[3]. In the descriptive geometry method of solution, plot the horizontal and vertical projections of the points A, B, and C, to some convenient scale. The strike of any particular plane is defined as the bearing of any horizontal line in the plane such as the horizontal line CE. The dip of a plane is the angle that plane makes with the horizontal plane. By passing an auxiliary plane perpendicular to the horizontal plane and perpendicular to the strike line CE lying in the plane, the plane ABC and horizontal plane project onto this auxiliary plane as edgewise views, the angle between these edgewise views is the dip of plane ABC.

In the approach as outlined by M. P. Billings the map view of the points A, B, and C are plotted. This of course is the same as the horizontal projections of the points in descriptive geometry. Next the highest and the lowest points (A and B) are connected with a straight line, and then at any convenience angle to this line a construction line BE is drawn. On this construction line BE, at any convenient scale, the difference in elevations between the points A and B is laid off as is indicated in Figure 1. Connect points A and E, and through the point F on the line BE at the 780 foot elevation draw a line parallel to AE until it intersects the line AB at C'. Point C' is the point on line AB whose elevation is 780 feet. Connecting point C' with the point C will give a

[1] A talk to be delivered at the Drawing Section of the A.S.E.E. 60th Annual Meeting at Dartmouth College, June 24, 1952.

[2] General Engineering Drawing Department, University of Illinois.

[3] M. P. Billings, "Structural Geology", pp. 444-445.

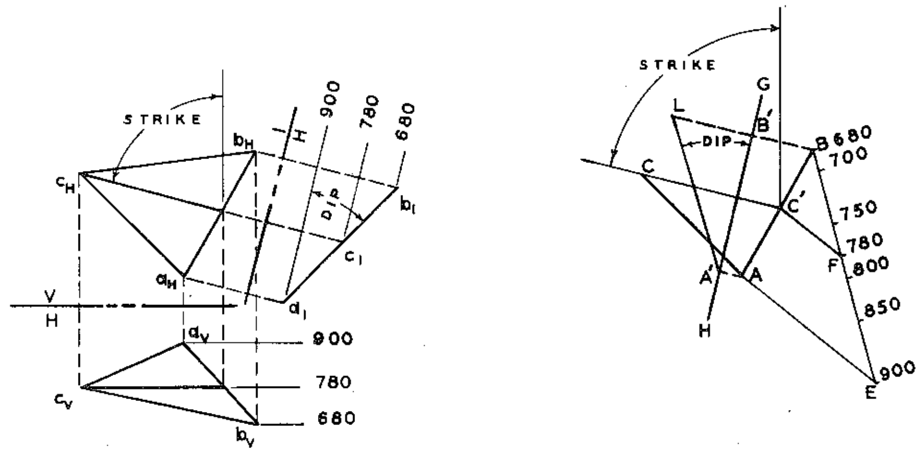

FIG. I THE THREE POINT PROBLEM
FIND THE STRIKE AND DIP OF A PLANE DETERMINED BY POINTS A,B&C ON THE TOP OF A LIMESTONE BED. POINT B LIES 400 FEET N30°E OF A. POINT C LIES 400 FEET N 45°W OF A. THE ELEVATIONS OF THE POINTS ARE AS FOLLOWS: A IS 900 FEET, B IS 680 FEET, & C IS 780 FEET.

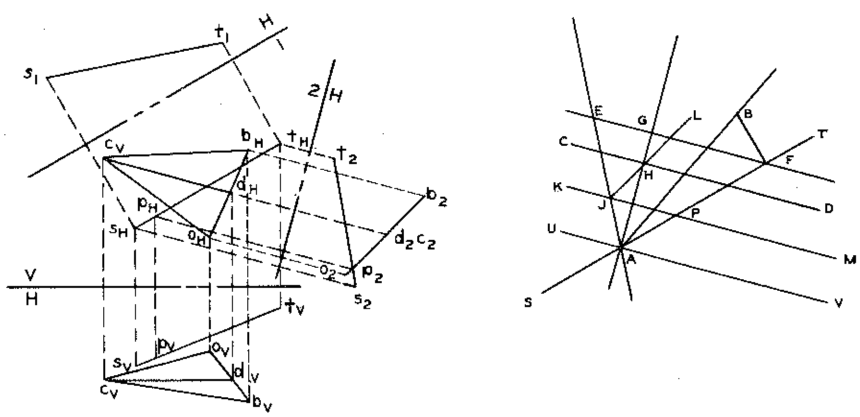

FIG. 2 POINT OF INTERSECTION OF A LINE AND A PLANE
FIND THE POINT WHERE THE LINE ST BEARING N60°E WITH A RISING SLOPE OF 19° INTERSECTS THE PLANE WHOSE STRIKE IS N60°W WITH A DIP OF 30°NE. THE ELEVATION OF THE STRIKE LINE CD IS 780FT.

strike line in the plane and the bearing of this line is the strike of the plane. The principle involved here, which is never mentioned in the explanation, is that of dividing a line into a given number of parts by using similar triangles.

Then at any convenient place draw the line GH perpendicular to the strike line CC' and locate points B' and A' on GH by drawing lines BB' and AA' parallel to CC', all of these being strike lines on the top of the bed of limestone. Therefore, by inspection the direction of dip is determined along GH from A' towards B' or in a northeasterly direction. Then by extending line BB', lay off from B', to the same scale as the horizontal scale, the distance B'L equal to the difference in elevation

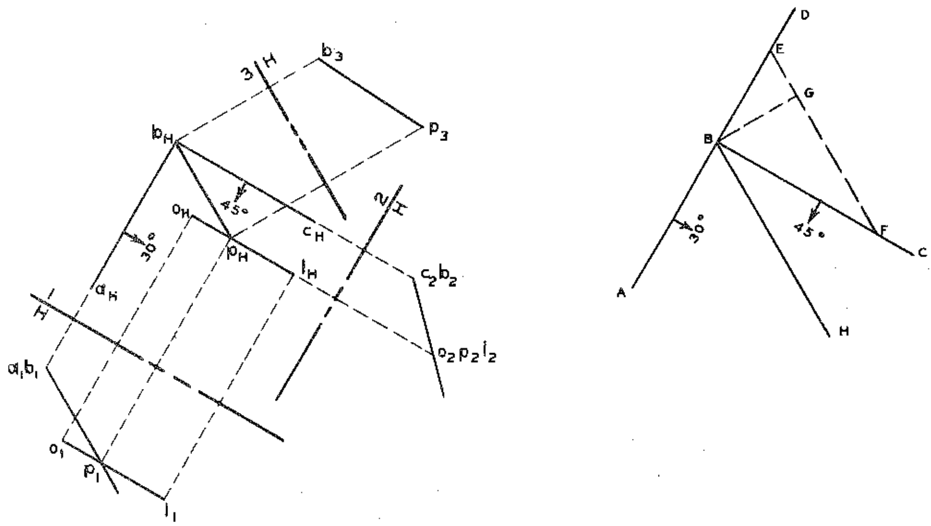

FIG. 3 LINE OF INTERSECTION OF TWO PLANES
FIND THE LINE OF INTERSECTION OF TWO PLANES. ONE PLANE BEARS N30°E WITH A DIP OF 30°SE. THE OTHER PLANE BEARS N60°W WITH A DIP OF 45°SW.

between points A and B. Then by connecting A' and L the dip angle B'A'L is obtained. The principle involved here is that of passing an auxiliary plane perpendicular to a strike line in the plane ABC and the horizontal plane thereby obtaining the edgewise view of both the horizontal plane and the plane ABC in the auxiliary view so that the angle between them can be determined.

POINT OF INTERSECTION OF A LINE AND A PLANE

Another very common problem encountered by the geologist is that of finding a point of intersection of a line and a plane. Figure 2 illustrates two solutions of this problem. The solution on the left is the typical descriptive geometry solution whereas the solntion on the right is one that is advanced by F. H. Lahee[4]. The statement of the problem is as follows: Find the point where the line ST bearing N 60° E with a rising slope of 190° intersects the plane CBO whose strike is N 60° W with a dip of 30° NE. The elevation of the strike line CD is 780 feet.

In the descriptive geometry solution of this problem as pictured at the left of Figure 2 the points C, B, and O are plotted to any convenient scale and the strike line CD is determined as outlined in Figure 1. The edgewise view of plane CBO is also determined as outlined in Figure 1. The horizontal projection of the line ST is plotted and an auxiliary plane is passed parallel to it so that the slope of the line can be determined. Having done this it is a simple matter to project the line ST onto the auxiliary plane 2 where the edgewise view of plane CBO appears and thereby obtain the point of intersection of the line ST and the plane CBO.

The cutting plane method of solution can also be used, however, since in most cases it is necessary to find the strike and dip of the plane first, it is much easier to project the line onto the auxiliary plane, where the given plane projects as a line, than to go through the cutting plane method of solution.

In considering the solution advanced hy F. H. Lahee in the right of Figure 2, first plot the strike line CD of the plane and the horizontal projection of the line ST. Through A, that point on ST which has the same elevation as CD, draw UV parallel to CD. Line UV is a strike line of a plane containing the line ST. It is to be pointed out here that UV and CD are parallel and lie in the same horizontal plane. Also, since UV and CD are strike lines

[4] F. H. Lahee, "Field Geology" 4th ed. Chap. XXI, pp. 687-689.

of two different planes, an auxiliary plane passed perpendicular to these lines would result in obtaining the edgewise views of both planes in the auxiliary plane. Such an auxiliary plane would be one passed through A and represented by AG.

From A draw the line AB making an angle with ST equal to the slope of the line ST. Through any point on ST such as F draw BF perpendicular to ST. The distance BF is the distance the line ST is above the 780 foot horizontal reference plane at F. This distance BF is projected onto the auxiliary plane by laying off EG equal to BF along the line FE drawn through F parallel to UV. AE is the edgewise view of the plane containing the line ST on the auxiliary plane.

Then through H draw HL making an angle with AG equal to the dip of the given plane. HL is the edgewise view of the plane whose strike line is CD. Extend HL until it intersects AE at J. Point J is actually the point projection of the line of intersection between the plane containing the line ST and the given plane whose strike line is CD. Then through J draw KM parallel to CD. KM then actually is the horizontal projection of the line of intersection between the two planes. Where KM intersects ST is the point where ST intersects the plane represented by strike line CD.

LINE OF INTERSECTION OF TWO PLANES

Still another problem that the geologist is confronted with is that of finding the bearing and slope of the line of intersection of two planes. A typical problem is illustrated in Figure 3. One plane dips 30° to the south east and has a strike line AB bearing N 30° E. The other plane dips 45° to the southwest and has a strike line CB bearing N 60° W. The strike lines AB and CB have the same elevations.

In the descriptive geometry solution at the left of Figure 3, one point common to both planes is determined by the intersections of the two strike lines at point B. Plane 2 is passed perpendicular to the line CB and the edgewise view of the plane is obtained. Line OL lying in the plane whose strike line is CB is taken parallel to CB. Plane 1 is passed perpendicular to line AB and here the edgewise view of the plane whose strike line is AB is obtained. The line OL is also projected onto this auxiliary plane 1 and where it intersects the edgewise view of the plane at P is another point common to both planes. Connecting point B and P with a line BP results in the line of intersection of the two given planes. Passing auxiliary plane 3 parallel to BP and projecting BP onto it will determine the slope of the line.

At the right of Figure 3 is described the solution as advanced by F. H. Lahee[5]. The strike lines AB and BC are drawn. Line AB is extended to D and along BD to some convenient scale the tangent of 30° is laid off as BE. Along CB to the same scale the tangent of 45° is laid off. Draw BH parallel to EF to determine the bearing and the location of the line of intersection. Construct BG perpendicular to EF and scale off BG to the same scale as used before to determine the tangent of the slope of the line of intersection. This latter solution is obviously based on some concrete geometrical basis but the proof is not easily forthcoming and in the discussion of it by F. H. Lahee no reference is made to the geometrical proof.

CONCLUSIONS

The methods of descriptive geometry are a very useful tool to the geologist in the solution of structural geology problems. By using the descriptive geometry approach the geologist is able to apply the same method of solution to all of his problems and he does not have to resort to memorizing a solution for each particular problem. In addition to being able to use descriptive geometry as a means of obtaining direct solutions to his problems, the geologist is also able to increase his ability to visualize three dimensional situations.

To accomplish this two fold purpose of using descriptive geometry, the geologist should have a basic course in the fundamentals of orthographic projection. This course should be designed to deal with direct applications to actual geological problems.

At the University of Illinois the author has designed such a course and it is a pre-requisite for advanced undergraduate courses in geology such as structural geology. Experience has shown that this course has been very useful to the student and has enabled the instructors in the advanced courses of geology to cover more subject matter.

[5] Lahee, F. H., "Field Geology" 4th Ed. Chap. XXI, pp. 685-687.

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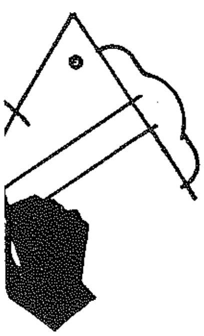

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—PHILMAC TYPOGRAPHERS

UNIFIED AND AMERICAN SCREW THREADS

by
Frank P.Tisch
Pheoll Manufacturing Co.
Chicago, Illinois

Interchangeability, the foundation on which modern mass production is based is a direct result of standardization. Standardization in turn is founded on the agreement of qualified individuals as to what constitutes the most practical and economical specifications covering an extensively used product. The evolution of internationally accepted standards demonstrates the necessity of definite specifications as the existing confusion due to the variation in designs, sizes and qualities becomes apparent.

Our discussion of the American Standard for Unified and American Screw Threads begins with the organization of Sectional Committee B1 in 1920 under the procedure of the American Engineering Standards Committee, later succeeded by the American Standards Association with the Society of Automotive Engineers and the American Society of Mechanical Engineers as joint sponsors. The first assignment was to review the Progress Report of the National Screw Thread Commission, Miscellaneous Publication of the National Bureau of Standards, No. 42-1921 and to report to the sponsors and take steps if possible leading to international agreement. The first edition of the report was issued as American Standard B1a-1924 covering both the coarse and find thread series. This was followed by ASA B1.1-1935 American Standard which reflected the efforts of an investigation jointly conducted by the National Bureau of Standards and the Sectional Committee. The Interdepartmental Screw Thread Committee was established by the Departments of War, Navy and Commerce in 1939 to promote uniformity in screw thread standards in the departments concerned. The first Handbook H25 published in 1939, was based on the last report of the National Screw Thread Commission dated 1933. This Handbook was followed in 1942 by H28 (a revision of H25) with additional pertinent standards approved and promulgated by the American Standards Association.

The war years brought renewed activity in the standardization and unification of screw threads and arrangements were made by the War Production Board with the American Standards Association to appoint a General War Emergency Committee on Screw Threads to expedite the work on the revisions in progress. Meetings with the British and Canadians were held in New York in 1943, in London in 1944, and a very extensive conference in Ottawa in 1945. The unified thread form with a sixty degree thread angle, rounded roots with the crests either flat or rounded to meet the individual preferences of the producer countries was adopted and it was recognized that INTERCHANGEABILITY had been accomplished. There remained only the tolerances of the various classes to be determined, so it was decided that the British and Americans should proceed to work out independent drafts and exchange them for comment and reconciliation.

The increased use of power drivers for use in assemblies brought out the need for an allowance to prevent the seizing and galling of Class 2 tolerance screws, bolts, and nuts. This led to several meetings in 1940 at which the need for an allowance was discussed. The subject remained static until it was reactivated in 1945 at a series of joint industry conferences. At these conferences the need for an allowance was discussed, with consideration given the plated product as well as the plain product. At that time it was agreed that the importance of pitch diameter fit on strength, work load capacity, fatigue life, and permanence of thread fastenings had been over-rated; that lead, ductility of materials, avoidance of stress concentration, proper tightening, and many other factors influence performance more than slight loss in engagement resulting from the looser fits. Consideration was given to the possibility that loads might be more evenly distributed in the looser fits by clearance which allows members to position themselves to each other over a greater length and area than in the tighter fits. It was submitted that the current tolerances for commercial nuts were unnecessarily restrictive and impractical from a cost standpoint for a mass-produced product; that commercial nuts outside the limits have been produced and accepted for many years past; and that the oversize more often than not is advantageous to the user where high-speed torquing and plated assembly are involved. The Class 2 tolerances in the internal threads and nuts were found to be too restrictive in the numbered sizes and quite liberal in the larger fractional sizes.

The joint industry conferences developed a recommendation to the ASA B1 Sectional Committee which included a statement that an allowance was to be placed on the external thread and suggested suitable allowances and tolerances for a new Class 2 external thread to be known as a Class A thread and tolerances for a new Class 2 internal thread to be known as a Class B thread. Subcommittees 5 and 6 of Sectional Committee B1 were assigned to formulate the tolerances and allowances conforming as closely to the original recommendation as practical and to work in conjunction with Subcommittee 1 in the preparation of the revision of the existing American Screw Thread Standard.

As the subcommittee work progressed, it was noted that the pitch diameter tolerances for the old Class 2 threads were predicated on pitch only and it soon became apparent that it would be desirable to develop a formula that would provide more tolerances for the fine thread series where the diameter and length of engagement were greater than for the same pitch in the coarse thread series. For example, the NC2-7/16-14 size having 7-1/2 lineal inches of thread measured on the pitch diameter had the same tolerance as the NF2-7/8-14 which had 32 inches of thread. Obviously, more tolerance was needed and this resulted in the 2A formula which was weighted for diameter, length of engagement, and pitch, with an allowance factor of 30 per cent of the tolerance value. Tolerances and allowances for the numbered and fractional sizes in the coarse and fine thread series were calculated and the 2A thread was established. The tolerances for the 2B internal thread were calculated by using 130 per cent of the 2A external thread values. The new tolerances and allowances were found to conform very closely with the original recommendations of the joint industry conference and considered to be satisfactory.

A series of conferences including representatives from Great Britain, Canada, the Interdepartmental Screw Thread Committee of the National Bureau of Standards, and Sectional Committee B1 in July of 1948 revealed the necessity for the development of suitable tolerances and allowances to replace the old Class 1 for ordnance and certain special uses. At the same time there appeared to be a need for a new thread classification to replace the old Class 3 where the thread tolerances were to be developed on the principle of the Class A formulation without an allowance for applications where closeness of fit and accuracy of angle and lead of thread are essential.

The formulation of the tolerances and allowances for the other classes on the 2A principle was approved by the Sectional Committee and later by the British and Canadians and has been used in the unified standards of the three countries. The Declaration of Accord was signed on November 18, 1948 by the delegations of the three countries agreeing that standards for the unified threads in the British Standards Institution, the Canadian Standards Association and the Interdepartmental Screw Thread Committee will fulfill all of the basic requirements for the general INTERCHANGEABILITY of threaded products. The American Standard for Unified and American Screw Threads ASA B1.1-1949 was approved by the American Standards Association on February 23, 1949 and published by the American Society of Mechanical Engineers in May of 1949. The first edition was soon exhausted and it was agreed by the Standing Committee on Unified and American Screw Threads that such errors as have been found should be corrected in the second printing and that some editorial revisions should be made to eliminate inconsistencies and otherwise clarify the standard. This correct and revised reprint is designated "Second Edition" and become available in June 1950.

The first fifteen pages of the Standard contain information that is of extreme importance to anyone concerned with the specification and application of screw threads. For example, the method of designating the screw thread by the use of the initial letters of the thread series, preceded by the nominal size and number of threads per inch, all in Arabic characters, and followed by the classification designation, with or without the pitch diameter tolerances or limits of size is found on Page 12.

Series of threads are classified and distinguished from each other by the number of threads per inch applied to a specific diameter. The Unified Screw Threads are limited to the coarse and fine thread series of Classes 1A, 1B, 2A, 2B, 3A and 3B as indicated in the tables of numerical values by bold type and preferred selected combinations of special threads of Classes 2A and 2B.

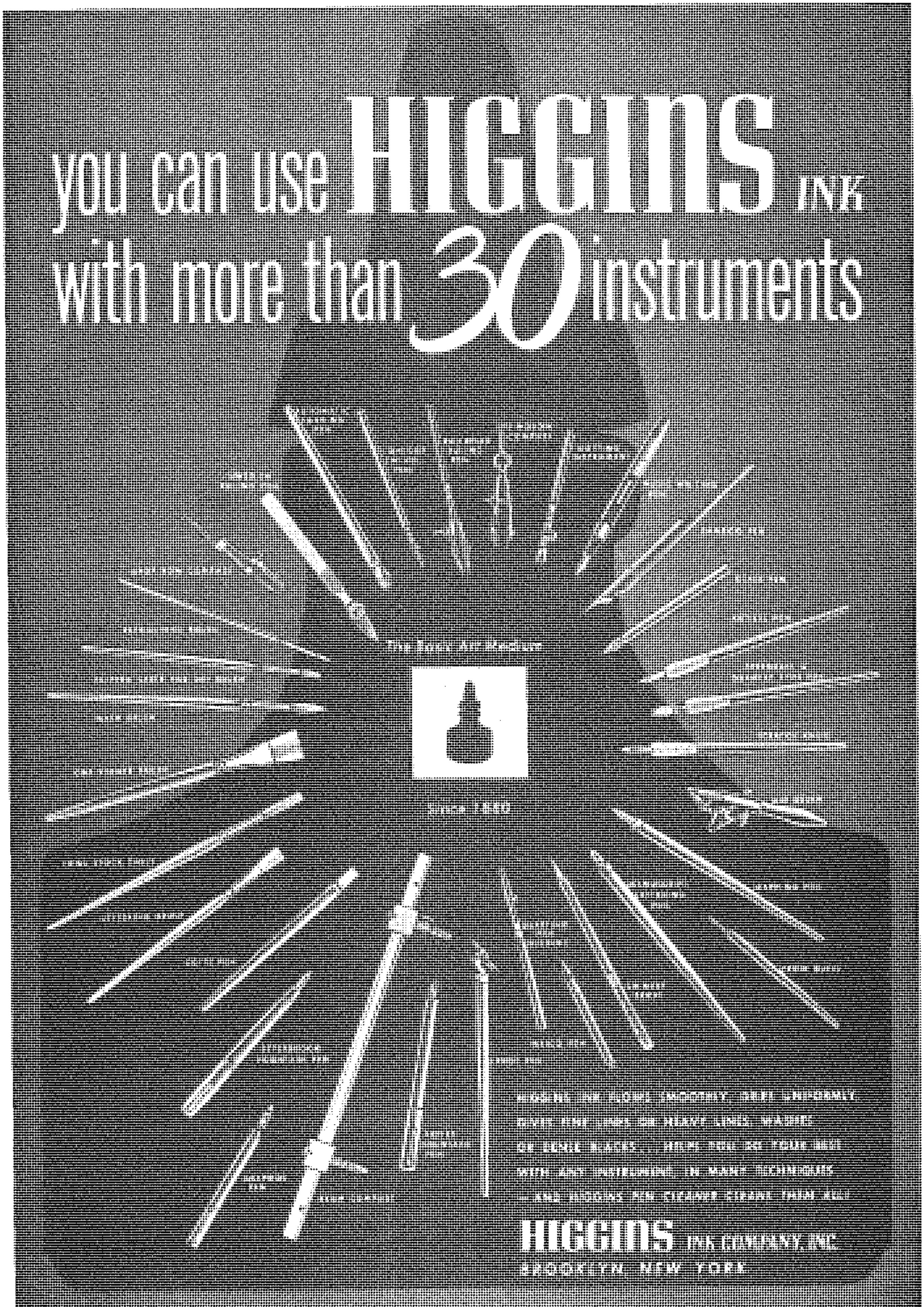
Wherever possible, a Unified or American thread of the coarse or fine thread series should be used. If no such thread meets the requirements of the design, it is important to refer to the various tables in proper sequence. After looking for the required thread in the tables of limits of size for the standard series, reference is made to the tables of limits of size for selected combinations of special diameter and pitch. Reference is made to the step tables as the third expedient. Calculation of thread values by formula is the last resort.

The American and Unified Screw Thread Standard presents an entirely new concept of thread classification. With the old standard, class in each instance had been misconstrued as fit with a strong implication that both components must have the same class of tolerances. For instance, the idea existed that a Class 2 external thread must be used with a Class 2 internal thread and that a Class 3 external thread must be used with a Class 3 internal thread. Classes of thread are distinguished from each other by the amount of tolerance and allowance specified. Fit is determined entirely by the selected combination of classes for external and internal threads of mating parts. The important fact to remember is that the new threads are entirely interchangeable with the old threads and that the new threads will provide far more latitude in design than was possible with the old thread specifications.

The new threads have been widely accepted in industry from the smallest numbered size to the largest fractional size. The transition is being accomplished by specifying the new class and permitting the acceptance of the old classes as optional for an indeterminate period. The Interdepartmental Screw Thread Committee of the Army, Navy, Air Force and Commerce Departments has published the 1950 supplement to screw thread standards for federal services H28-1944 which contains all of the new tables and dimensions and makes them available for the various branches of government services.

A recent mission to Great Britain has negotiated the Unification of the 4-40, 6-32, 8-32, 10-24 and 10-32 numbered sizes for use as attachment screws. These sizes have been recognized as unified sizes although the United States will continue to use all of the numbered sizes as in the past. The Unified sizes will be recommended for use as attachment screws. Negotiations have brought about the reestablishment of the 1/2-13 as a Unified thread to replace the present 1/2-12.

Credit for the current status of the Unified and American Screw Thread Standard is due to the splendid guidance of the sponsors, The Society of Automotive Engineers, The American Society of Mechanical Engineers, and the excellent unselfish individual efforts of the members of the Interdepartmental Screw Thread Committee and ASA Sectional Committee B1.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FROM THE MINUTES OF THE ANNUAL MEETING DIVISION OF ENGINEERING DRAWING DARTMOUTH COLLEGE JUNE 24, 1952

Professor Justus Rising presented changes for Article VI of the Articles of Procedure Of The Division. These changes govern election procedure and the determination of the membership of the election committee. The recommended changes were unanimously adopted. Article VI as approved reads as follows:

Article VI. ELECTION. 1. The Vice-Chairman and two members of the Division appointed by the Chairman at the annual meeting shall be a Committee on Nominations and Elections for the following year. The Vice-Chairman shall be Chairman of the Committee.

2. Report of elections shall be made at the Division business luncheon during the annual meeting of the Society.

3. Newly elected officers shall take office ten (10) days after the close of the annual meeting of the Society.

4. On or about March 1, the Secretary shall mail to each member of the Division a ballot for nominations. On April 1, the Vice-Chairman shall ask each nominee regarding his willingness to accept nomination and to serve if elected. The Committee on Nominations and Elections shall canvass the nominating ballots and prepare a slate containing, for each office to be filled, the two names of eligible candidates receiving the largest number of votes. On May 1, and returnable by May 20, the Secretary shall mail to each member of the Division on election ballot bearing the slate prepared by the Nominating Committee. The Nominating Committee will canvass the election ballots and report the results of the election at the annual business meeting. Nomination and election ballots shall be returned to the Vice-Chairman of the Division. Any holder of an elective office whose term extends beyond the current year shall *NOT* be eligible for nomination to another office.

5. If any of the elected officers other than the five members-at-large of the Executive Committee are unable to perform the duties of their offices, the duties of each shall be assumed by a member of the Executive Committee in order of length of service, until the next regular election. Vacancies among the five members-at-large of the Executive Committee shall be filled by appointment by the Chairman of the Division, such appointees to hold offices until the next regular election.

6. Persons elected to unexpired terms of members-at-large of the Executive Committee, Publishing Board, or Members of Council shall hold office to the end of the term for which the original incumbent was elected.

Professor Brattin presented the report of the Election Committee. The report indicated that the following persons were elected:

Chairman: Jasper J. Gerardi, 1952-53
Vice-Chairman: Ralph T. Northrup, 1952-53
Secy's Treasurer: John G. McGuire, 1952-53
Member Executive Comm.: Randolph P. Hoelscher, 1952-57
Member of Council: Ralph S. Paffenbarger, 1952-54
Editor of Journal: Warren J. Luzadder, 1952-55
Editor of T-square Page: John Russ, 1952-53
Circulation Manager of Journal: Edward M. Griswold, 1952-53

The following invitations were received for the Mid-Winter Meeting, January 1954:

Professor Tozer of Northeastern University invited the group to come to Boston in 1954.

Professor Jorgenson invited the group to come to Philadelphia in 1954. No formal action was taken, and the problem was passed on the new Chairman Jasper J. Girardi.

Professor R. P. Hoelscher, University of Illinois, made a brief report on the A.S.A. Standards--what has been achieved and the progress that has been made on the various divisions of standards. He further reported on the task of the Unification Committee composed of members from the United States, Great Britain, Canada, and the armed services. Hoelscher pointed out that the military services of Great Britain are now using third angle projection. It is their practice to stamp upon a drawing the quadrant in which the drawing has been made. Tolerances for parallelism, squareness, flatness, concentricity, etc., are well advanced in Great Britain.

Professor Hoelscher, Chairman of the Policy Committee, reported that leaders in industry seem to have varied ideas about engineering drawing. In the minds of some, it is a skill. In the minds of others, it is a method of expression to be used by engineers in either the sketch or finished drawing forms. He stated that no national survey is contemplated by the Policy Committee at this time.

Tbe Policy Committee proposed a three-fold program of education: A. Education of industrial leaders to the fact that we are interested primarily in teaching the theory of engineering drawing and not in developing a manual skill. B. Education of college administrators in our engineering schools as to our aims and objectives. C. Education of our own teachers to accept the idea that we are not just teaching skills but engineering graphics and are attempting to develop creative imagination.

PROBLEMS IN

ENGINEERING DRAWING

ABRIDGED

by

W. J. LUZADDER
ASSOCIATE PROFESSOR IN
ENGINEERING DRAWING
PURDUE UNIVERSITY

J. N. ARNOLD
ASSOCIATE PROFESSOR OF
GENERAL ENGINEERING
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ASSISTANT PROFESSOR OF
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UNIVERSITY OF CALIFORNIA
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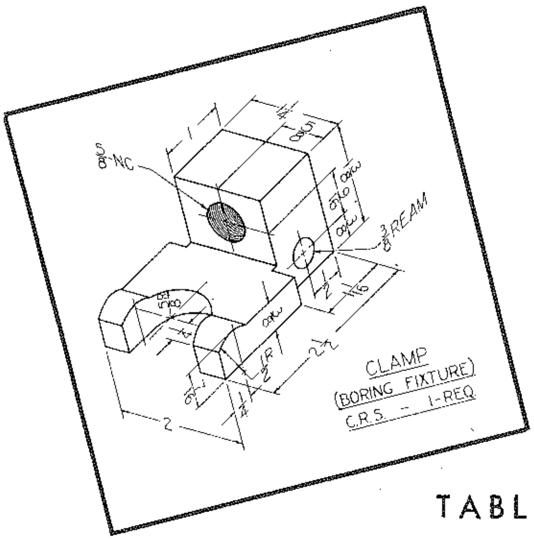

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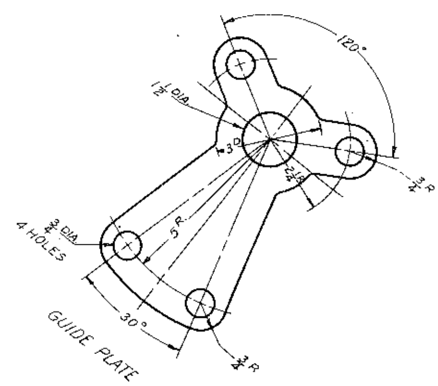
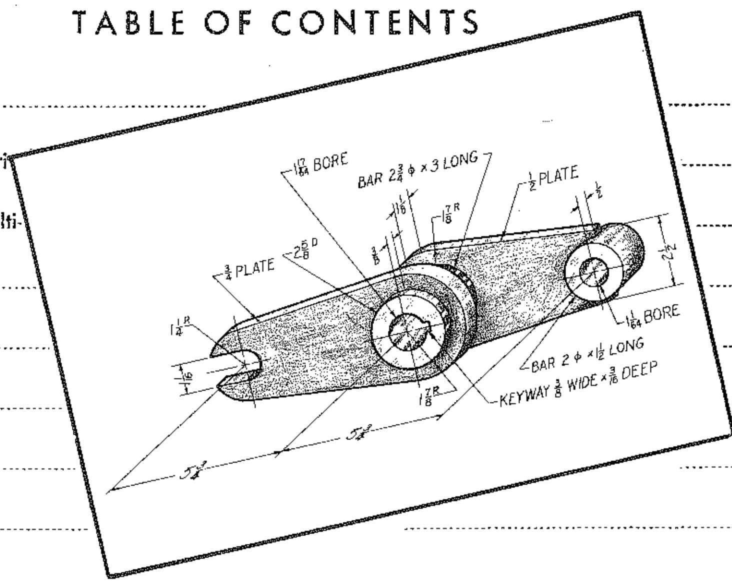


TABLE OF CONTENTS



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308½ STATE STREET
WEST LAFAYETTE, INDIANA

PROGRAM
MID-WINTER MEETING
of the
ENGINEERING DRAWING DIVISION OF THE A.S.E.E.

The Drawing Division was invited to hold its Mid-Winter meeting at the University of Nebraska during the annual meeting at East Lansing, Michigan. The Executive Committee accepted this offer and fixed the dates of January 29, 30, and 31, 1953. The tentative program includes:

Thursday, January 29:

9:00 - 10:30 a.m. . .	Registration, 2nd floor, Bancroft.
10:30 a.m..	Meeting, auditorium, Bancroft. Greeting: Dean Roy M. Green, Engineering College University of Nebraska. Response: (for the division) Dean Jasper Gerardi, Chairman of the division. "Reduction of Forces in Space by Graphical Methods," Professor E. J. Marmo, Department of Engineering Mechanics, University of Neb.
12:00 noon.	Luncheon, Student Union.
1:00 - 1:15 p.m.. . .	Board Buses for Boys' Town (Arrive Boys' Town about 2:40)
2:50 - 4:30 p.m.. . .	Inspection of Boys' Town.
4:30 p.m.	Board Buses for Lincoln (Arrive Lincoln about 6:00)
7:00 p.m.	Executive Committee Meeting.
8:00 - 10:00 p.m. . .	Informal get-together, Faculty Lounge, Student Union.

Friday, January 30:

9:00 - 10:00 a.m. . .	Inspection of Engineering College facilities.
10:00 a.m..	Meeting, Ferguson Hall, Room 215. 1. "Opportunities and Responsibilities of Drawing in an Engineering Educational Program," Professor John T. Rule, Chairman Section in Graphics, M.I.T. 2. Title not available at present. 3. Title not available at present.
12:00 noon.	Luncheon, Student Union.
1:15 - 3:15 p.m.. . .	Inspection Trip to Elgin Watch Co.
3:15 p.m.	Board Buses for State Capital.
3:30 - 4:30 p.m.. . .	Inspection of State Capital.
6:30 p.m.	Annual Dinner (men and women) at the Student Union. Speaker: R. G. Gustavson, Chancellor the University of Neb.

Saturday, January 31:

9:30 a.m.	"Manufacturing and Design Problems," Elgin Watch Company, followed by discussion. "Objectives of Courses in Engineering Drawing" -- Panel Discussion. Professor James Rising, Department of Engineering Drawing, Iowa State College.
12:00 noon.	Luncheon, Student Union.

LADIES PROGRAM

Thursday, January 29:

9:00 a.m.	Registration, second floor, Bancroft.
10:30 a.m..	Visit to local department stores, art galleries, and other points of interest.
12:00 noon.	Luncheon.
1:00 p.m.	Board Buses for Boys' Town (Arrive Boys' Town about 2:40)
2:50 - 4:30 p.m.. . .	Inspection of Boys' Town.
4:30 p.m.	Board Buses for Lincoln (Arrive Lincoln about 6:00)

Friday, January 30:

9:30 a.m.	Tour of University of Nebraska museum and art gallery.
1:00 p.m.	Luncheon and bridge.

NOTES ON THE PROJECTION OF A CIRCLE

by
John T. Rule
Steven A. Coons
Massachusetts Institute of Technology

The following determination of the major and minor axes of the ellipse representing an orthographic projection of a circle may not be new, but we are unable to find it in the literature. Though this is always an easy problem, the method presented here has great simplicity and in some instances is very convenient.

Any plane may be fixed by two points, namely, the foot, F, of a perpendicular to the plane and any other point, P, on the perpendicular. In particular, if it is desired to draw a circle of given diameter in the plane, the foot of the perpendicular, F, may be taken at the center of the circle. The second point, P, may be taken so that FP is equal to a radius. Furthermore, the minor axis in any view will lie along the perpendicular FP, as both must appear perpendicular to the true length major axis.

If the circle is given in normal and edge view (Fig. 1), the major and minor axes in all subsequent views may be obtained as follows. Suppose the circle is desired in view 5. In the edge view erect a perpendicular FP to the plane of the circle at its center, F, equal in length to its radius. Project the line FP into view 5 and draw the major axis perpendicular to P_5F_5, extending the length of a radius to each side of F_5.

Then the distance P_4M, (equal to the difference in distance of P_4 and F_4 from the reference line between views 4 and 5), will be equal to the semi-minor axis in view 5 which may be constructed directly in that view. The ellipse may then be trammeled. Note that the semi-minor axis in every view may be obtained directly from any adjacent view.

The proof of the last statement is simple. Consider any view of a circle and the line FP and an edge view obtained from this view (Fig. 2). The distance AB is equal to the semi-minor axis in view 1. The distance MP_2 is equal to the difference in distance of F and P from the reference line for *every* view taken off view 1. However, triangle ABF_2 is congruent to triangle MP_2F_2 and hence MP_2 = AB = semi-minor axis in view 1.

Furthermore, it is not even necessary to return to any adjacent view to obtain the length of the minor axis. If we strike off the radius from P_1 intersecting the major axis at N, then the triangle NP_1F_1 is also congruent to triangle ABF_2 and hence NF_1 is the length of the semi-minor axis. Thus if we have the line PF in any view and know its true length, we can immediately construct the ellipse without reference to any other view.

In the light of this construction, consider the following problem. Given line FP (Fig. 3a). Construct a circle perpendicular to FP at F and having a radius equal to FP. The axes in both views may be obtained immediately as shown in Fig. 3b.

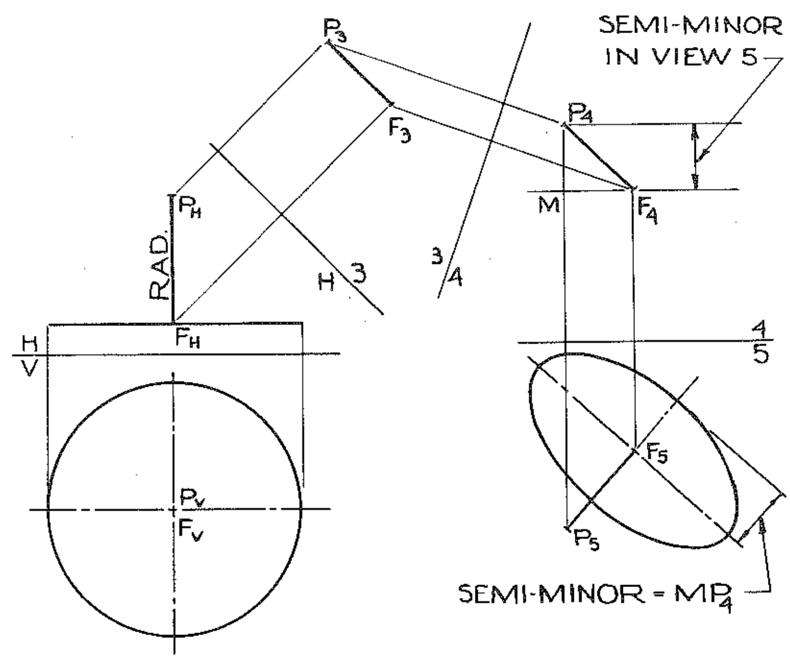
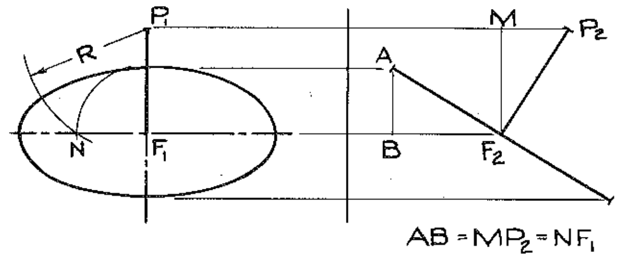
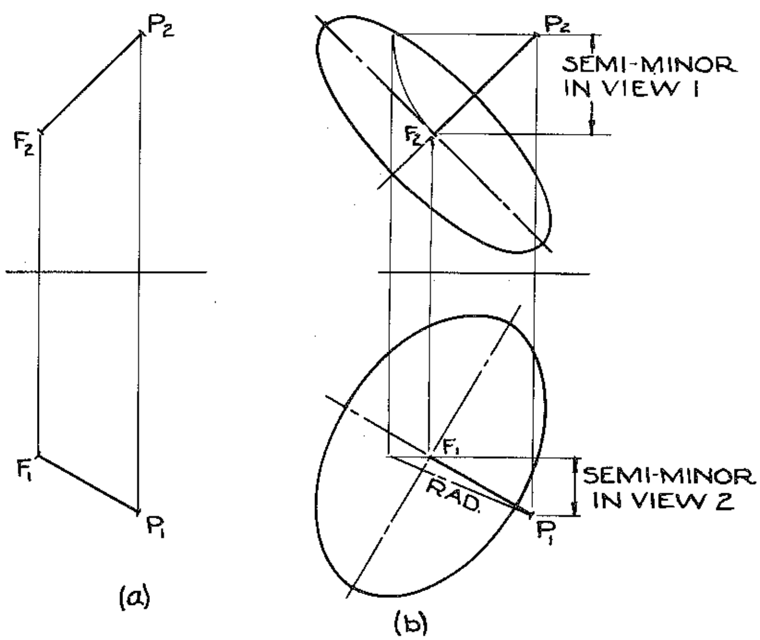


FIG. I



P1
M
P2
R
A
N
F1
B
F2
AB = MP2 = NF1

FIG 2



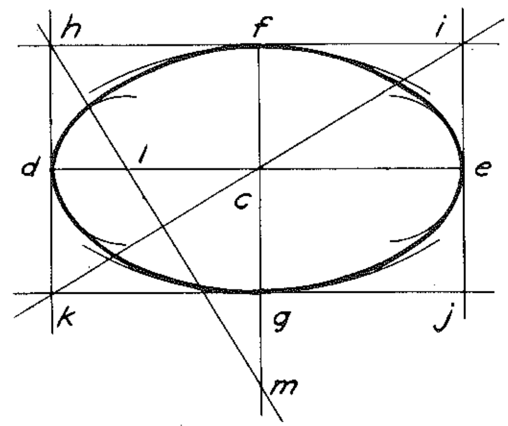
P2
F2
F1
P1
(a)
SEMI-MINOR
IN VIEW 1
SEMI-MINOR
IN VIEW 2
RAD.
(b)

FIG. 3

GEOMETRIC CONSTRUCTIONS

by
Frederick E. Giesecke, Ph D
Formerly, Professor of Drawing, Texas A & M College

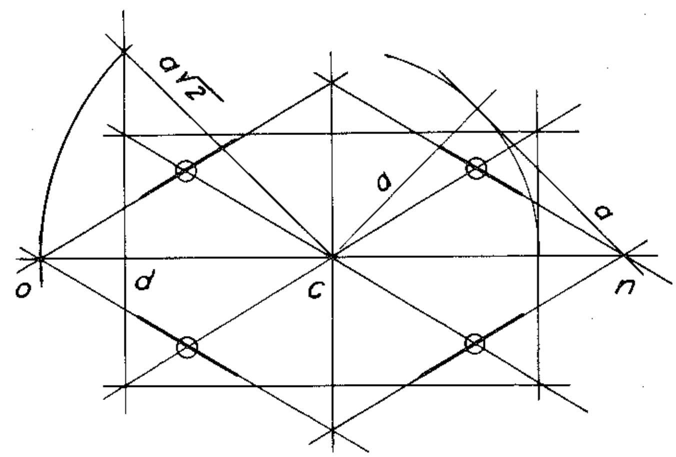
No. 1. To draw an ellipse with the aid of tangents.



Let d e and f g be the axes of the required ellipse. If a and b represent, respectively, the semi-major axis (d c or c e) and the semi-minor axis (f c or c g), then $\frac{a^2}{b}$ and $\frac{b^2}{a}$ represent, respectively, the radii of the osculating circles at the major axis vertex and at the minor axis vertex of the ellipse.

Circumscribe the rectangle h i j k about the required ellipse; draw the diagonal k i and draw a line from h perpendicular to the diagonal k i to intersect the major axis at l and minor axis, extended, at m.

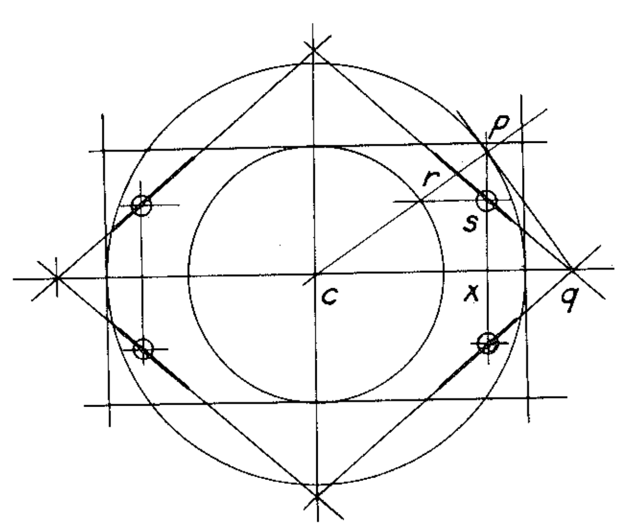
The triangles h d l and i f c are similar; hence d l : fc = h d : i f or d l : b = b : a or $d\ l = \frac{b^2}{a}$.



The point l is, therefore, the center of the osculating circle at the minor axis vertex; similarily, the point m is the center of the osculating circle at the major axis vertex.

Draw arcs of the four osculating circles; these four tangent arcs are, in many cases, sufficient to guide the drawing of the ellipse.

If greater accuracy is desired, circumscribe, about the required ellipse, the rhombus whose vertices are in the axes of the ellipse. This rhombus may be considered to be the projection of a square circumscribed about the major circle of the ellipse. The length of the major semi-diagonal of the rhombus is $a\sqrt{2}$; it can be found graphically by drawing a quadrant of the major circle, and at its mid-arc, a tangent intersecting the major axis extended, at n; or by constructing an isosceles right triangle on the semi-major axis and setting its hypotenuse off on the major axis from c to o, as shown.



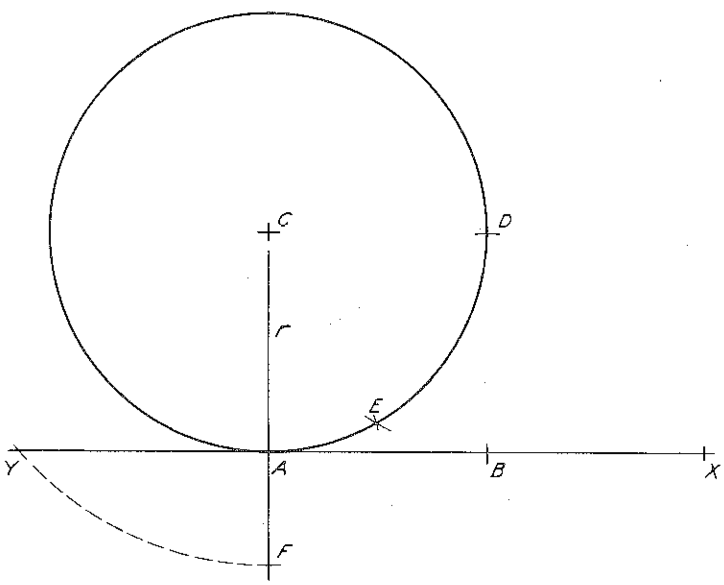
The sides of the rhombus are parallel to the diagonals of the rectangle h i j k and they are tangent to the required ellipse at their mid-points.

If still greater accuracy is required, draw a perpendicular to the major axis at any point x to intersect the major circle at p; draw a line tangent to the major circle at p to intersect the major axis, extended, at q; draw the radius c p of the major circle to intersect the minor circle at r; through r draw a line parallel to the major axis to intersect the perpendicular p x at s; draw the line q s; it is tangent to the required ellipse at s; three other symmetrical tangents can be drawn as shown.

RECTIFICATION OF THE CIRCUMFERENCE OF A CIRCLE

by
Professor Paul Hessemer
The John Hopkins University

There is another graphical method for the rectification of the circumference of the circle, which is equally simple and as easy to remember as the construction reported by Professor John S. Rackway in the November 1948 issue of the Journal of Engineering Drawing. This construction furthermore reduces the absolute theoretical error to 0.000 007 36...r, while Prof. Rackway's method is "only" correct within 0.000 118 60...r.



GIVEN: AC = r; tangent line in A, perpendicular to AC

CONSTRUCTION:

1) AC = AB = BX = BD = DE = r
2) AF = AE
3) CY = CF

XY is very near $r\pi$.

PROOF: $AE = AF = r\sqrt{2-\sqrt{3}}$

(Side of reg. inscribed 12-sided polygon)

Therefore:

$CY = CF = r + r\sqrt{2-\sqrt{3}}$

$CA = r$,

$AY = r\sqrt{(2-\sqrt{3}) + 2\sqrt{2-\sqrt{3}}}$	= 1.141 588 97...r
AX	= 2.000 000 000...r
AX + AY = XY	= 3.141 588 97...r
$r\pi$	= 3.141 592 65...r
Absolute theoretical error: $r\pi$ - XY (For the half circle)	= 0.000 003 68...r
For the full circle:	= 0.000 007 36...r

Reported by G.G. Kerzdorfer in a German Publication 1938.

WINNERS

CHICAGO -- Winners of a technical drawing contest, sponsored jointly by Illinois Institute of Technology and the Chicago public high schools have been announced by Henry C. Spencer, chairman of Illinois Tech's drawing department.

The contest was divided into four divisions for first semester, second semester, and advanced drafting students. More than 650 entries were submitted by students in 14 high schools.

First prize in the advanced class, a one year scholarship to Illinois Tech, was won by John H. Linder, a student at Chicago Vocational high school.

Tadashi Kuroda, a student at Lane Technical high school, was awarded top prize of a drafting table in the competiton for third semester students.

In the contest for students of Drafting II, Kenney Morishige, a student at Tilden Technical high school won first prize of a drafting machine.

Michael Somin, also a student at Chicago Vocational high school, won first prize among students of Drafting I.

DRAFTING PROCEDURES THAT REDUCE COSTS

by
A. F. Townsend
Heald Machine Co.

In general there are two types of problems that are encountered in an engineering department or drafting room. First the mass producer whose product will be manufactured in very large quantities, such as refrigerators, washing machines, automobiles and the like, finds it economically sound to spend some little time in making drawings, making sure that they contain all possible information and are as complete as possible in every respect. The cost of these drawings, being spread over thousands of units, of course becomes negligible per unit manufactured.

The second problem is the one faced by the maker of special equipment where the units, machines or fixtures will only be built once and it is necessary to absorb the complete cost of engineering in the one project. This is the problem that we are faced with at the Heald Machine Co. where at least 50% of all the equipment we make is of a very special nature designed particularly to handle a given customer's problem. In an effort to make our costs of this special equipment as low as possible so as to serve our customers at a reasonable price, and to meet competition, we have spent a great deal of time studying the problem of making drawings in the minimum length of time and with the smallest number of lines and notes that will still give our factory the necessary information to build the required equipment.

A great deal can be done along the lines of having generally accepted company standards in regard to quality, finishes and general appearance of work. For example, at our plant our standard thread fit for screws and the like is a class 3 fit. This information has been given to all our men throughout the shop and therefore in writing a note for a tapped hole it is not necessary to specify this information each time except in a special case where something better than a class 3 fit is required. Another example is the matter of general appearance of tool blocks, tool holders, fixture clamps and the like. It has been made known generally throughout our shop that a certain degree of finish, rounded corners and all around good workmanship are a must, therefore all these things do not have to be specified on the drawing.

In regard to dimensioning we have adopted a simplified scheme which we feel is much clearer than our previous method, being quicker to draw and quicker for the machine operator to read and interpret. In the case of our old method, long extension lines are involved which confuse the face of the drawing and also make it difficult to follow from the element being dimensioned to the position where the dimension is. In the case of long extension lines that are close together it is very easy to skip from one to another and read the wrong dimension. Our simplified form of dimensioning uses established horizontal and vertical base lines from which practically all the dimensions start. This gives the jig borer or boring mill operator just the information he needs for zeroing out his machine. Each dimension is then shown with a short arrow as near to the element being dimensioned as possible and not way across the drawing, maybe two or three feet away. It is of course understood that dimensions start from the indicated hase lines.

In the new abbreviated note form for tapped holes all superfluous information is eliminated. The matter of the tap drill size and depth for a given depth of thread is information available to all our men in the shop through charts which they have. We estimate that in the course of a normal year we print 30 to 40,000 such notes. Assuming that 1 minute is saved in printing the shorter note we save 500 to 700 productive man hours per year in our drafting room.

In the matter of specifying tolerances, we have changed from the scheme where both the maximum and minimum figures were shown to the scheme where only the mean or basic figure is shown, the tolerances being shown as plus and minus figures. This in our opinion has the advantage of giving the machine operator the point at which he should aim instead of having to make a mental calculation of some in between value. On many ordinary drawings we have estimated that it is possible that one tolerance may apply to 90% or more of the dimensions. When this situation is encountered the tolerance is put on in the form of a note making it necessary to only write the tolerance once instead of many times. Those dimensions requiring tolerance from the one specified in the note carry their own tolerance immediately following the dimension.

We have found that various photographic means have proved very helpful in saving time and cost on much of our work. Very frequently a customer will require that the original drawings of a fixture be on his own paper carrying his own title block, part numbering system, etc. For our own records we require a reproduction from which we can make prints in case we receive a duplicate order or repair parts are required for this fixture. This used to be accomplished by making tracings by hand of the original drawings which involved many hours of work for which it was often difficult to get paid. We have tried the Ozalid Sepia print method but never found that it gave us satisfactory reproductions from which additional prints could be made. A year or more ago we adopted the use of auto-positive paper which can be exposed on a blueprint machine or other light source and which is developed and fixed by usual photographic methods. This paper can be handled in subdued daylight without any trouble and it gives dark black lines on a white background without the necessity of making a negative. Often a customer submits prints of a fixture which they have already designed and which they desire us to build. It is necessary for us to reproduce additional prints from those which are submitted so that our shop will have the necessary number of working prints. This is done using auto-positive paper.

We also make a great deal of use of a so called Revolute machine which is a light source for exposing light sensitive paper. In cases where we have a badly tattered and torn original we make a negative. On this negative with a special red paint we paint out the imperfect parts of the drawing and then make a positive which is a reproduction of all useable parts of the original damaged drawing. We then fill in by hand lines as necessary to complete a new original. This method is also used where we have a part to draw that is very much like some previous part we have drawn. As before we make the negative, paint out the unuseable parts then make a positive and add only the lines necessary to show the new part and part number.

The use of printed forms can be used advantageously to save drawing time. For example, we have several standard flange mountings for rotating boring bars and these standard flanges we have printed on drawing sheets including all the dimensions applying to them. We use similar forms for drawing cutting tool bits. In the case of these tool bits the drawing is not to scale but we find them entirely satisfactory by specifying the proper dimensions and notes. Still another such form is used for springs.

The drawing of electrical equipment and diagrams is quite a problem for us in view of the fact that most of our automatic machines are electrically controlled. Thus it is necessary to make a special wiring diagram which may involve certain standard circuits such as that for a motor starter. These standard circuits we have drawn up in such a manner that they can be placed under the drawing and traced through. The location of the various electrical controls has to be planned so that at assembly they will be put in the proper place in the electrical box. We use templates which are an outline of various starters, contactors and other electrical items as being a quick and convenient way to draw the control location. The drawings of control locations are made to scale with no dimensions, the electrician using the print either as a pattern or scaling it. Motors of different makes, even though they have the same NEMA frame size, are often different in the shape of the end bell particularly, which in many cases could cause interference with other elements of the machine. Thus these motors are drawn up full size, if possible tracing from a composite motor layout. The various outlines are designated by letters and different colors.

On this electrical work we are planning to try out a different scheme where the outline of standard switches and contactors or standard control circuits are made up on rubber stamps. It appears to us that this will be quite helpful and be quicker than the template or tracing methods just outlined. Of course such stamps can only be used where size is not too great.

I certainly appreciate this opportunity to talk to you on this subject which is one in which we are most vitally interested, and which has really paid off in saving time and cost on this special engineering work. I hope some of the things covered will be of help to you.

THE EDITOR'S CORNER

Up to the time of going to press our subscription file shows that one school, namely CLEMSON COLLEGE, has achieved a 100% subscription record. Congratulations to CLEMSON. Let us have more schools join our select group having 100% records.

Our new cover design, which first appeared in our November 1951 issue, was prepared by our advertising Manager Professor C. J. Vierck. This new cover is just one of the planned changes which will appear in the near future.

It should be noticed that a new form of type was used for this issue. It is our hope that this change will make the JOURNAL more enjoyable to read. Our printer assures us that the new type offers more flexibility in the preparation of the magazine.

Even though our new printing contract calls for a sharp increase in the cost of preparing the JOURNAL it will be possible to improve both the appearance and content of Volume 17 which starts in the 1953 calendar year. Watch for the February issue.

Professor Wladaver of New York University has generously offered to prepare an index of all of the articles which have been published in Volumes 1 to 16 inclusive. All persons who are interested in receiving a copy of this index should place his name on the editors list. It is possible that it will be necessary to make a small charge for this index in order to cover typing and printing costs.

Our editorial files need replenishing with articles suitable for publication. Your editor would like to contact prospective writers.

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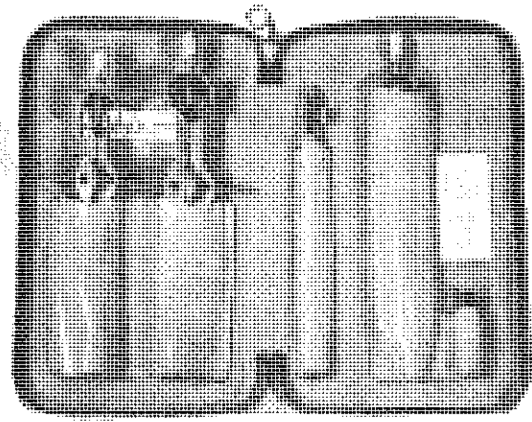
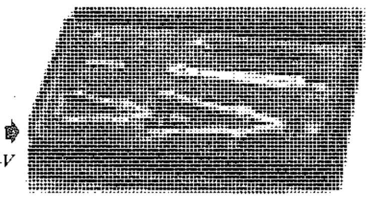


[illegible] (4¾"x7 [illegible]) [illegible] *with zipper* [illegible] *includes 6½"* [illegible] *Compass, 6½" Friction* [illegible] *Slip Handle Ruling Pen* [illegible] *extra leads and points.*



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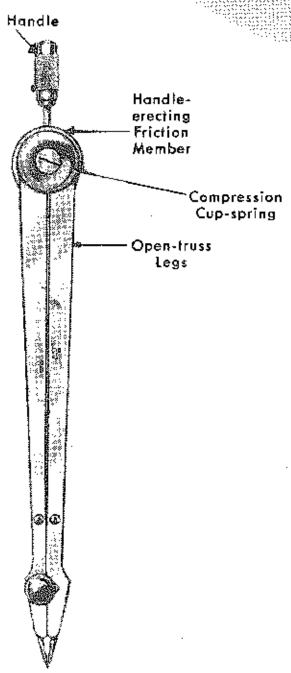

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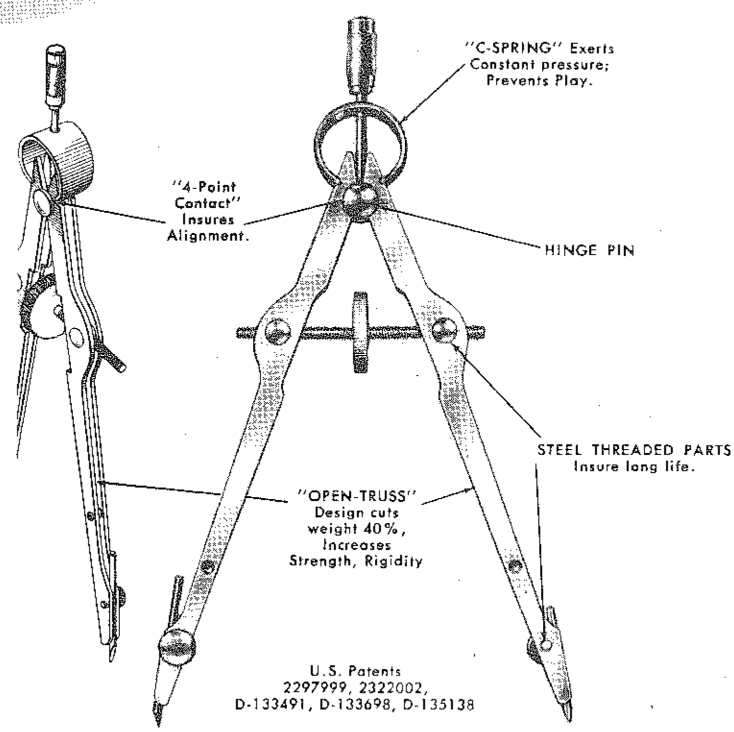

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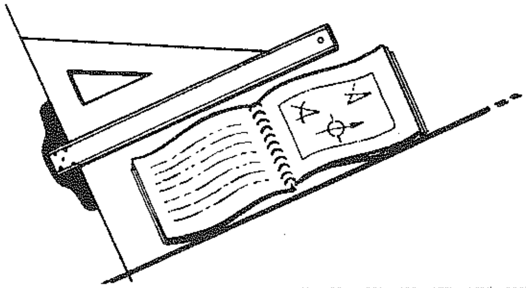
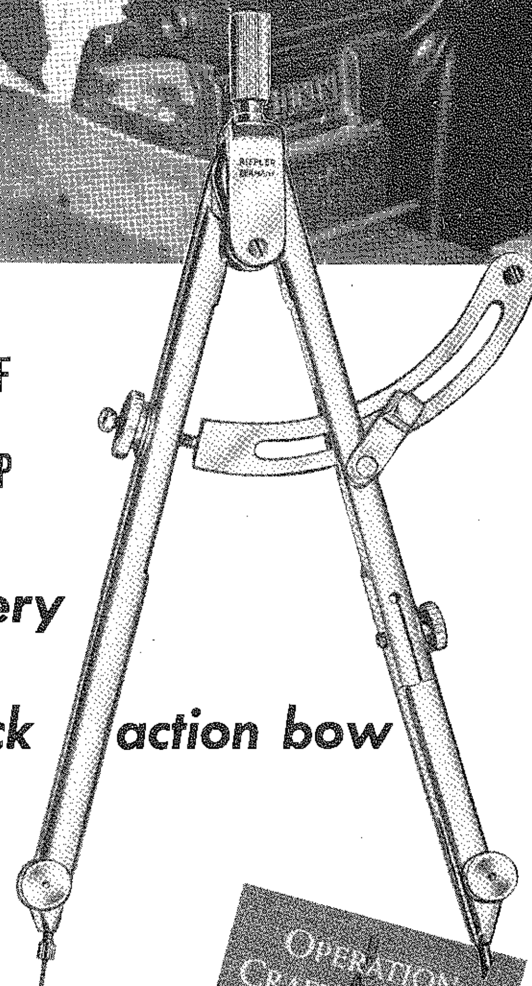


THERE ARE YEARS OF

UNHURRIED CRAFTSMANSHIP

behind every

RIEFLER *quick action bow*



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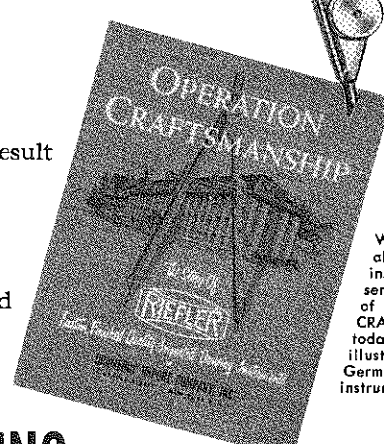

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