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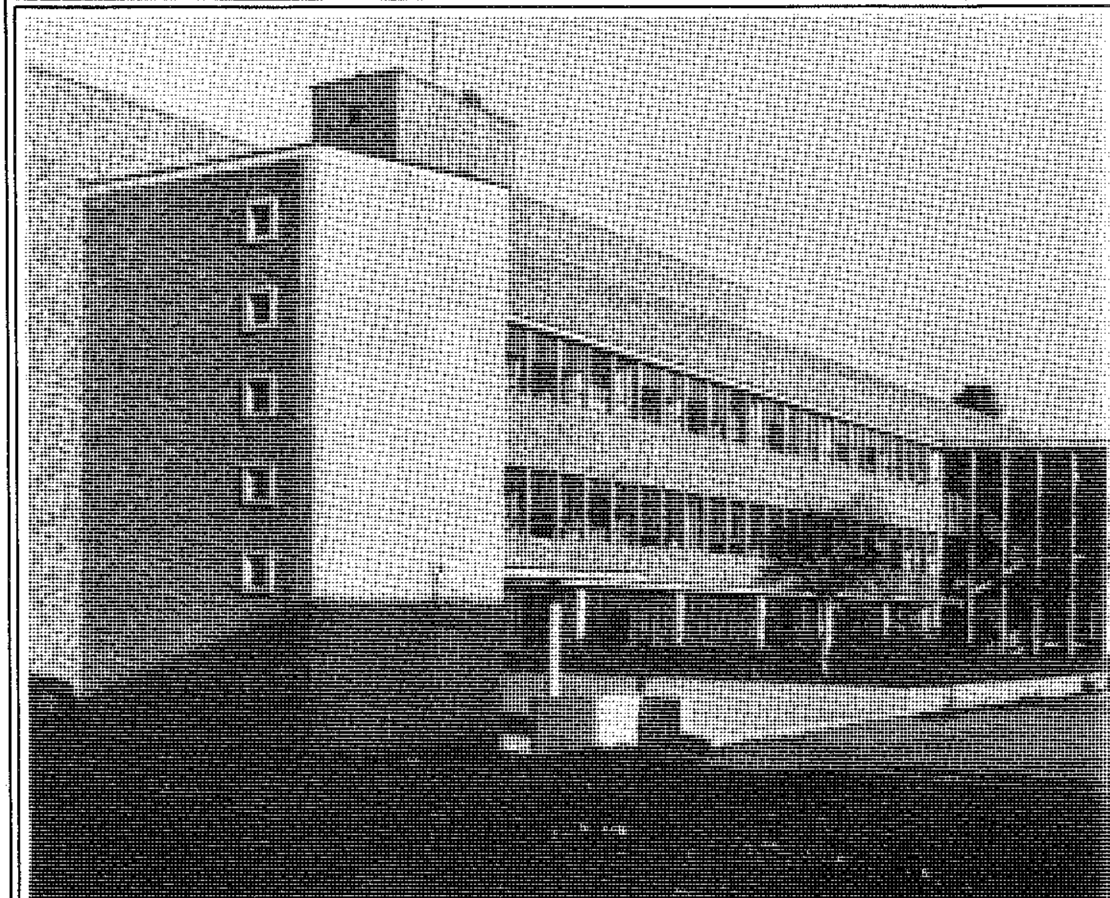

Electrical Engineering Bldg.
University of Washington
Seattle, Washington

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

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CONTENTS

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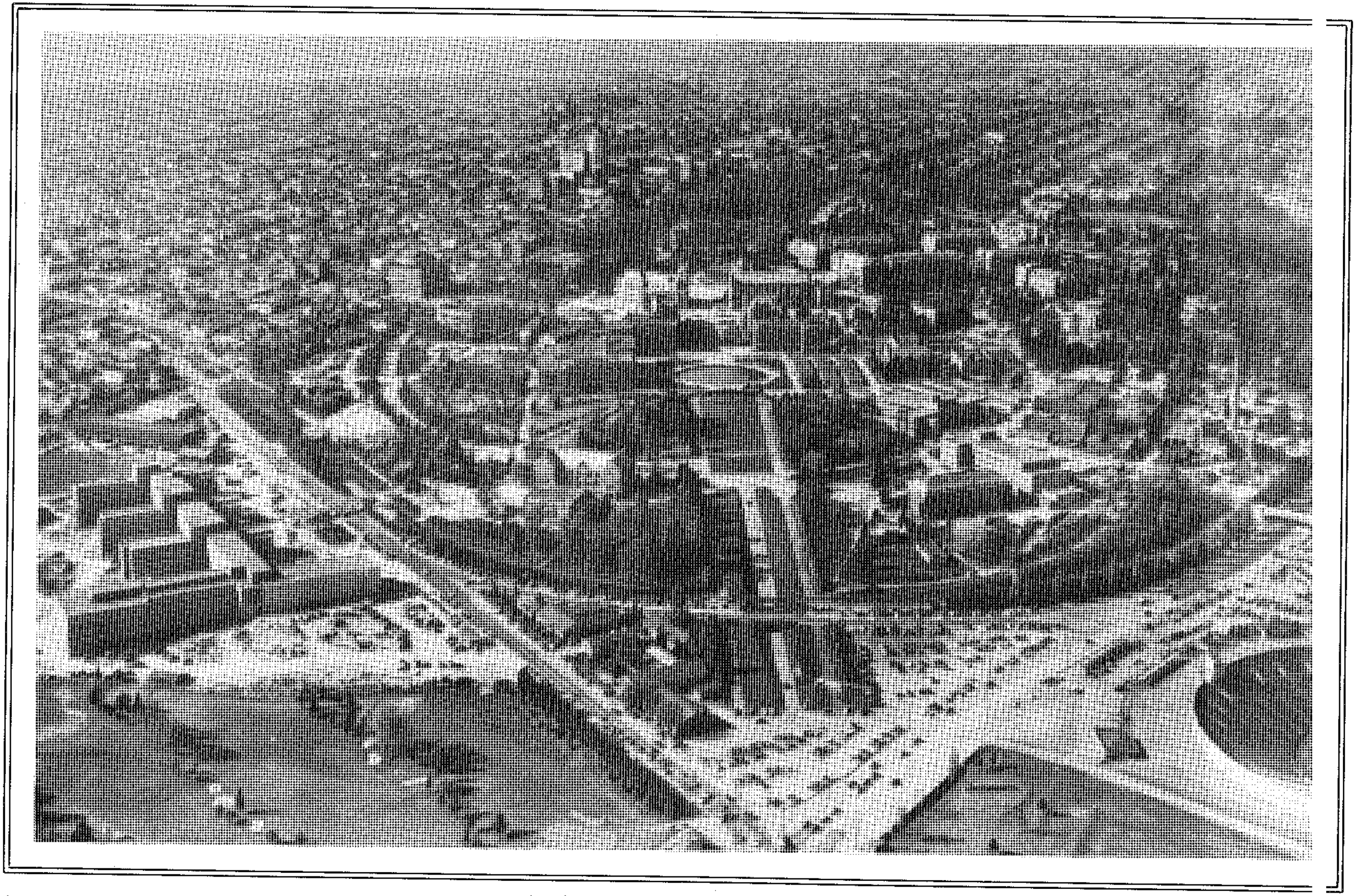


University of Washington
Seattle, Washington

WELCOME TO SEATTLE

by

Professor Frank M. Warner
University of Washington

The faculty of the University of Washington are looking forward to the opportunity of being host to the members of the Drawing Division of the A.S.E.E. We extend to you a most hearty welcome and are planning on showing you a wonderful time. You will enjoy our Pacific Northwest, our city of Seattle, our campus, our convention program and the meeting with old and new friends. Plan to come and to combine educational inspiration with a wonderful vacation trip.

Seattle, the "Queen City of the Pacific Northwest", and home of the University of Washington, is located on the inland waters of Puget Sound and is easily accessible by train, air, bus or ship. It is the closest major Pacific Coast city to Chicago, New York, to Alaska and to the Orient.

Seattle is served by four transcontinental railroads; the Great Northern, the Northern Pacific, the Union Pacific and the Chicago-Milwaukee-St.Paul and Pacific. Two Canadian transcontinental lines connect directly with Seattle from Vancouver by Canadian Pacific Steamship or by rail.

Keeping in step with the most progressive cities, Seattle boasts two major first-class airports--Boeing Field and the Seattle-Tacoma airport, one of the most beautiful and modern fields in the country. Nine scheduled and ten non-scheduled airlines serve Seattle regularly.

The Pacific Coast Highway, U.S. 99, and the main East-West highway over the Cascade Mountains, U.S.10, pass directly through Seattle. An excellent system of country and state paved roads radiate from the city with auto ferries connecting with the Olympic Peninsula and the Coast Highway, U.S. 101.

Built around Elliott Bay, Lake Union and Lake Washington, Seattle has both salt and fresh water harbors. The outer salt water harbor on Elliott Bay has an area of about six square miles; while the inner or fresh water harbor, consisting of two lakes, is connected to the outer harbor by an eight mile Ship canal and by the Government Locks, second in size only to those of the Panama Canal.

Lying principally between the Salt water of Puget Sound and the fresh water of Lake Washington, Seattle looks west to the Olympic Mountains and east to the Cascade Range, both snowcapped the major part of the year. The Olympics, a portion of the coastal range, rise in a broad mass of peaks to 7915 feet and are surrounded by one of the few remaining virgin forests of the nation. The Cascades are an unbroken North-South ridge presenting as rugged terrain as will be found anywhere. Mount Ranier, third highest peak in the United States, dominates the scene with an altitude of 14,408 feet and has fourteen glaciers on its slopes.

Protected against cold air flows from the interior by the towering Cascades, the climate of Seattle is influenced by the Pacific Ocean breezes and tempered by the Japanese current. Temperatures vary between average minimum of 35 degrees in the winter and 74 degrees during the summer months. A healthful climate is one of Seattle's drawing points.

Bountifully endowed by nature, Seattle has capitalized on its advantages to create a city of pleasant living. Unlike so many parts of the United States, here the sports enthusiast is required to travel only the shortest distances to find salmon and trout fishing, swimming, cruising, sail-boating, golfing or relaxation in a theater of lakes and mountains. There are over four hundred lakes just in our county.

The ninth largest state university in the country, the University of Washington is situated on a 600-acre campus, with a shore line of more than a mile on Lake Washington and a quarter of a mile on Lake Union. Nearly 100 buildings, valued at over $50,000,000, are available for classroom and administration work. Over 800 full-time faculty members instruct a student body which totalled 16,380 in the fall quarter 1949.

The College of Engineering was founded at the University in 1898 and now ranks second only to the College of Business Administration in enrollment in professional schools. Each quarter over 200 students are instructed in eight departments of engineering. Five buildings, including two new structures for civil and electrical engineering, provide excellent facilities for instruction. Parts of several other buildings are also used for engineering training.

This will give you a little idea of our country and our campus. We feel that you will want to see all this for yourselves. Look to the west and you will dream about the west long after you return home.

AMERICAN SOCIETY FOR ENGINEERING EDUCATION ENGINEERING DRAWING DIVISION

Annual Meeting
University of Washington, Seattle, Washington
June 19-23, 1950

PROGRAM

Monday, June 19, 1950 - 9:00 - 12:00 Registration and Open House Conference - 2:00 P.M.
Room - O. W. Potter, University of Minnesota, presiding

1. A course for the Training of Teachers of Engineering, Drawing.
   H. R. Skamser, Michigan State College

2. Coordinated Drawing and Engineering Problem Courses for Freshmen
H. Boehmer and C. E. Douglas
University of Washington

3. The Use of the Principles of Engineering in the Organization and Operation of the Drawing Department
Sound Film: Shape Description
Justus Rising, Purdue University

Executive Committee Meeting - Dinner 6:30 P.M.

Tuesday, June 20, 1950
Conference - 10:00 A.M. Room
O. W. Potter, University of Minnesota, presiding

1. Lighting in the Drafting Room
Walter E. Potter, District Engineer
General Electric Company
Portland, Oregon

2. Functional Layout and Design in Aircraft
Clyde Chaffins
Boeing Aircraft Co.

3. Manufacture of German Drawing Instruments
Frank Oppenheimer
Gramercy Import Co., Inc.

Luncheon - 12:30 P.M.
O. W. Potter, University of Minnesota, presiding

Business meeting: Publication Board, Executive Committee, T-Square Page, Z-14 Committee, Advanced Graphics Committee, Committee on Teaching Aids, Bibliography Committee, Committee on Drawing Instruments, Election Committee and discussion.

Conference, 2:00 P.M., Room
O. W. Potter, University of Minnesota, presiding

1. Reasons for the sequence in teaching drawing at the University of Southern California
L. R. Shruben, University of Southern California

2. Graphics in Research
A. S. Levens, University of California (Berkeley)

3. Making the Lettering Practice more interesting
Earl C. Willey, Oregon State College

Wednesday, June 21, 1950 - 6:30 P.M.
Annual Dinner - Room
O. W. Potter, University of Minnesota, presiding
Speaker: E. H. Adams, University of Washington
Subject: "Reading for Fun".

Thursday, June 22, 1950
Plant Visitation

ENGINEERING DRAWING DIVISION OBJECTIVES

by

Professor F. G. Higbee
University of Iowa

The Division of Engineering Drawing may, without being either complacent of self-lauditory, look back upon its twenty some years of existence with pride.

We have originated and pioneered the division idea in the parent society. We have established--out of very rarified financial air indeed--a Journal of Engineering Drawing and have made it a success professionally and financially. We have proved that a mid-year meeting is worthwhile and important. We have had and shall continue to have an effective influence on the standardization of the graphic language. Perhaps most important of all is the warm professional and personal regard which has grown up among our membership through these many years of association; the reaffirmation of our belief and conviction in the importance of our work; the spirit of devotion to the task to which we have dedicated ourselves.

At times during our division meetings, and as I have reflected on the work of the division, the thought has come to me "Are we, as a division, exploring enough? Are there elements about our work we are overlooking? Are there directions toward which have not yet taken the long look?

Allow me to illustrate very briefly by a few and disconnected ideas.

far as I know the division has never taken under consideration the problem of recruit- veloping teachers of engineering drawing.

For years I have listened to discussions about the best style and form of lettering to use on engineering drawings. So far as I know no one has ever taken a serious enough interest in this matter to investigate it scientifically.

The problem of teaching by blackboard illustration is of almost daily occurance. Has any study ever been made to adopt daylight projection devices so that a quicker, a better, and a more applied job may be done in the teaching of dimensioning for example?

A quick survey of current text books on engineering subjects and of technical periodicals will reveal the unfortunate fact that the illustrations and drawings are not in conformity with our teaching or our standards. Is this situation one in which the division should take a stand?

I am not suggesting topics for a paper before one of our division conferences. I am raising a question about the lack of systematic inquiry into those elements of our work which may be overlooked unless, as a division, we provide organizational facilities both for a review of our problems and for the cataloguing of inquiries of purposeful character.

Teaching, research, and service are all elements of our divisional job. Certainly the horizon advances as we advance. We might well take the long view now and decide upon what elements of our profession need divisional attention and decide in what manner such attention may be secured.

GOOD OL' JOE DOAKS

by

Professor Harold P. Skamser
Michigan State College

What ever happened to good ol' Joe? He looked like he might turn out to be a pretty good man, but he seemed to fizzle out. Joe seemed eager and interested at first, and because he had made a pretty good record scholastically, we had high hopes for him. Joe had started out like a house afire, but then the novelty wore off and pressure decreased, and Joe just appeared to let down. Even then, he thought he was getting by all right, but Joe didn't really learn "the tricks of the trade" as he supposed. He just learned how to get by.

Well, what about Joe Doaks? What about his being bored by teaching the same course or two over and over again? Does he get a chance to work into an advanced course occasionally? Should he?

What about the impression he has that all we need to worry about is to see that he and the students get through the term, and finish up the plates; no more, no less!

During the first years of teaching, Joe made some inquiries in the department to try to find out how to teach. One professor told him, "Make them dig it out. Wait until they ask you, before you tell them anything. From the general tone of the conversation, Joe got the idea that, if they don't ask, they don't really want to know and don't deserve any help anyhow. He soon picked up the idea that "Get 'em young, treat 'em rough, and tell 'em nothing" was the educational ideal in his school.

The second man that Joe talked to told him that engineering school was nothing but a series of hurdles; the higher, more difficult and more numerous the hurdles, the better. Especially, if the students seem to be doing too well or getting too high grades, just be tougher on them.

Another instructor with a very fine background of industrial experience told Joe that Engineering Education was just a contest between the students and the faculty. You try to knock them down (scholastically) or keep them down and they fight back.

Many of Joe's engineering colleagues pooh-poohed the idea of getting any training in techniques of successful teaching. There is an attitude that those in Education don't know anything, they can't agree on anything, and their entire program is just a lot of superficial, vague generalities which are not practical or useful anyhow. I suppose that they assumed that no one in the past had ever figured out any better ways to do things and that they themselves were just naturally excellent teachers. It is a little like assuming that you could make all the inventions and discoveries just as well by yourself; that you never need to depend upon the brains, genius, and past efforts of others.

Joe had learned all his psychology in that great school of "Experience", and no one had ever even hinted to him that an instructor might need a rudimentary knowledge of some practical psychology in his teaching. Later on, Joe adopted the philosophy which he thought some of the older men had; "Anyone teaching in any other field doesn't have much of anything that could possibly be worthwhile to an engineering instructor". This was a sufficient alibi for Joe. He just skipped psychology; didn't need it anyhow.

What would you do after a series of encounters like Joe had?

Almost any successful teacher of experience will assure you that there is a lot more to good teaching than just going through the motions, the material, etc. and putting the students through their paces. Poor Joe wasn't even aware of many of the techniques of good teaching.

Does Joe know much about some of the basic principles of learning - repetition, spaced learning, motivation, timing, etc. ad infinitum? Where could he have learned how to get the most across, in the best manner? Was learning "how to teach" left to pure happenstance?

Joe has had little chance to learn the psychology of people, of handling groups for maintaining the maximum "urge to achievement" through inspiration, good will, student responsibility, etc.

What training has Joe had, to really make him a master of the field of drawing? So often his training is the usual bare minimum required of all engineering students. A friend of mine, from one of the leading schools and one of the top engineering drawing departments of the country, remarked to me recently, "Our new men seem to know so little, actually, about the field of drawing". They did the required jobs in the required courses and that was the limit of it. Has Joe had any specific training in the art of teaching?

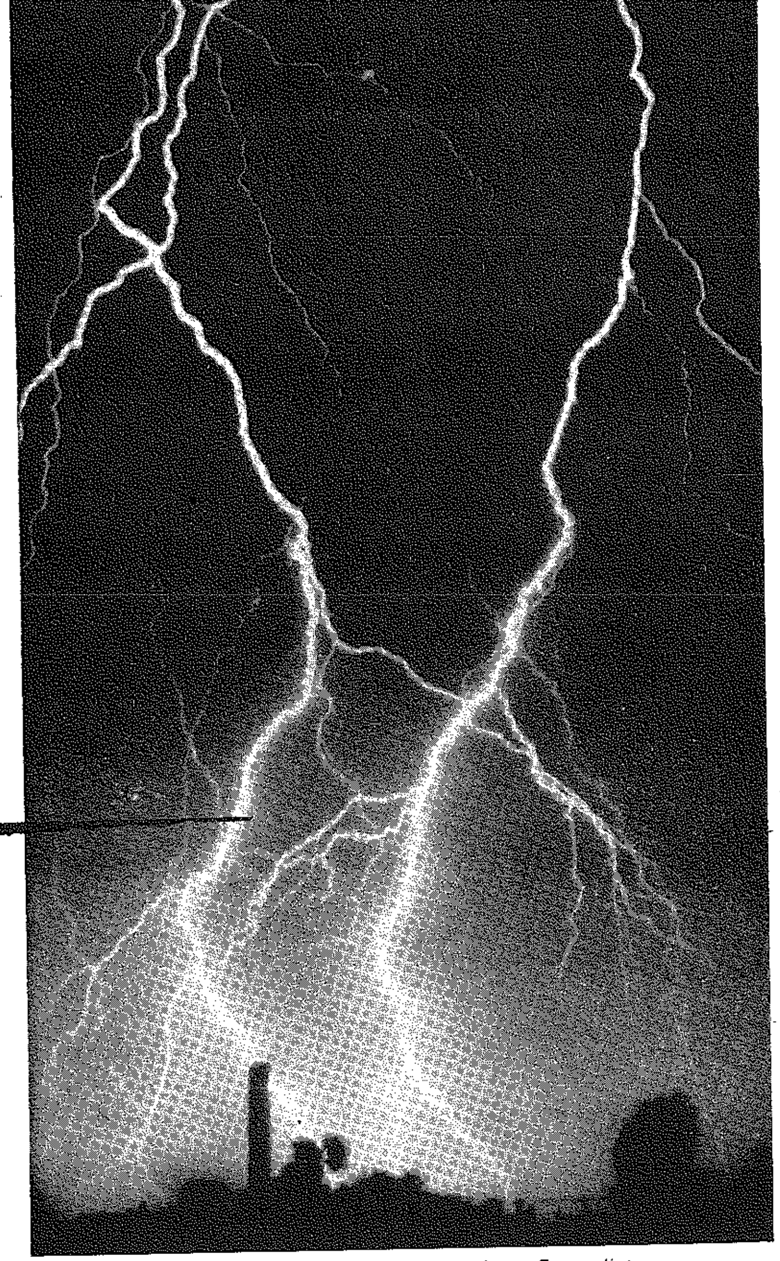
It is also doubtful that Joe has learned how to grade drawings so as to be uniform, fair, accurate, and to teach the most. How does he learn to use his grading as a teaching tool and an incentive? Can he use tests as a teaching tool, or is he even aware that they are, or can be, used as such?

Will he know anything about organizing material, or a course, or working out problems or tests suitable for use? Does he make a lesson plan, or use it? Can he make a job analysis in order to help him do a better teaching job? To what extent does Joe know how to select and use high quality visual aids?

Does he have methods at his finger tips for improving drafting techniques which he can pass along to students at opportune moments? Has he any means at his command to utilize or adjust for individual differences? What kind of training, if any, does he have which would prepare him to do these things?

(Continued on page 17)

then... the flash of light



Photograph courtesy Westinghouse Electric Corporation

PHYSICISTS say a bolt of lightning occurs when a negative charge in the clouds and a positive charge in the earth reach a spill-over point. Then almost as if feeling its way blindly, an arm or tentacle of current probes its way earthward; it touches, and a tremendous burst of illumination springs skyward.

Almost as if feeling *its* way blindly, the negative potential that is the growing youngster reaches out for contact. If he is fortunate, if he finds a good and positive potential in the teacher he has, then often it is as if a burst of light passes from teacher to pupil. Then often the youngster sees as if in a flash of light the opportunity that life presents to him, the terms on which the offer is made, how he may comply.

Perhaps here the analogy ends, for hereafter it is a task of building such perceptions into abiding standards and habits. But the whole vital point is that the lad *will* build up habits whether or no, habits that are good or bad depending on wheth- there has been contact and illumination.

en the youngster first comes to drafting class, with what will he be met . . . the *negative* potential of indif- h repels . . . or the *positive* potential of interest, enthusiasm and a concern for the finest? Will he be met with an attitude that implies the *tools* of the work are not important . . . and, therefore, the work itself is unimportant? Or will he be met by a recognition that these first tentative steps *do establish direction, that the only possible direction can be utmost concern for the work and utmost concern for the tools of that work?* Inspiration never can be built on the shoddy and the indifferent.

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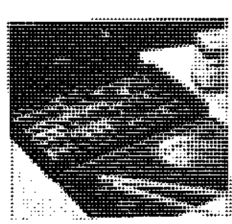


DIETZGEN

EVERYTHING FOR DRAFTING AND SURVEYING

ELIMINATION OF THE INTERMEDIATE VIEW IN AXONOMETRICS BY DIRECT PROJECTION *

by

Professor R. O. Loving
Illinois Institute of Technology

It is not, of course, a new conception that true axonometric projections can be secured by either of our two old standbys in Descriptive Geometry, auxiliary views and revolution. We have long known that if, for instance we view any object, such as Fig. 1, in a direction parallel to a diagonal of a cube, the resulting auxiliary view is a true isometric projection. Viewing the object in some other oblique direction produces either a dimetric or trimetric.

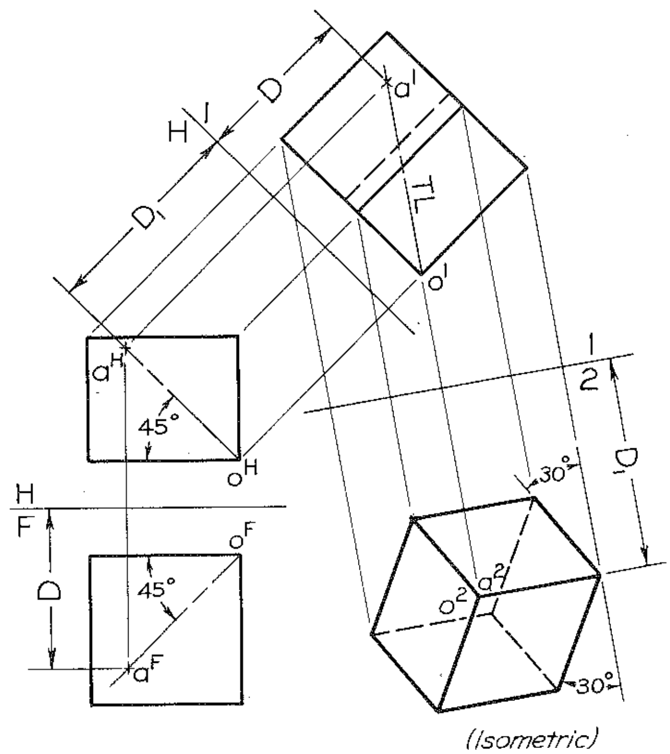


Fig. 1. Isometric projection by successive auxiliary views.

By two successive revolutions (Fig. 2) we may secure the same result -- an isometric, dimetric, or trimetric, depending on the direction of the diagonal we choose to show as a point.

The objection to these methods, - which renders them largely impractical for routine use - is that we must construct two views to secure one. The primary auxiliary view in the first method and the first revolved view in the second method are "useless" drudgery as far as the end product is concerned.

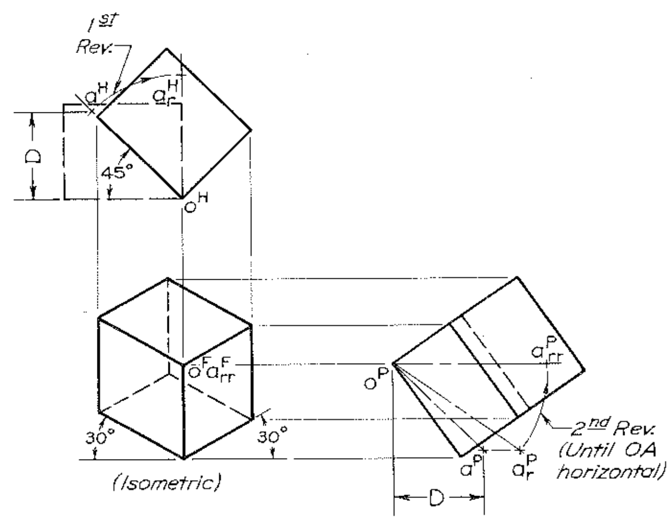


Fig. 2. Isometric projection by successive revolutions.

It is the purpose of this paper to discuss methods by which the drawing of these annoying intermediate views may be eliminated.

PART I - ELIMINATING THE INTERMEDIATE VIEW IN THE AUXILIARY VIEW METHOD.**

Suppose we assume a random diagonal (OA, Fig. 3) to be shown as a point, thus producing an axonometric projection. Let us designate the angles which the two views of OA make with horizontal (on paper) as α and β as shown. Let us further assume two "reference planes", one, the β-plane, coinciding with the top view of OA, and the other, the β-plane, coinciding with the front view of OA. Line OA, is, then, the line of intersection of these planes. Since our auxiliary views are so constructed as to produce a point view of OA, both these reference planes will be made to appear as lines. The true angle Θ between them will be shown in the secondary auxiliary view.

**The construction to follow, while discussed here in terms of its application to axonometric projection is actually a method for drawing any secondary auxiliary view without constructing a primary auxiliary. In technical drafting practice, however, this would probably be of little use, since machine parts requiring a secondary auxiliary view usually require the primary auxiliary for clarity and for dimensioning purposes.

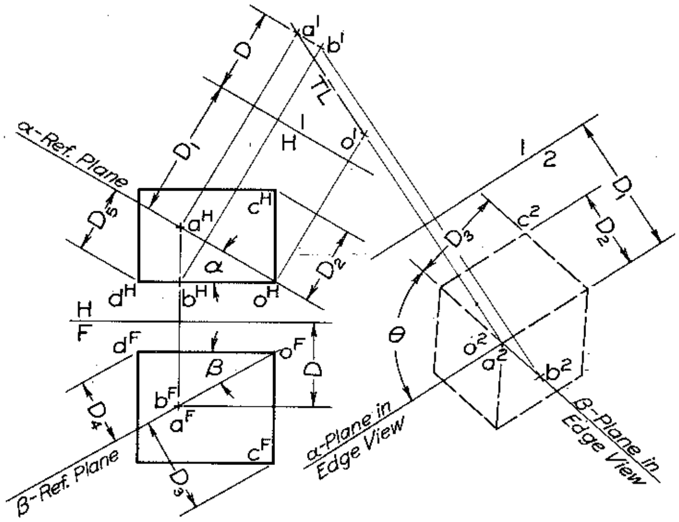


Fig. 3. Construction of axonometric without a complete primary auxiliary.

Since the two planes will be in edge view, any point of the object may be directly located in the secondary auxiliary view by its respective distances from the α - and β-planes, secured from the top and front views.

In Fig. 3, point B is any convenient point in the β-plane, used to establish the direction of the β-plane in the secondary auxiliary view. Point C is one corner not on either of the two reference planes, located in the axonometric projection by distances D_2 and D_3, thus eliminating plotting it in the primary auxiliary. When the remaining points of the object are thus located, the axonometric drawing is completed.

In many illustrations it is probably more convenient to re-orient the axonometric view until a more conventional position on the paper is selected. In Fig. 4 the situation of Fig. 3 has been repeated but with the α-plane vertical. The angle θ is set off in, or transferred to, the new figure and the points of the object - for example, point C again, and point D - are located to complete the drawing.

Thus far, we have eliminated drawing a complete primary auxiliary view; but we still have a rudimentary successive auxiliary view process to follow in order to establish the angle θ. This construction may also be avoided.

In Fig. 5 a frontal line OX, of any convenient length, is drawn perpendicular to OA (the line of intersection of the α- and β-planes) and to the β-plane. Since the axonometric projection shows line OA as a point, line OX must appear in true length. Hence, distances D and R will locate point X in the axonometric. The β-plane will then be at right angles to line OX as shown.

Alternatively, a horizontal line OS may be drawn perpendicular to the α-plane. Point S may then be located in the axonometric as indicated. The true

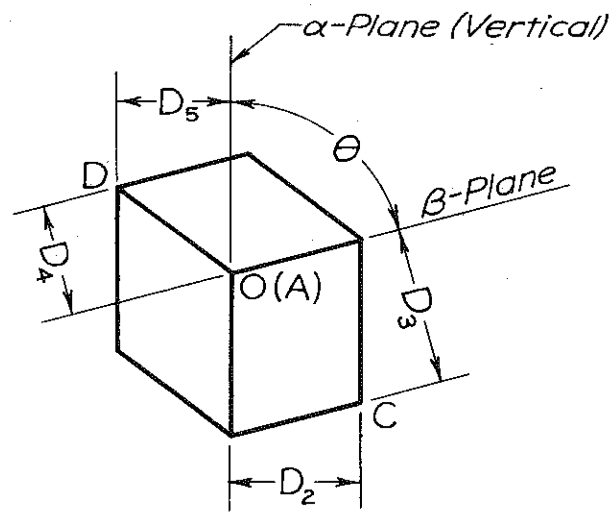


Fig. 4. The axonometıic completed with the α-plane re-oriented to vertical.

distance R_1 from point S to the β-plane is shown in the front view and hence may be used to locate the β-plane in the axonometric as illustrated.

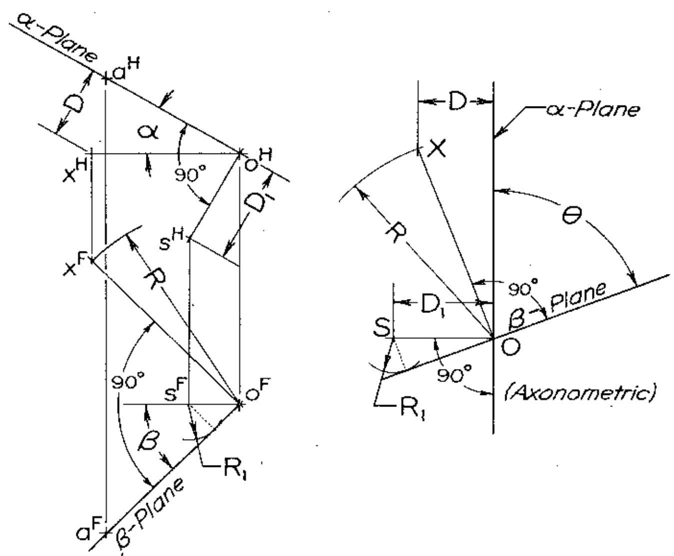


Fig. 5. Establishing θ without a primary auxiliary. (Two methods shown.)

These constructions may be "reversed" for desired values of θ and α. For instance, x^H may be assumed in the top view. In the axonometric the distance D plus a perpendicular to the β-plane at point O establishes the length R. This in turn is used to find x^F and, at right angles to o^Fx^F, and β-plane is the front view. The alternate construction is reversed by assuming point S in the axonometric and then finding s^F. The β-plane passes at distance R_1 from s^F.

The geometry of our construction is such that the following formula may be derived for the angle θ in terms of our assumed angles α and β : $\cos\theta = \sin\alpha \sin\beta$.

Thus θ may be calculated instead of constructed, which should give us a more dependable method from the standpoint of accuracy. If much of this work were to be required, a table might be computed. A very abbreviated one is given as Table I.

TABLE I. VALUES OF θ FOR TYPICAL SELECTIONS OF α AND β

Values of α (or β)	Values of α (or β): 15°	30°	45°	60°	75°
15°	86°-10°	82°-34'	79°-27'	77°-3'	75°-31'
30°	82°-34'	75°-31'	69°-18'	64°-20'	61°-7'
45°	79°-27'	69°-18'	60°	52°-14'	46°-55'
60°	77°-3'	64°-20'	52°-14'	41°-25'	33°-14'
75°	75°-31'	61°-7'	46°-55'	33°-14'	21°-6'

It should be noted that the formula is symmetrical with respect to α and β so that it makes no difference in the value of θ which of the two angles is designated as α.

The combination of $\alpha = \beta = 45°$ gives a value of $\theta = 60°$, isometric projection. (Compare this with Fig. 1). For $\alpha = 45°$ and any other value of β, the result is dimetric projection. Other combinations give either dimetric or trimetric. Actually we are not particularly concerned with the theoretical name of our drawing. The method of construction is independent of the title.

Other conveniences in construction are possible. In Fig. 6 values of $\alpha = 75°$ and $\beta = 30°$ were selected, making $\theta = 61 -7'$. The top and front views were then drawn (or thumb tacked) in positions such that the axonometric could be constructed by projection instead of by transferred distances.

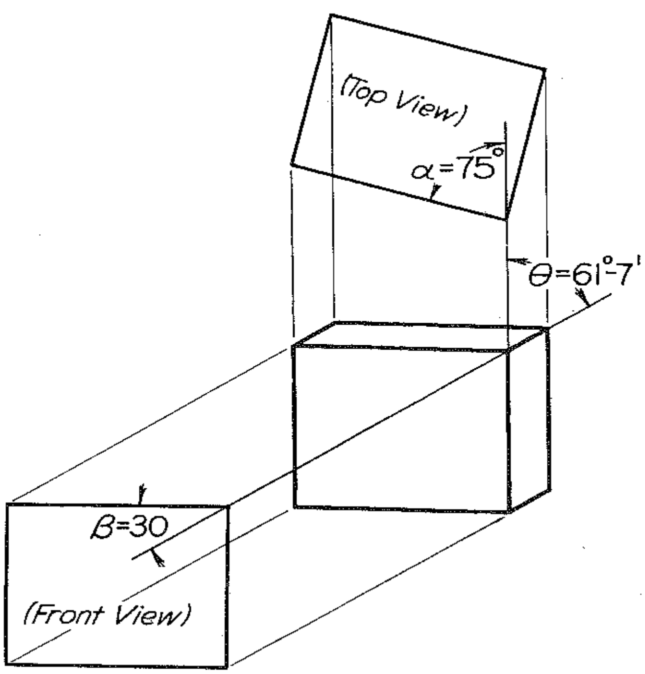


Fig. 6. Placing views for convenient projection.

Under some circumstances it may be more convenient to rewrite the formula as:

$$\sin\alpha = \frac{\cos\theta}{\sin\beta}$$

This will give a table of the form shown as Table II which allows a choice of values for θ and either of the two angles α and β, the other being read from Table II.

TABLE II. VALUES OF α (OR β) FOR SELECTIONS OF θ AND β (OR α)

Values of θ	Values of β (or α): 15°	30°	45°	60°	75°
15°	--	--	--	--	90°
30°	--	--	--	90°	63°-43'
45°	--	--	90°	54°-44'	47°-4'
60°	--	90°	45°	35°-16'	31°-10'
75°	90°	31°-10'	21°-28'	17°-23'	15°-33'

Of course, all of the preceding discussion has been based upon a particular series of auxiliary views - a primary constructed from the top view and then a secondary projected from the primary in the usual way. In Figs. 1, 3 and 5 the α-axis was drawn upward to left in the top view and the β-axis was drawn downward to left in the front view. This is done merely because it happens to be a good direction in which to view many objects drawn in conventional front and top view arrangement. It should be noted before leaving this method, however, that other possible positions for the α-and β-planes will have the arithmetical relations to the angle θ. For desired different positions of the object, the views of Fig. 6 may be reoriented to different (but symmetrical) positions with respect to the α- and β-planes, the β-plane may be drawn sloping downward to the right instead of upward, and so on. See Fig. 7.

(Continued on page 24)

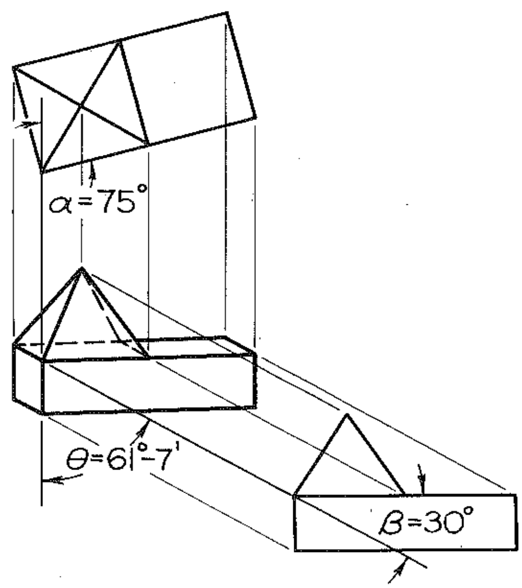


Fig. 7. A different orientation.

AN INTRODUCTION TO PRODUCTION ILLUSTRATION

by

Professor Harold G. Kinner
Rensselaer Polytechnic Institute

Production Illustration is now being taught in a number of technical schools. The prerequisites and contents of the courses vary greatly, as well as the emphasis given to certain phases of the work.

In this article we will look into the reasons which justify giving such a course, with a little thought on the work to be covered. When one considers the amount of labor required to produce any type of rendered picture, in contrast to orthographic projection, the value of such pictures must be great, if we are to justify their existence in our already crowded program.

We are all familiar with exploded drawings and other similar representations used during the war, where inexperienced or semi-skilled help was used to assemble various mechanisms. Time did not permit the training of help in the language of industry which we call orthographic projection. Therefore Production Illustration with all of its time consuming work saved many hours and dollars for industry.

Today with most industries back on a peace time basis, production is largely for consumer use. The making of drawings for use in producing goods is only one phase of the work. Of equal, if not more importance, is the production of drawings to be used in catalogues and other sales material. Articles must be sold if industry is to keep on going. The articles itself must not only be attractively designed, but expertly presented in picture form. There may have been a time when a machine or an object that functioned mechanically met all of the requirements, but that is not true today. The mechanical side is only half of the story. Any article today from fountain pens to automobiles must have eye appeal as well as being mechanically sound, if it is to stay on the market very long. We may go to the corner drug store to purchase a small article and find that the carton or wrapper is a better design than the article inside. The customer sees the package, therefore eye appeal is put on the outside.

There are a number of instances on record where large firms have lost thousands, if not millions of dollars in sales as well as the cost of producing new models, because they introduced new merchandise which was poorly designed from the standpoint of art. The new design had poor proportions with little eye appeal and occasionally was downright repulsive to look at, even though the product may have been excellent mechanically.

Many engineering students have an attitude of indifference, often bordering on contempt for anything approaching the fine arts, but it must be remembered that art no longer is something to be leisurely viewed on a Sunday afternoon in some museum. Art is not divorced from everyday life. It now has an economic value, and is found in practically everything with which we come in contact. Witness the transformation which has taken place in the appearance of appliances and all sorts of mechanical gadgets. Much of this designing has been done by industrial designers, some having an engineering, and others an architectural background on a combination of both.

In the October 31, 1949 issue of "Time" we read that industry expects to spend five hundred million dollars on design for appearances next year. Many of these ideas will take form on the drawing board. We, as drawing teachers can not afford to ignore this fact.

Before some feel that I am trespassing in the realm of industrial design, I would add that the line between production illustration and industrial design can not be closely drawn. Both fields employ many of the same principles in their work. We might look briefly into several of these- namely, form, composition, technique and color.

To begin with, it is assumed that the course will give a good foundation in the principles of perspective, including one, two and three point perspective, as well as conventional short cuts so that the student will be able to draw a picture from any conceivable point of view. I have in mind a background in perspective which goes well beyond the scope of the average textbook on the subject. Other more elementary types of picture drawing such as isometric, cabinet projection, oblique, etc. may be largely limited to the drawing of small objects to be built in the shop. Because of their distortion, they are not well suited to the high class of work which we have in mind.

Getting back to elementary principles, composition, is essential to all good work, whether it is the layout of a two dimensional drawing, a photograph or the design of an object using three dimensions. A composition is a harmonious arrangement of related elements, one of which is the center of interest and dominates all others in importance.

Probably the first principle of composition is singularity of theme. The drawing should have one dominent feature which is the object or principal part of the object which we wish to represent. Anything else on the drawing should be subordinated to it, but contribute to it in a supporting way.

This principle is found in all fine arts, no matter whether we are talking about music, architecture, sculpture, literature or photography. In all great music there is one principal theme running through the work. This one theme is dominent and any lesser themes or variations are used only to support, enrich and point the way to the main theme. Anything which does not reenforce the principal theme has no place in the composition and only detracts from the work. Likewise, in all great architecture, we find our attention focused on a prominent doorway, or it may be a great tower. There may be other towers designed in a similar spirit, but they will be subordinated to the main tower. They will emphasize and contribute to the greatness of the central theme.

Again, in photography we would not photograph a landscape having equal amounts of foreground and sky. This would make a line cutting through the center of the picture, dividing the picture in half so that we no longer have dominence or singularity of theme in our composition. We would never place a tree or a pole in the center of the picture which again would divide it into equal parts. Our eye would then flit from one side to the other leaving us in a state of mental confusion. Again we would have no dominent theme and no composition. There should be no question about the subject of the picture or the purpose for which it was made. We might go on indefinitely using other fine arts, but the above examples should establish our case for singularity of theme or dominence.

Another phase of design is form or proportion. Some one has stated that "A thing of beauty is a joy forever." Most of us know that there are good proportions and bad proportions, even if we do not know why they are good or bad.

In matters of proportion, the ancient Greeks had the highest development of the aesthetic sense of any people who have ever lived. In their temples they attempted to overcome optical illusions in their search for perfection. They observed that if the ridge of a building were made level, it would appear to sag in the middle, so they made the center higher. Likewise, the cornice was crowned to a lesser degree and the stylobate, as the stepped base was called, a still smaller amount. Not only their buildings but the smallest articles of everyday living received art attention.

Optical illusions are corrected today in the design of small articles. For instance, a rectangular jewel box, or even a small soap box would seldom be made with flat sides for they would appear concave. You will usually find them made slightly convex. This is true of the outside shell on refrigerators and other modern appliances.

Many of the so-called classic proportions used by the Greeks were stimulating to the eye. Some contemporary designers speak of a design being satisfying. Satisfying is not enough in these days of stiff competition. In fact satisfying is a very unfortunate term in modern design. A thing that is merely satisfying never thrills anyone and will not stand the test of time.

Have you ever stood before a great piece of architecture and felt its enobling and uplifting spirit? Have you ever listened to a symphony that made thrills run up and down your spine, or any similar experience that seemed to lift you above yourself? If you have, you know the kind of drawing that I am speaking about. Remember the beautiful rendering, or piece of merchandise, or perhaps an intricate automatic machine that you went back to look at again and again, and when you saw it you had difficulty taking your eyes from it. We can not hope to make every drawing of this calibre, but it is an objective toward which we should aim.

Most subjects that we take in school tend to get away from us unless we use them all the time. We forget formulas, rules, etc. but in the field of design it is different. By constantly observing, and drawing comparisons, we enrich our experience whether we actually draw the objects or not.

The thing that we do today that looks like perfection will seem ridiculous and stupid if we look at it a few years from now. Only occasionally do we go back to an old drawing or composition made years ago and marvel at our own ability. Nevertheless if our drawing in production illustration is only satisfying, it will never "ring the bell." We need a composition that will lift a man off his feet. Our drawing should create an irresistable sales appeal. We have all had the experience of seeing something and not being satisfied until we own it. Causing a man to desire and buy something he doesn't actually need may not be good economics, but I am sure it is good salesmanship.

Many attempts have been made to analyze good design in order to formulate a set of rules, but good composition in the field of design is not as easy to take apart as a machine or perhaps a chemical composition. The ancients knew that dividing a line in half did not cut it into its most pleasing proportions, also making the division near one end was not much better. Many designers used what was known as the "Divine Proportion," in which the shorter part of the line was to the greater, as the greater was to the entire length. In other words we have a ratio 1 to 1.618 which incidentally makes a very pleasing rectangle when these proportions are used as its sides. It is often referred to as the "Golden Rectangle."

Even a novice at proportions can see that a rectangle that is nearly square, say 5" by $5\frac{1}{2}$" or 6 is bad design. (When nearly square, it might better be square.) If we make the length fifty percent longer than the width we have a much more pleasing rectangle, or if we make it 5" by 8" which is approximately 1 to 1.618, it is still more attractive. This ratio occurs many places in nature but time will not permit going into that in this article.

We are not always able to control the shape of the rectangle we are using. If a vertical rectangle appears too wide, we may resort to the architect's trick of adding a few vertical lines which will tend to make the rectangle appear narrower. However, too many vertical lines would have the opposite effect and make the rectangle appear wider. This is only one of the numerous methods designers use constantly in getting desired effects with shapes which have to be maintained.

Many attempts have been made to analyze the system of design used by the Greeks. Some of their most prominent architectural monuments have been measured many times. After changing these measurements to decimals, scholars have attempted to apply some of the so-called rules of design. In many instances the proportions have checked within several thousandths of an inch. These errors could easily have been made in measurement or in the original construction of the building. When a large number of proportions check so closely, it does not seem that it could be a coincidence. Either the Greeks used some module or formula as a key to their designs or they had an unusual sense of proportion. Some of the generally accepted rules of design and proportion can be a great help in production illustration. However, we should never try to make our composition fit a certain rule, but having the rules in the back of our heads may help us over many a rough spot and greatly improve our composition. Engineers like to reduce something to an exact formula,

(Continued on page 31)

THE RESULTANT OF COUPLES IN SPACE

by

Professor E. J. Marmo
University of Nebraska

There are many instances in dealing with problems having to do with forces in space where it becomes necessary to find the resultant of a system of couples acting in planes which intersect with each other. Fig. 1 shows a pictorial possibility where a case of this type might exist.

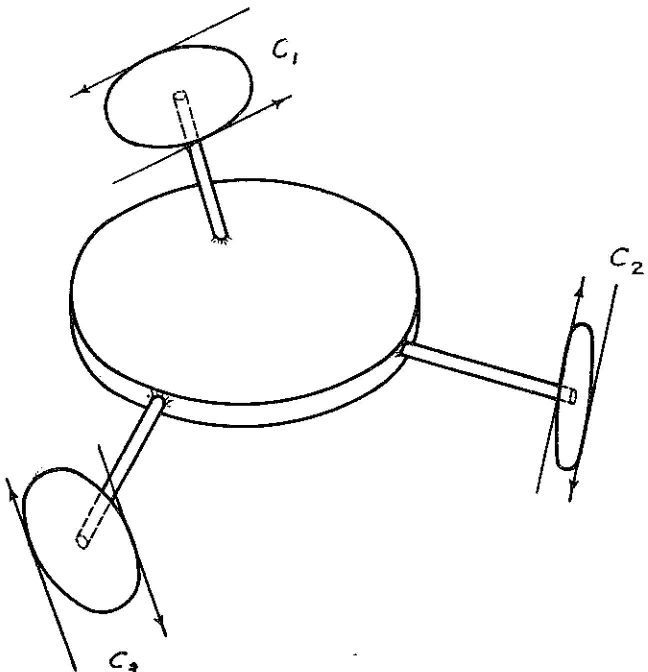


Fig. 1

The mathematical solution for such a problem is well established and it can be obtained in any standard text in mechanics which deals with forces in space. The graphical solution as outlined in the following discussion has not been established and it does offer a splendid opportunity for saving time and, in cases, can be used as a check on the more involved and time consuming mathematical solution.

To illustrate the graphical solution, consider the three couples which are represented by the forces shown in the top and front view of Fig. 2(a) on page 23. These couples might represent a condition in actual practice where both the magnitudes of the couples and the direction of the planes in which each couple lies is known. The condition might also be one where neither the magnitudes of the couples, nor the direction of their respective planes are known. This latter condition is especially true in a problem where it becomes necessary to find the resultant of nonconcurrent, nonparallel forces in space. The resultant in this case could be a force and a torque.

It is my intention in this solution to present an outline which could apply to either condition, but in view of the additional steps involved, I will take a case similar to the one which exists in the reduction of a system of nonconcurrent, nonparallel forces in space. That is, neither the magnitudes nor the directions of the couples are known.

For convenience in explaining let's refer to the couple determined by the two equal and opposite parallel forces JK and LM as couple 1, the one represented by EF and GH will be called couple 2, and the one by AB and CB will be couple 3.

All of these forces are represented vectorially by being drawn to a definite scale and in a given direction in both the top and front views. Top view points carry a subscript T and front view points, a subscript F.

After the forces have been set up in both the top and front views, the next step is to find a view in which the plane of each couple (two parallel lines determine a plane) appears as an edge view. This can be done by looking at the plane in the direction of any horizontal or frontal line in the plane. The plane of couple 1 appears as an edge in the auxiliary view carrying the subscript A_1. This was obtained by drawing a view in the direction of a horizontal line (not labeled). The edge views of couples 2 and 3 were obtained by drawing views in the direction of frontal lines in their respective planes. Each edge view is labeled with a subscript A, indicating that it is an auxiliary view.

The step which follows this operation is the one in which the magnitude of the couple is determined. In other words, it becomes necessary to find a view in which the two parallel forces which make up the couple are in their true length and, at the same time, the distance between the forces also appears in its true length. Taking the case for couple 1, the view labeled with the subscript O_1 shows that this oblique view was taken at right angles to the auxiliary view J_{A1} K_{A1} and L_{A1} M_{A1}. That is, take a view at right angles to the view in which the plane of the couple appears as an edge. This was also done in the case of couple 2 and couple 3. In each case the letters carry the subscript O (oblique view).

The magnitude of each couple can now be found because we have the magnitude of each parallel force making up the respective couples and also the perpendicular distance between each pair of parallel forces. In the case of couple 1, the magnitude is found by multiplying the scaled value of either J_O K_O, or L_O M_O, with the 0.98 in. which is the distance between them and we obtain the magnitude which is equal to 1570 lb in. In the case of couple 2 where the distance between the forces EF and GH is 1.00 in., the magnitude of the couple is 2000 lb in. Couple 3 has a magnitude of 1500 lb. in.

(Continued on page 23)

INDUSTRIAL ILLUSTRATION AS IT RELATES TO THE STUDENTS AND PROFESSIONAL ENGINEER

by

Professor S. E. Shapiro
University of Illinois, Chicago

In reviewing the excellent articles presented in the Proceedings of the American Society for Engineering Education for 1948, Volume 55, I came to one entitled "What is This Culture?" by A. M. Buchan of Washington University, which, from the standpoint of the Engineer, is very interesting.

The author quotes Professor Gilkey of Iowa State College, who gives us an interesting and scholarly definition of an engineer and I quote, "a greasy, illiterate individual who sure can use a monkey wrench and a slide rule, but who is naught but an embarassment and liability in polite society," end quote.

This definition conforms, to some extent, to the student and layman idea of the engineer. The movie industry has also "glamorized" the engineer from the standpoint of the rough and ready fellow who directs work with a slide rule in one hand and a dumpy level in the other; a roll of blue prints bulging from underneath his arm pits.

We, of course, know that this is not the entire picture of the engineer. Still, there is a great deal of truth to all this when one considers the various engineering curricula. In practically all cases there is a lack of the humanistic branch of learning.

In an address given at the Massachusetts Institute of Technology in connection with the inauguration of President James R. Killian, which was held last spring, Dr. Karl T. Compton said, and I quote, "The School of Technology realizes that more than technical competence is needed in the training of the engineer. The stress on the place of the humanities in the discussions at the Massachusetts Institute of Technology Convocation gives assurance that more and more attention will be paid to humanistic studies," end quote.

Let us consider the potential engineering student at the preparatory stage of his education, i.e. the high school.

Here the importance of mathematics, drawing, shops and related subjects are stressed as the fundamental need of the student who is to take up engineering as a profession.

Psychologically, his thoughts are being directed along lines away from the humanities. His goal is along lines of technocracy. Can he be judged for following in the footsteps of his predecessors?

He consults curricula from different Universities and finds that the need for cultural - Social subjects is not there.

His advisors, even though they themselves feel that the need for the humanities is great, must direct the student in his preparation for entering the University, toward the technical phases of endeavor.

What can we, as drawing teachers, do to help in this approach to the humanities?

The fundamentals of art are to be found in the teachings of Gaspard Monge and later contemporary methods of Engineering Drawing and Descriptive Geometry.

The oblique, the axonometric, and the perspective are methods used by artists in their presentations.

To the engineering student, the first courses in General Engineering Drawing and Descriptive Geometry are real basis for one phase of the fine arts, i.e. Industrial Illustration.

The correlation between the first two courses and the third is logical. Here is a wonderful opportunity to carry on the graphic language in a humanistic way.

In Industrial Illustration, the student is thoroughly grounded in the mechanical projection of all types of pictorial drawing. His powers of visualization are further enhanced because he is working in three dimensions.

He finds that he no longer has to put all his graphical thoughts down with T-Square and triangle. He can sketch them in pictorial form quickly and easily.

He is taught the various methods of molding the object or objects by means of different types of techniques of rendering. These techniques will be taken up later in a realistic approach.

The methods of obtaining pleasing shades and shadows, proper arrangement of highlighting and reflected light, correct choice of paper for the individual project so as to obtain the effect desired, and a study of the subject with regard to composition, scale, type of rendering to be used, choice of color, analysis of complementary colors, tone and values are but a few of the things the student must consider in planning an illustration.

Also, the various types of characteristic reflections are discussed and envisioned from the standpoint of materials. For example:

Cast Iron reflections are slow and heavy with dull highlights;
Finished Steel has sharp, cold, hard reflections;
Copper reflections are soft, smooth and liquid like;
Brass is similar to copper except that the reflections are just a bit sharper;
Black Plastic has a mysterious, deep mirror-like reflection.

To give you a few concrete examples of methods and types of rendering, I will now illustrate through the medium of television, how the student himself approaches the problem.

The following is a resume of the demonstration over the television:

Two television cameras, ten television receivers, two drafting easels and various equipment were set up. Because of the limited time, each project was designed so that one student would begin a project and another would finish the same project. Approximately five minutes was allowed each student.

The television receivers were placed about the room so that the audience could easily see the television screens.

Project I was a smudge rendering of a machine piece. The line drawing in isometric had been done previously and the shades, shadows and highlights had been studied and designed beforehand because of the time allotted to each project.

First, the student penciled in a small area in the base with a 2B pencil and then a paper smudge was used to rub in a graded surface.

Highlights were put in by the use of an eraser. At the end of the first five minute interval, the second camera was put into play on the student who was to finish up the work.

Project II was a soft pencil rendering of an offset bracket also drawn in isometric; the same procedure was used to start and finish the work. Each project had a different pair of students.

Project III was a line pencil rendering with emphasis on the reverse type of highlighting of a highly polished steel bearing drawn in dimetric.

Project IV was a stipple and block type rendering of a bearing drawn in isometric.

Project V was a crooked line rendering of a cast iron hanger drawn in perspective.

Project VI was a Zip-A-Tone rendering of a building drawn in perspective with shades and shadows.

Project VII was a double-tone or craftint rendering of wood, a screw which had been drawn in isometric.

Project VIII was a sponge rendering of an offset bracket (same as the second project), and showed how the same object looked with a different type of rendering.

Project IX was an air brush rendering of the same offset bracket, showing the use of frisket paper, and the various steps in completing an air brush drawing. (End of resume of television demonstration which was made possible through the courtesy of the American Television School of Chicago.)

And now let us consider the practical side of Industrial Illustration as it relates to the professional engineer.

Recently, I received a "paper" on Perspective Drafting from the North American Aviation, Inc. which gave a different slant to drafting in general. Quoting from the paper, "Although necessary for original design layout, an orthographic drawing conforming to general practice throughout the industry is usually a confusing and unnatural presentation."

This company finds that three dimensional drawings were, and I quote "greeted with considerable enthusiasm in various manufacturing departments of the company. This favorable comment from tooling, sub-assembly, final-assembly, cast estimating, purchasing, and material control has steadily increased until now they are considered by these departments to be almost indispensable to getting into production on an entirely new design."

The automotive industry has also found that three dimensional drawings are a definite aid to their production.

Other industries, including Western Electric Co., have found that the use of a pictorial drawing in conjunction with the orthographic is not only a necessity in clearing up views of a working drawing, but also a means of setting up sectional views.

Since the working drawing is used in many departments of a large organization, the need for the additional three dimensional drawing is evident. To the man in the shop, a quick, accurate picture is obtained and checked; the orthographic with the pictorial. To men in other departments, such as cost estimating, purchasing, sales and administration, clarity of detail parts and assembly is cost and time saving.

Other fields of Engineering have also greatly benefited by the use of pictorial drawing. The Civil Engineers have found that Industrial Illustration is a must in their professional work.

Because they must deal with administration branches of governments, they find that to intelligently explain a project to men who do not have a knowledge of the graphic language, they must depend on the three dimensional drawing. Projects of great cost and importance depend on a satisfactory explanation in the form of drawings. Even charts and diagrams have been drawn in three dimensions to satisfy the questioning administrative body.

To give you a few concrete examples, I will now show you by means of colored slides, some of the illustrations which the Cook County Highway department have made for presentation to the County Board and the Federal Government.

Slide Illustrations Were Shown

In closing, in a bit of a philosophical vein, it is to be hoped that these relatively insignificant references to the humanities will somehow act as a catalyst for the inclusion of more humanities in engineering curricula so that the future years will bring to engineering graduates a real and just understanding of men.

Presented at the Mid-Year Meeting of the Drawing Division of the A.S.E.E., January 21, 1950 at the University of Illinois, Navy Pier, Chicago.

(Continued from page 7)

As for correlation, does he know how and when to correlate, especially so it will contribute the most to understanding by the average engineering student?

How is Joe on self-evaluation and self-criticism?

Do you think Joe realizes just what the "elements" are that each student should learn or master in each unit or job? If so, does he know just what to do about it?

What is done to permit him to acquire the techniques of presentation, etc., beyond a few casual opportunities to observe someone who has been at it longer than he has? This is very good if the man is an expert; it is not so good if the man is just in a rut - a man who has never had any more opportunity to learn how than Joe has had, except for one year's experience twenty times. (Continued on page 38)

GOOD ENGINEERING INFORMATION FOR PRODUCTION

by

Charles A. Koepke, Consulting Engineer
Minneapolis, Minnesota

1. Neither drafting principles nor methods of teaching drafting are on my agenda today.

2. However, if a blueprint can be considered as a language, I am strongly in favor of it being more literate and able to speak for itself.

    2.1 If the engineering design and drafting department were to be charged with the extra costs incurred in the shop because a blueprint was ambiguous or incomplete, it might help to get better information for the mechanic.

    2.2 Mechanic's wages have been going up for some years so that a 10 minute delay necessary to straighten out a tolerance or add or subtract some dimensions to get one that is needed to machine the part, may easily cost a dollar with the labor and overhead charge.

3. In my experience as an engineer, teacher, management consultant and industrialist the lack of adequate and correct information on the shop blueprints has been a source of irritation for many years.

    3.1 I have found cases in many different plants where mechanics made crude drawings on wrapping paper to include necessary information which was missing on their regular blueprints.

    3.2 This of course sounds foolish. It is foolish and very expensive in many ways.

        3.21 Just consider what the cost might be if a drawing change were made and the mechanic continued to use his old wrapping paper sketch when the part was to be made again.

4. Let's consider what the fundamental functions are for an engineering design and drafting department.

    4.1 We can truthfully say it is not primarily to provide jobs for engineers.

    4.2 Many products require a theoretical design which is often a very technical procedure carried out by thoroughly competent men. The design layouts are made, working parts linkages and functions are all carefully coordinated into the designer's idea of a mechanism which will do what is required.

    4.3 Often a working model is made by skilled model makers who many times need only a suggestion or simple sketch to work out the designer's ideas.

        4.31 The cost of such models is usually high but this is not under consideration today.

5. Quite often when the model proves to be successful the designer loses his intense interest because he is given a new design problem. This of course is good management of expensive talent and should be done more frequently.

6. If the next development step is done in a routine matter without giving careful consideration to the adequacy of the information furnished to the production department, the stage will be set for higher than necessary costs every time the part is made in the shop.

7. Types of necessary information to be released by the design and drafting group.

    7.1 The part number should be unique, simple as possible, without attempting too much information in the number itself.

        7.11 If a part is changed so that it is not interchangeable with the older version, it should be assigned a new number.

        7.12 Identical parts used on different divisions of the same company should have the same number. Purchasing, manufacturing, storing, and inventory control is easier and less costly.

        7.13 It would be advantageous to have the same part names for units which serve the same purposes on various products. This is difficult and is not generally done. That is why the unique part number is so necessary.

    7.2 Material should be specified exactly.

        7.21 Rubber, aluminum, wood, steel, or cast-iron doesn't mean much today. There may be literally hundreds of different kinds of rubber with widely different characteristics.

        7.22 Yet many blueprints from good companies are not specific here.

    7.3 Some prints call for heat treatment but what specifications are to be met by such heat treatment?

    7.4 Finishes required on the surface.

        7.41 Considerable money can be wasted by making a part smoother than necessary or by making the surface too rough. Often the part is scrap. The mechanic usually takes pride in a nice smooth finish, so unless a coarse feed finish is specifically called for, he will waste time on giving everything a fine finish.

            7.411 More and more companies are using finish specifications or blueprints for machined parts to reduce cost or scrap.

7.42 Some parts must be lapped to get the proper finish. However, the word "lap" means little unless the quality of the lapping desired is specified by a symbol such as R.M.S.

7.5 Drawings showing sharp corners are always a question for the mechanic. Actually sharp corners are difficult and expensive to make. If a small radius is permissible, state the wax radius which can be tolerated. Even a small "0.15 radius wax" note on a drawing will reduce the cost of a steel part considerably. If a really sharp corner is needed, it should be so stated.

7.6 Dimensions along with their allowable tolerances are often handled rather carelessly.

7.61 If you were a mechanic, how would you like to be told to measure to 1/1000 inch from a cast surface?

7.62 Dimensions in .0001 or even .001 tolerance are expensive. If we need them to make a product successful, the tolerances should be honestly stated. Some engineers state they ask for tolerances much smaller than needed in hope the shop will work to the tolerance actually wanted.

7.621 Costs can be multiplied unnecessarily by using tolerances too small.

7.6211 .001 tolerance, ground finish, was found on one drawing. Where the surface was later covered with about an .008 coat of paint. It fits nothing but the air around it.

7.6212 Studies made and reported in the A.S.M.E. journal showed that costs tended to go up as the square of the tolerance demanded.

7.622 Close tolerances are very necessary when they are actually needed, but only increase cost and scrap when they are not.

7.63 If a succession of tolerance, particularly covering lengths, are used, interferences often occur if a tolerance chart is not made to study the accumulated tolerances.

7.631 A recent study by our design department to find out why trouble was encountered in assy. found that a complicated mechanism in which revolving surfaces did not dare to touch the possibility according to the stated tolerances was .003 tight to .009 loose. A rearrangement of these tolerances made the mechanism operable.

7.7 Changes in drawings are usually necessary in most plants for various reasons.

7.71 Records of changes should be carefully made on the tracings, and all departments working with the drawings must be notified as quickly as possible.

7.711 If not carefully and currently done, the cost of scrap and possible damage to the delivery schedule may be disastrous.

7.8 Part standardization

7.81 Means of accomplishing this desirable cost reducing device.

7.82 Minneapolis Moline plan.

7.83 Waterous plan hydrant studies.

7.84 Example of a collar to protect a pin, to protect a set screw, to protect a pipe plug.

7.9 Part lists

7.91 Engineering design and drafting people are the only ones who know in the beginning what parts are needed for a product. Complete lists down to the last screw, nut and washer are necessary.

7.92 Moreover, each part down again to the last screw, nut and washer, should have a record in some form to show which products use them.

7.921 Show master part number record.

8. Production departments have been and are getting more insistent that adequate information is furnished by the engineering design and drafting department on blueprints, part lists, and other part uses.

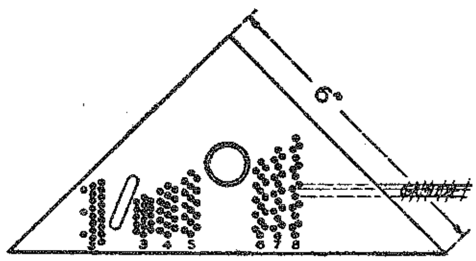
8.1 Panel discussions at S.A.E. on lack of engineering design information.

8.2 Engineering design and drafting have fought back in some cases through American Machinist and other magazines by suggesting that designers should be in charge of manufacturing because production men have not been able to understand what is needed.

8.3 The most successful plan generally used is to have a balance and check type of organization which is set up to act as friendly critics of each other. This works particularly well between engineering design and the manufacturing divisions. Here the lack of essential information, necessary complication, tolerances which are not set properly, redesigns to lower cost, and other points of controversy should be argued out in good faith and fellowship and settled without ultimatums. This kind of cooperation in any company will always lower costs, make better products, and increase the fun of working together in a live organization.

BRADDOCK LETTERING ANGLES

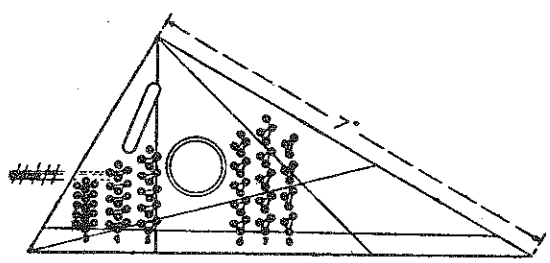
DESIGNED FOR STUDENTS, ENGINEERS,
DRAFTSMEN AND ARCHITECTS



6"-45° STYLE "B" BRADDOCK-ROWE LETTERING ANGLE

The Braddock Lettering Angle has three uses:

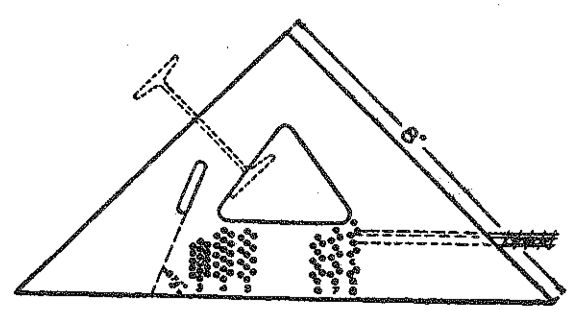
1. As an ordinary standard triangle, it is exceedingly accurate.
2. It is used to obtain uniformly and accurately spaced lines for lettering.
3. It is used to obtain parallel lines at uniform spacings.



6"60° STYLE "A" LETTERING ANGLE

The Lettering Angles are made in twenty-four different sizes and styles.

We are now also making a **very good standard triangle** carrying the same guarantee of accuracy and workmanship as our Braddock Lettering Angle.



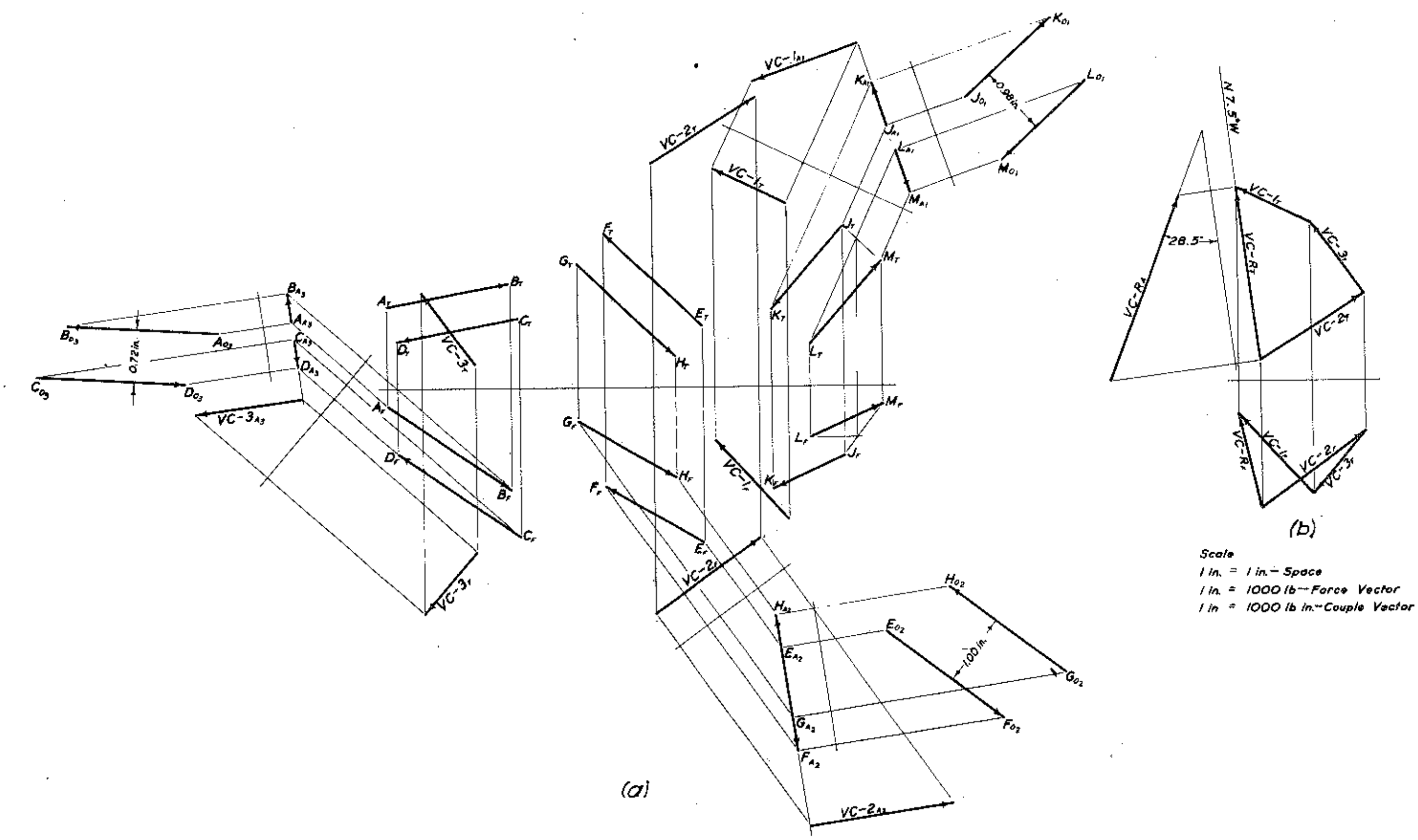
8"-45° STYLE "C" LETTERING ANGLE

Write To Us For Descriptive Circulars.
Your wholesale dealer will supply you.

BRADDOCK INSTRUMENT CO.

PITTSBURGH 18, PA.

(Continued from page 15)



THE RESULTANT OF COUPLES IN SPACE

Fig. 2

The next step involves the representation of a couple by a vector. Fig. 3 shows an example of how

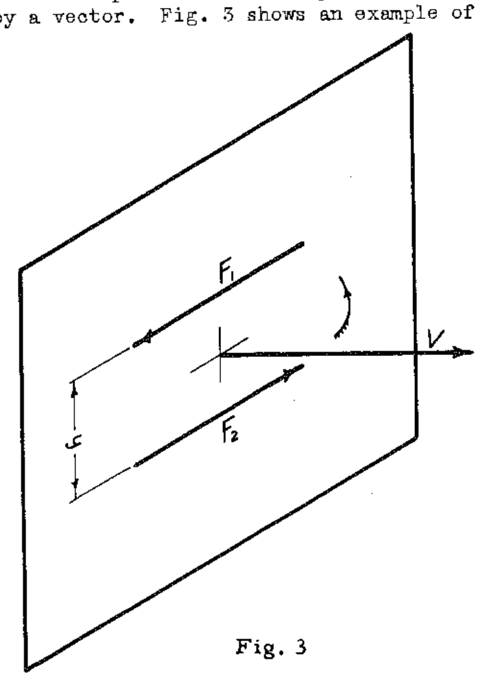


Fig. 3

this is done. If two forces such as F_1 and F_2 form a couple, the magnitude of the couple is F_1 or F_2 times the distance y. If F_1 is in pounds and y is in inches, the magnitude is in lb in. This magnitude can be represented by a vector V, by drawing to a definite scale (representing lb in.) a line which is perpendicular to the plane of the couple and which is directed so that it projects outward from the view of the plane which shows the couple action appearing in a counterclockwise direction.

Referring to Fig. 2(a) again, the magnitude of each of the three couples is represented by a vector quantity. The moment vector for couple 1 is drawn to a scale 1" = 1000 lb in. in the view which shows the plane determined by the two forces JK and LM as an edge. This vector quantity is labeled VC-1A_1. (The vector for couple 1 in auxiliary view 1.) It should be noted here that this vector is at right angles to the plane of the couple and it projects out from the plane on the side which shows the couple acting in a counterclockwise direction. The same procedure is used to draw moment vectors for planes of couple 2 and couple 3. These are respectively labeled VC-2A_2 and VC-3A_3. In order to expedite the final step in the solution of this problem, it is necessary to carry the projection of the moment vector for each of the three

(Continued on page 29)

(Continued from page 11)

If any difficulty is experienced in placing the views properly in a new orientation, a quick outline sketch of the successive auxiliary views will settle the controversy.

Thus, a true axonometric projection or secondary auxiliary view may be drawn of any object by placing any two corresponding views at any desired positions on two axes which are at a graphically constructed or calculated angle with each other, and then projecting directly to the desired axonometric or auxiliary view.

PART II. ELIMINATING THE INTERMEDIATE VIEW IN THE REVOLUTION METHOD.

In Fig. 8 the simple object used previously has been drawn in dimetric projection by the revolution method but without the use of a complete revolved side view. Only the three edges meeting at the leading

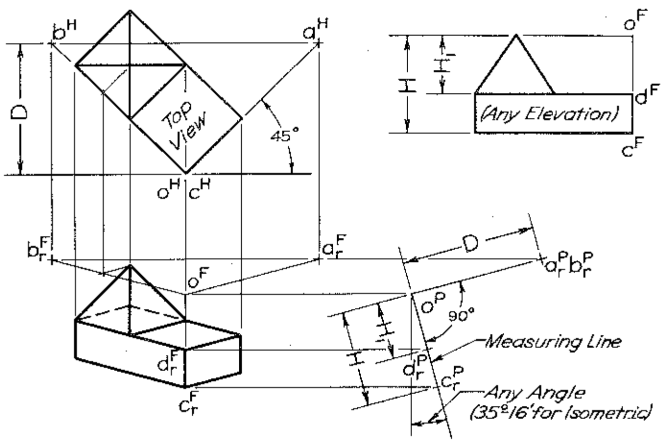


Fig. 8. Dimetric by revolution without a complete side view.

corner OA, OB and OC, are drawn in revolved positions. Instead of actually revolving these edges as was indicated by the construction of Fig. 2 in Part I of this paper, the points a^P_r, b^P_r, and c^P_r are located by transferring distances D and H with dividers directly to their inclined positions in the "substitute" revolved side view. Location of the points a^F_r and b^F_r in the axonometric projection of the enclosing "box" serves to establish the two inclined axonometric axes $o^Fa_r^F$ and $o^Fb_r^F$. The vertical axis $o^Fc_r^F$, of course, remains vertical. Line $o^Pc_r^P$ in the side view serves as a "measuring line" for heights, since all vertical dimensions of the object will be foreshortened in the same proportion. Thus, height dimension H_1, transferred from any available view or set off with a scale, establishes point d^F_r on the axonometric.

The remainder of the pictorial drawing is completed with parallel lines and by projection from the top view. Actually, the construction has a number of points of similarity with perspective drawing - much as if we had vanishing points at infinity.

To help clarify the use of the "measuring line", Fig. 9, involving a number of height dimensions, has been drawn. (Note, incidentally, that this is a trimetric projection). Height dimensions are established in several ways: h_1 by direct projection, h_2 by "indirect" projection and h_3 by transfer with

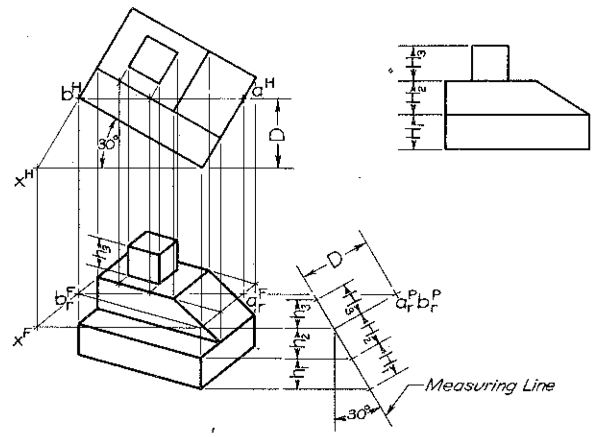


Fig. 9. Methods of establishing height dimension.

dividers. Height dimensions may also be established in a fashion almost exactly corresponding to the method used in perspective drawing. The "measuring line" is actually an edge view of a revolved frontal plane. Thus, if we extend a construction line from any point, such as b^H in Fig. 9, parallel to one of the principle edges and forward to this frontal plane, the piercing point X will be at the actual height projected from the revolved side view. This locates the axonometric projection of our extended construction line and, of course, b^F_r may then be located by projection from the top view.

Two indications of how curves might be handled are shown in Fig. 10.* Alternately (Fig. 11) the major and minor axes of the ellipse may be determined and the

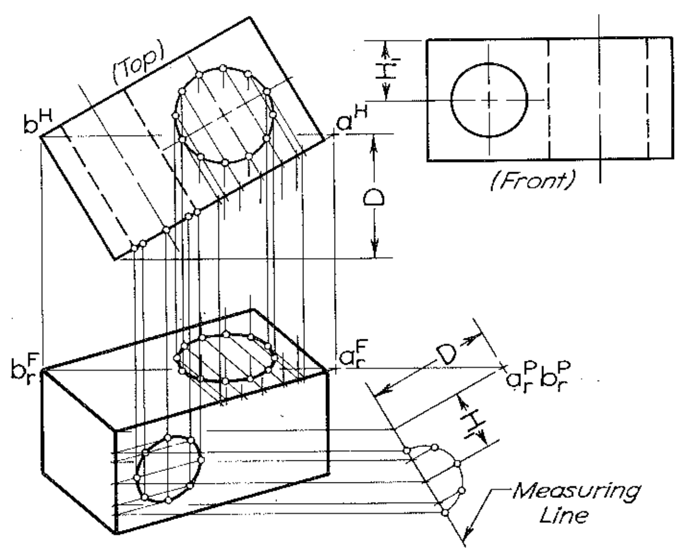


Fig. 10. Curve plotting.

(Continued on page 29)

*A similar construction might, of course, be used in the auxiliary view method of Part 1.

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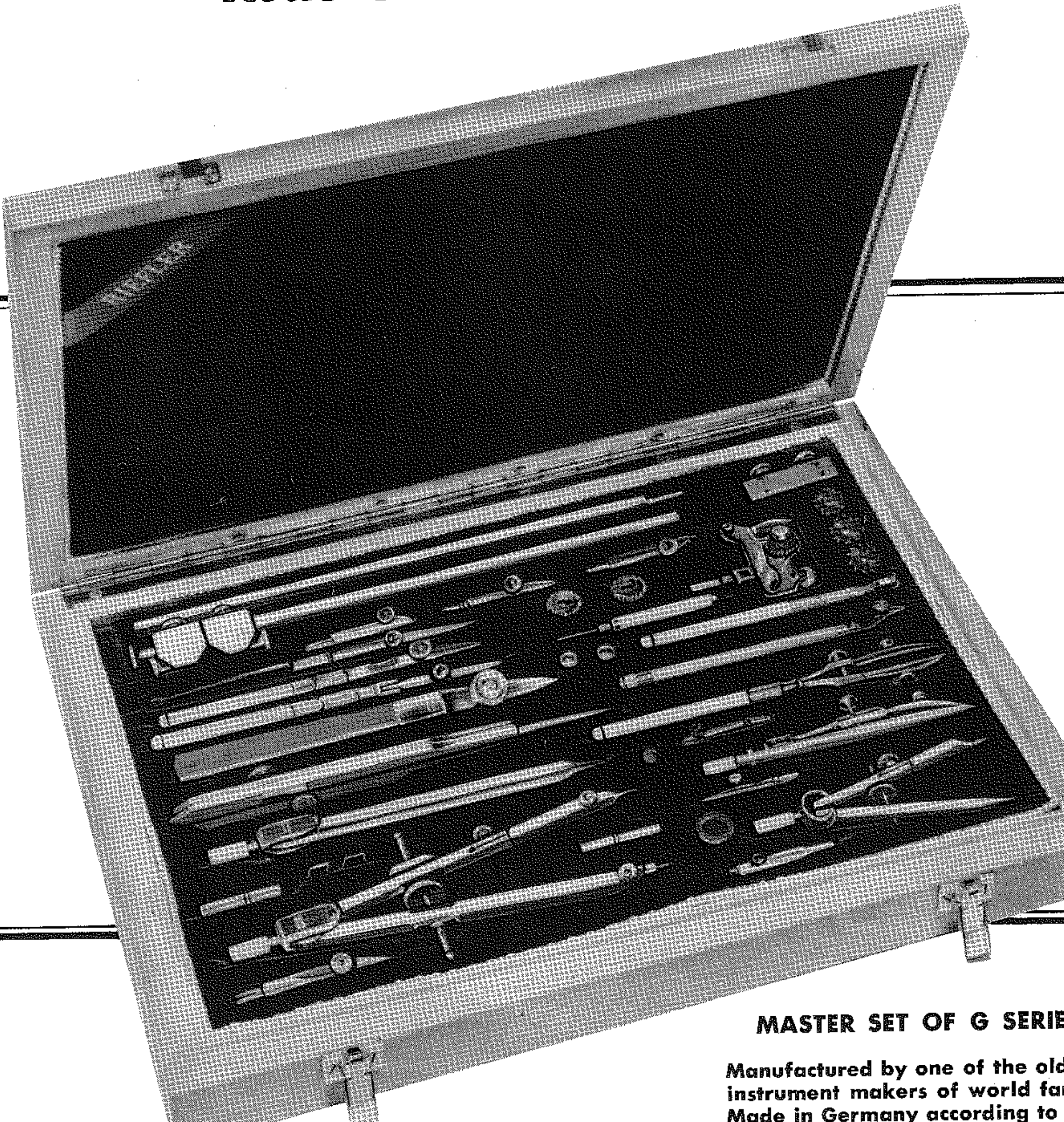

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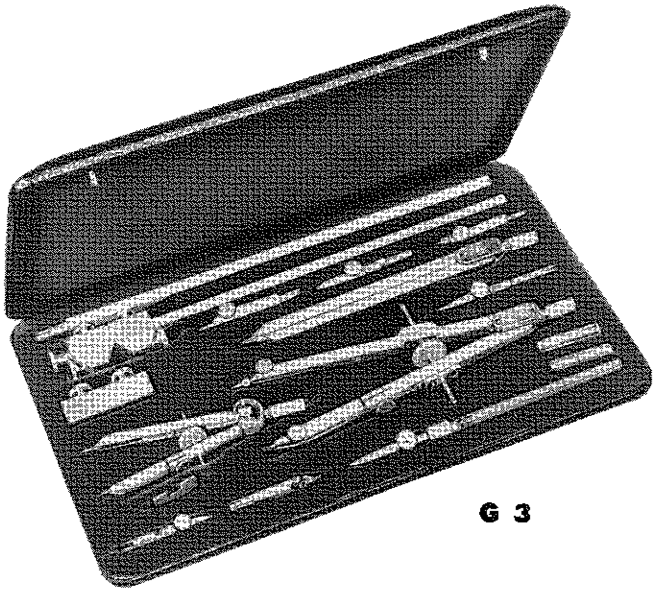
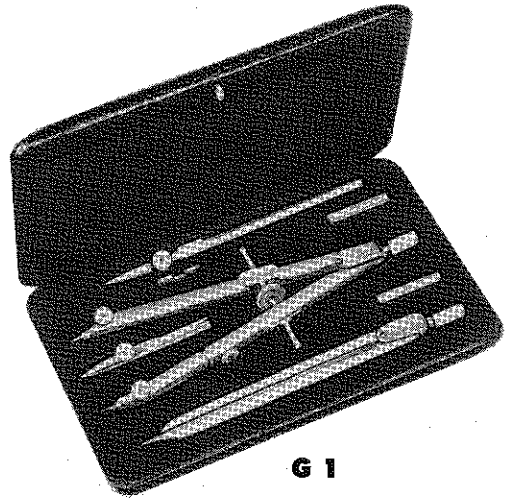


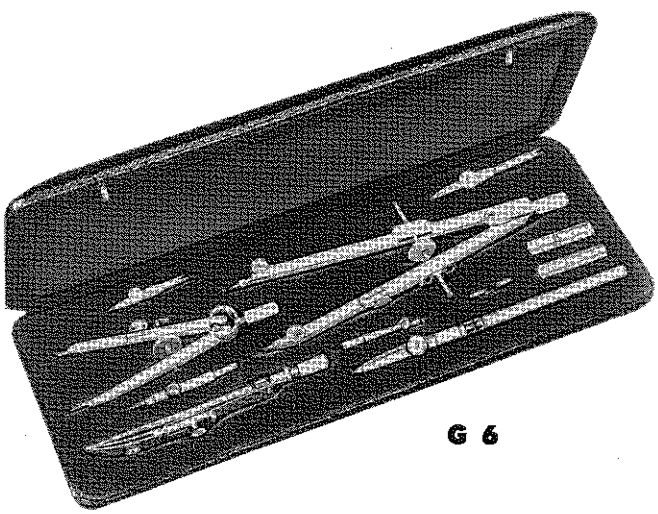
G 3



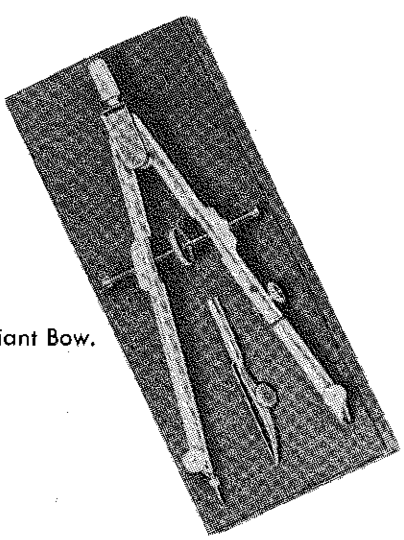
G 1

G 1/8 — Similor to G 1, with space provided for Combination Bow.

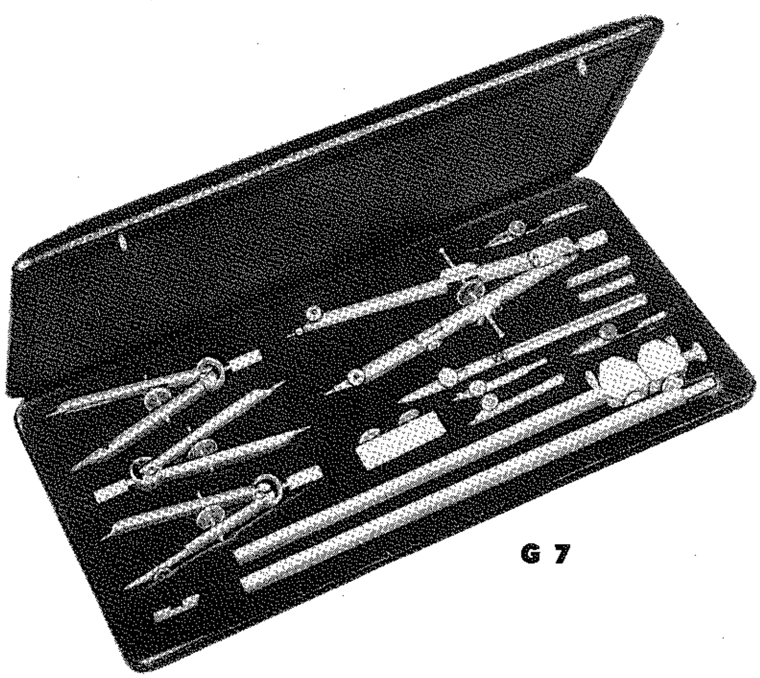
G 2/3/8—Similar to G 1, with spaces provided for Beam Compass and Combination Bow.



G 6



Giant Bow.



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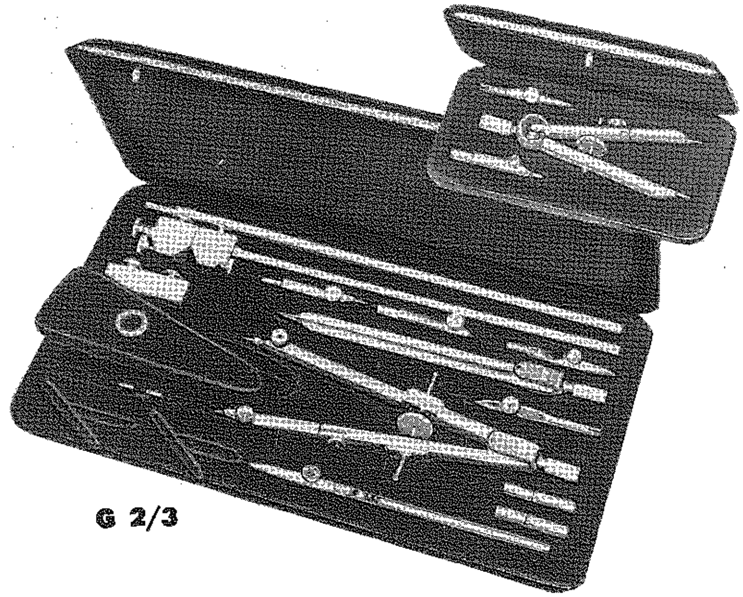
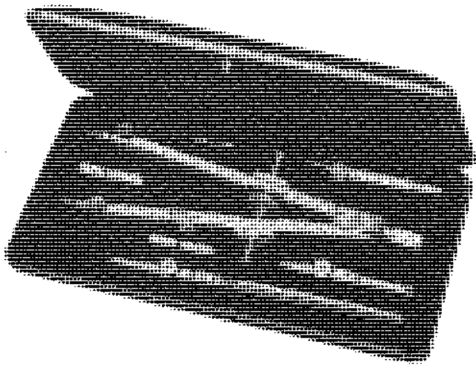


G 2/3

G 2/3—Space provided for addition Combination Bow as illustrated.

G 2—Similar to G 2/3 without additional spaces.



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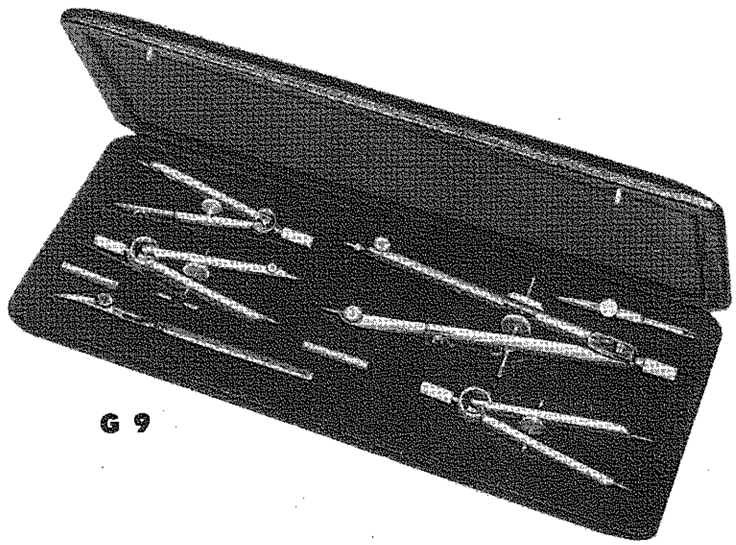
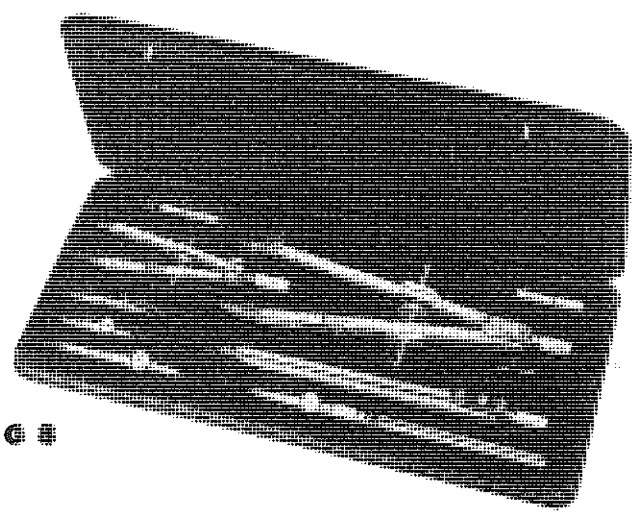
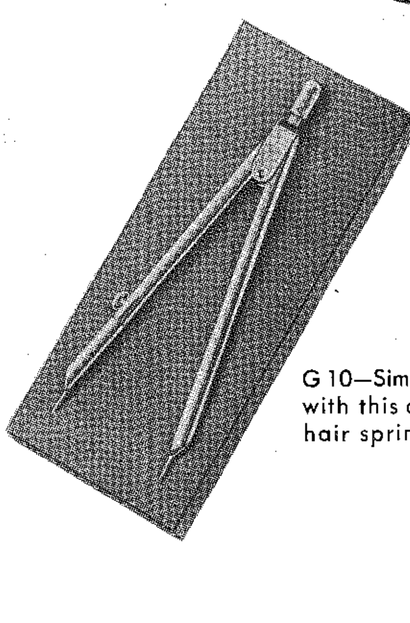


G 9

G 8/3—Similar to G 8, with space provided for Beam Campass.



G 8



G 10—Similar to G 9 with this additional hair spring divider.

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(Continued from page 24)

curve approximated with one of the four-center methods. The major axes 1' 2' and 5' 6' must always be the actual diameters of the holes, therefore true length, and therefore at right angles to the respective axes of the holes. The minor axis 3' 4' will be at right angles to the major axis 1' 2' and its end points 3' 4' may be established by direct and indirect projection from points 3 and 4 in the top view as shown in Fig. 11.

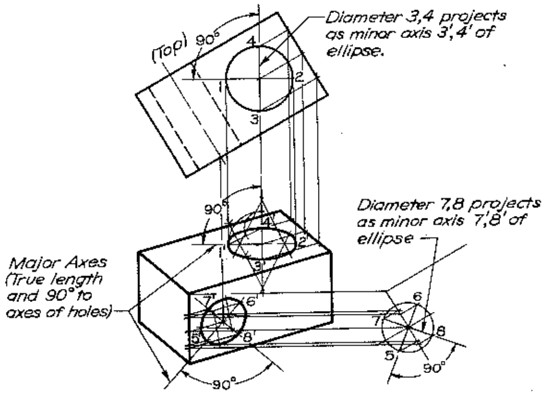

Fig. 11. Establishing axes for approximate ellipses.

With major axis end points 5' 6' established as indicated, we may project "backwards" to the side view as shown to locate diameter 5,6. Diameter 7, 8, at right angles to 5, 6, will then project in the usual manner to 7', 8', the minor axis of the second ellipse.

In actual practice it is often more desirable to assume axonometric axes and establish the positions of the top view and measuring line to agree. This may be for reasons of convenient angles for the axes $o^F a^F_r$ and $o^F b^F_r$, or because we already have a good idea as to a desirable position for the particular axonometric. Fig. 12 shows the construction by which this may be accomplished.

The three axes in the axonometric view are assumed, points a^F_r and b^F_r being placed on the same horizontal construction line. Points a^H and b^H are then assumed on a second horizontal construction line at any convenient distance above a^F_r and b^F_r. A semicircle is then drawn with $a^H b^H$ as diameter, and o^H is located by projecting upward from o^F. This establishes the top view of the axes (unrevolved). Side view o^P is then drawn at any convenient distance to the right of o^F. Line AB will appear in the side view as a point $a^P_r b^P_r$ located by projection from a^F_r and b^F_r plus the transfer of distance D from the top view. The measuring line is then drawn perpendicular to $o^P a_r{}^P b_r{}^P$, and construction of the axonometric may begin.

In Part I of this paper emphasis was placed on the mathematical method of establishing necessary angles for an axonometric

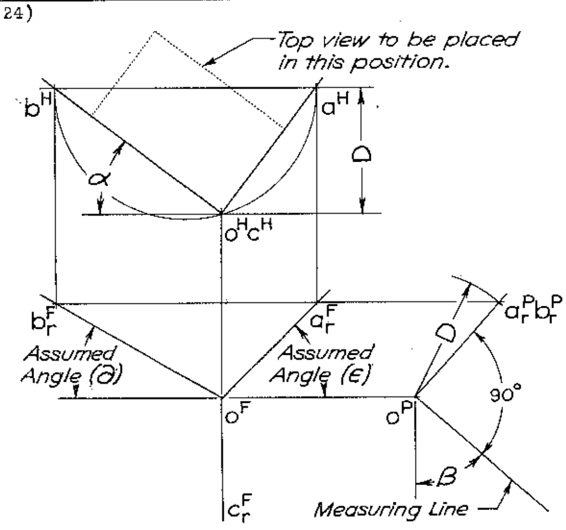

Fig. 12. Establishing positions of top view and measuring line to fit assumed axes.

construction because the graphical method is likely to be subject to drafting inaccuracies. The construction for axes in the revolution method is, of course, subject to similar errors and if a high degree of accuracy is desired, suitable mathematical formulas may be derived.

In Fig. 12 the necessary angles have been designated as α and β, and ∂ and ϵ. The following expressions obtain:

If suitable values for α and β are to be assumed, ∂ and ϵ may be secured from:

$$\tan \partial = \sin \beta \tan \alpha,$$

and

$$\tan \epsilon = \frac{\sin \beta}{\tan \alpha}$$

If values for ∂ and ϵ are to be assumed,

$$\tan^2 \alpha = \frac{\tan \partial}{\tan \epsilon}$$

and

$$\sin^2 \beta = \tan \partial \tan \epsilon.$$

Conclusion:

Of course no dimetric nor trimetric projection is worth the trouble of its construction if an isometric drawing or oblique projection serves the particular purpose. Anyone who has made many of these pictorial drawings knows, however, that often special characteristics of particular objects make isometric and oblique unsatisfactory. In such cases a reasonably convenient method of constructing a dimetric or trimetric projection is useful. It is hoped that one or the other of the methods presented herein meets this requirement.

(Continued from page 23)

couples back to the top and front view. The subscripts T and F are used to designate these projections such as $VC\text{-}1_F$ and $VC\text{-}1_T$.

After these projections are established in the front and top views, the final step is to combine the vectors in order to find their resultant.

Fig. 2(b) shows that these projections are combined by using the polygon of forces. Since the forces are in space it becomes necessary to draw the polygon in both the top and front views. The direction and magnitude for each projection of the moment vector has already been established in Fig. 2(2). In drawing the polygon, any order can be used. The order in this case was VC-2, VC-3 and VC-1. The closing side of the polygon as represented respectively on the top and front views is $VC\text{-}R_F$ and $VC\text{-}R_F$. The magnitude and direction of this resultant is found by taking a view at right angles to the projection in the top view $VC\text{-}R_T$. This view shows that the resultant is sloped at 28.5 and that its magnitude obtained by scaling is 2700 lb in. Its bearing as indicated on the top view is N 7.5° W.

This indicates that the original three couples in space can, for external force effects only, be considered to be replaced by a couple whose moment vector is VC-R. This couple has a magnitude of 2700 lb in. and it lies in a plane which is at right angles to its vectorial representation. In other words, the plane that it lies is in perpendicular to a line which is sloped at 28.5° and bears N 7.5° W. It must be remembered that the rotation of the couple has to be counterclockwise with respect to its moment vector when the two are properly considered according to the explanation given above.

It is evident from the foregoing discussion and the accompanying solution that the application of graphics offers a splendid opportunity for arriving at a rapid solution for problems dealing with the analysis of couple action in space. The accuracy attained will naturally depend upon the precision in workmanship and also upon the selection of suitable scales. It will conform to the same degree of accuracy that the graphical solution has to the mathematical solution for problems dealing with forces lying in one plane.

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by

Professor O. W. Potter, Chairman
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The Division is endeavoring to render a service to teachers of both drawing and industry. Your support and participation is necessary for the maximum benefit for all.

(Continued from page 14)

but art is not that easy. It takes years of training and experience to master the subject. Practically every one can be trained to appreciate art, but to create it is another story. A certain amount of natural talent is almost a necessity for that.

Assuming that we have a few ideas on form and composition, together with a little good judgment, we are ready to put our subject on paper. We already have a good background in perspective and now comes the time to select a point of view (station point.) Our experience with a camera tells us that if we get too close to the subject we will get a violent perspective. This may or may not be good. If we wish to convey the true shape of the subject, it is not good. If we wish to convey the true shape of the subject, it is not good. If we want a dramatic representation of the subject, it may be just the thing. On the other hand, if we move our camera too far back from the subject, the picture will appear too flat and uninteresting. After making a few thumbnail sketches, we should be able to decide upon an angle that meets our requirements. We may then go ahead and draw the object.

An interesting problem for the course would be to take some small object having a simple geometric shape and photograph it on a table top a few feet from the camera, keeping a record of all distances. Then with this data, make a perspective of the object using the same station point and all other measured distances. When the negative is developed, make an enlarged print to some scale and see how the perspective you have drawn compares with the photograph made from the same point.

The next question that comes up is one of technique. We may use various materials such as pencil, ink, crayon, water colors, air brush, etc. We may use a fine ink technique similar to etching, or a very bold black and white effect in masses with no lines at all. Effects with an air brush are almost unlimited, as are also those with water color. In any event our technique should be appropriate to the article we are rendering.

The lettering should also fit into the spirit of the composition and help support the main theme of the drawing. For instance, we would not use delicate French script in illustrating bulldozers or heavy moving machinery. Likewise, we would not use heavy black modern Russian block letters to advertise fine precision instruments such as timing mechanisms or electrical instruments.

Now the question of color comes up. Color greatly broadens our field or possibilities. Many books have been written on color, but most of the working fundamentals can be boiled down to a lecture or two for our purpose.

We are told that over eighty percent of our impressions are made through the eye, which is, quite phenominal when we consider the limited range of perception. In the entire range of frequencies from radio to cosmic rays, color occupies a small part, the wave length of violet is half the wave length of red, or an octive higher. On the other hand treble C on the piano is half the wave length of middle C, or an octive apart. We can hear through a range of approximately eleven octives, while we can see only one. Nevertheless color is before our eyes at all times, constantly making impressions.

Bright colors such as red, orange and yellow seem to be advancing, while green, blue, and violet seem to be receding. If we were air brushing a job to go into a sales catalogue we would want the drawing cheerful, and not use colors which would make the potential customer tighten up on his purse strings.

We know that colors opposite each other on the color wheel are called complementary. When used adjacent or near each other, each tends to intensify the other or make the other seem more brilliant.

Suppose we wish to make a drawing with the greatest amount of punch. Having layed out the principal objects as a dominent theme in our composition and having selected the most advantageous view point, we are now ready for color. We will use a bright advancing color for the object and a complementary cool receding color for the background. The advancing color of the object intensified by the neutral receding background will create a picture that will seem to jump right at you. It never fails to be an attention getter. We have thus coordinated the principles of art and design to our economic advantage.

The engineer's position is unique if he has had a course in production illustration. Knowing the mechanics of the machine he wishes to illustrate, he can select the most effective viewpoint for his illustration. The art student does not have this background and while he is well trained in the field of art, and if often very clever at illustration, too many times his perspectives are only freehand approximations. A young engineer with a technical background and a passion for exactness is in a very fortunate position if he has completed a course in production illustration built along the above lines. There are not many of his kind, in fact, an engineer's education today can hardly be considered complete without at least one course which considers the appearance of mechanical things.

The type of work that I have outlined in these few rambling thoughts would seem like a big order for one short course, but it can open up an entirely new field of thought for the engineering student.

Some may feel that this type of course in production illustration might be difficult to handle in a department of engineering drawing, particularly if most of the members of the staff have had no training outside of the engineering field. Lack of interest may be a far greater handicap than lack of training. Most drawing departments have at least one person who is interested in photography or one of the fine arts, and since all fine arts have principles in common, the development of a course in production illustration should be a delightful experience. There may be those who feel that time will not permit the addition of any more cultural work to our busy program, but here is a course that can be made both technical and cultural. If we think of the final objective of all education as the enrichment of human experience, this course will strike as direct a path to that goal as many of our more time honored courses.

Now that I have tried to show the need, or justify the existence of a course in production illustration as well as suggest a few phases to be covered, we might conclude by mentioning a few general outcomes of the course. Outside of its commercial value there are a number of cultural overtones to be derived from a good course in production illustration. A student's training in form, composition, technique and color will open his eyes to many things he never saw before. He will understand the reason back of color combinations that he sees everywhere. He will be far more critical when he goes to the store to buy a piece of merchandise. Texture and color will help him even in purchasing a suit of clothes, in fact he will be daily using these principles which will not only enable him to produce more effective drawings, but will add immeasurably to his enjoyment of life. Few courses in the entire curriculum have such an immediate, practical and lasting value as production illustration.

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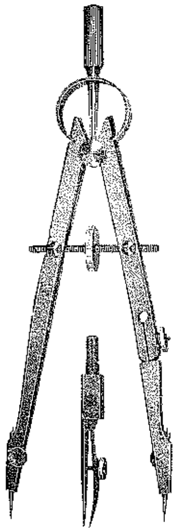

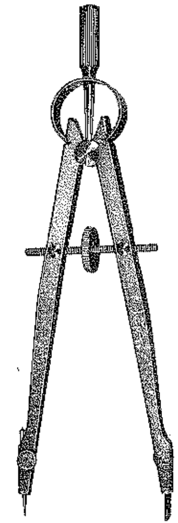

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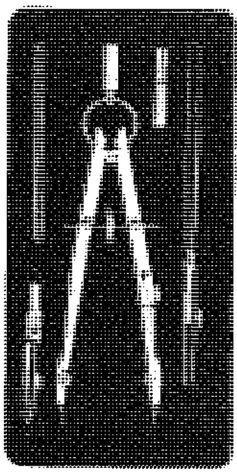

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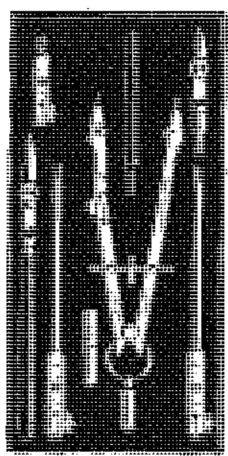

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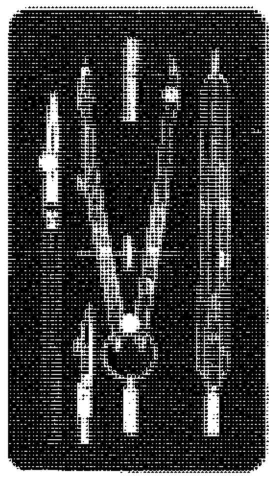
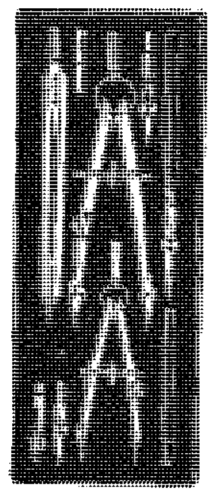


No. 975—with 5½" Ruling Pen and 6" Divider with straight, dev. nickel silver, in barlock case. $17.50



No. 976 — same as 975 plus additional 4½" combination bow with pen, pencil and divider parts and extra handle. $24.50

No. 947 MB (not illustrated) Same as 966 with Beam Compass for large diameters up to 48 inches consisting of two 13" bars, with micrometical adjustment in two flap velvet lined pocketbook case $27.00

All sets can be furnished without Ruling Pen, at a reduction in price of 2.50

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SOME RECENT DEVELOPMENTS IN DRAWING REPRODUCTION

by

Mr. H. L. Francis, Eastman Kodak Company
Rochester, New York

The word blueprint as it is used today may mean almost any type of a reproduction of an engineering drawing or other data. The reason behind the broad use of the term is that blueprints have provided a reliable low cost method of reproduction since 1842. The wide spread use of the term "Blueprint" is sometimes confusing because actually blueprinting is a separate and distinct process.

The next oldest type of reproduction is the Sepia or Van Dyke negative. For many years this type of print was the only medium available when a blue line was required from an original drawing. Van Dykes have always been widely used to provide government departments, prime contractors and others with a medium which they could use for making additional sets of blueprints.

Direct process prints were the next step forward in the reproduction field. There are several types of direct process papers available at the present time, but for the purpose of our discussion today, we selected prints made by the diazo process. These prints are exposed in exactly the same manner as blueprints. After exposure, they are developed by passing them through a chamber containing hot ammonia fumes.

Direct process prints have certain advantages. They can be produced much quicker than blueprints, less floor space is required for equipment, and they are better suited for checking purposes, since notations can easily be made on the print. Direct Process prints are a real contribution to reproduction methods.

The complete line of diazo materials covers a wide range of papers, cloths, films and foils. In addition to the papers most commonly used for making reproductions from engineering drawings, the Sepia or Intermediate papers are used extensively in the Engineering field. These papers serve the same purpose as the more familiar Van Dyke papers, and provide a medium from which it is possible to make additional copies. They have one disadvantage, in that they discolor and become opaque with age to the point where they can no longer be reproduced.

For many years in order to make a cloth tracing from a pencil drawing, it was necessary to trace it by hand. There are still a large number of tracings made in this manner.

In 1932 the Eastman Kodak Company offered to the trade a method of reproducing drawings on cloth by photography. The name of this product has been changed several times and today is known as Kodagraph tracing cloth. There are two types: Kodagraph Contact cloth and Kodagraph Projection cloth. These are strictly photographic products and a darkroom is required for processing. Making tracings by photography results in a great saving in time and cost. It saves time and trouble in checking and eliminates mistakes which might be made in tracing. There is little chance of error in dimensions or details because the method of making the tracing is entirely photographic and gives facsimile reproduction. Erasures and additions can be made on the finished tracing, and areas can be blocked out during the process of making the tracing.

To make a tracing by photography with Kodagraph Tracing cloth, it is first necessary to make a negative of the original. There are two methods of making the negative. One requires a vacuum printing frame with proper illumination; the other requires a darkroom camera. After the negative is made, by either of these methods, it is inspected on a retouching table and any faults or parts to be deleted are painted out. The Kodagraph Tracing is then made from the negative.

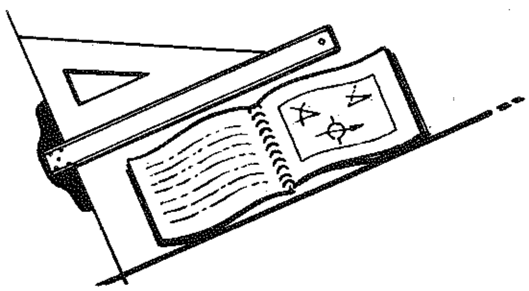
If made in a vacuum printing frame, the negative is made on Kodalith Orthochromatic negative paper and will be the same size as the original drawing, subject to processing distortion and humidity amplitude. The negative paper is placed in the vacuum frame with the emulsion side up. The original drawing is then placed on the negative paper face down with the pencil lines in contact with emulsion. The frame is then closed and the two sheets of paper drawn into close contact by means of a vacuum pump. The paper is then exposed to the light, taken out and developed; the result being a high contrast paper negative. The negative is full size on negative paper and the tracing is made by contact in the vacuum printing frame. The sensitized tracing cloth is placed in the printing frame, emulsion side up, and the negative is placed on top of it, emulsion side down. After making the exposure, the tracing is developed, fixed, washed and dried the same as any photographic print.

When the negative is made by means of the darkroom camera, the drawing is placed on the copy board and a picture is taken of it on Kodalith Orthochromatic Film. The resulting negative is a reduced copy of the original and is developed the same as any other photographic negative. The tracing is made from the negative by using the darkroom camera as a projector. The negative is placed in the negative holder and the tracing cloth is placed on the copy board. The drawing is enlarged back to its original size and the tracing cloth is then processed in the usual manner.

In addition to line drawings, sensitized tracing cloth is suitable for copying photographs, blueprints, and other engineering data. By building up composite negatives, this type of information can be reproduced whole or in part on our regular drawing forms.

In September 1947 the Eastman Kodak Company introduced to the trade a product known as Kodagraph Autopositive Paper. This paper is probably one of the most revolutionary products that has ever been offered in the reproduction field. It provides a method of making low cost reproductions to replace methods which

(Continued on page 36)



OBLIQUE AS A MEMBER OF THE PICTORIAL FAMILY

by

Professor John P. Oliver
Texas A & M College

As a member of the family of pictorial projection, oblique seems to be the neglected step-child. That is unfortunate since the little fellow has decided possibilities. There are circumstances under which the use of oblique is more sensible and more quickly executed than either orthographic or perspective. For that reason, I have depicted oblique projection in two of its several forms and attempted to place it in its proper position in the family group.

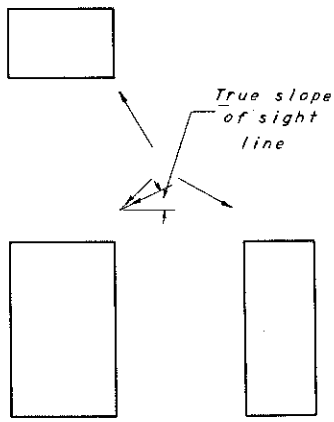


Fig. 1

For purpose of illustration, a block in the form of a rectangular right prism has been chosen as shown in Fig. 1. An observer position is indicated by the sight line shown in the front, top and right side views. The slope of the sight line is also indicated. This position of the sight line is used throughout both the oblique projections and the orthographic perspective comparisons.

Parallel Oblique. Fig. 2. Parallel oblique may be defined as that form of parallel projection in which the image screen is oblique to the observer's sight line and parallel to one of the principal planes of the object. In this case, the screen is placed coincident with the front face of the block. The screen appears as an edge in both the top and side views of the block. The sight line is located in its proper position in these views. In the oblique projection, the front face appears in true size and shape. The problem is to find the position and length of the receding axis. This is done quite easily by projecting the upper right rear corner of the block parallel to the sight line into the image screen and locating this point in the oblique projection. It will be noted that the receding axis is parallel to the front view of the sight line. The oblique projection may now be completed.

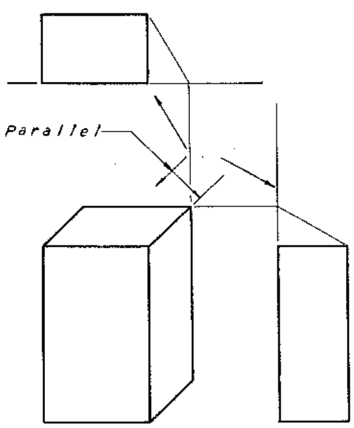


Fig. 2

Fig. 3. It is not necessary to draw the orthographic views since determination of the sight line gives all the information needed. We know that the height and width dimensions are in true length and relationship to each other and the receding axis is parallel to the front view of the sight line so we may draw these axes without further ado. There remains the problem of finding the scale of the depth dimension. A quick method of determining that scale is shown here.

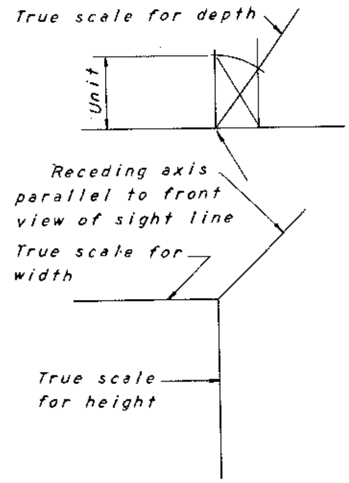


Fig. 3

Angular Oblique. Fig. 4. For cabinet, furniture and many forms of architectural details, a very simple form of pictorial is the angular oblique. This type may be defined as parallel projection in which the screen is at any angle to the sight line other than normal or parallel to a principal plane of the object. The most convenient position is nomal to the plan view of the sight line. That position is used here. The plan is revolved until the screen is parallel to the front and will appear as an edge in both the top and side views. The slope of the sight line shows true in the side view. Only the top surface

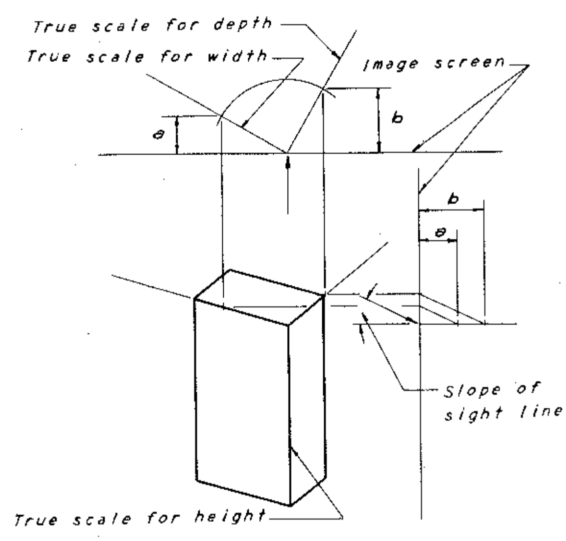


Fig. 4

need be shown in the side view since the only use made of it is in determining the position of the width and depth axes. Width and depth scales are true in the top view and points may be projected from them onto the axes in the oblique projection.

The Family Group. Fig. 5. Here the block from Fig. 1 is shown in an illustration of each of the six types of pictorial projection. The view point is the same in each case. In the upper row, the screen is placed parallel to the front principal plane of the object. On the left, the observer-object distance is infinite and we have parallel oblique. On the right the observer-object distance is finite and we have parallel perspective. In the middle row the screen is normal to the plan view of the sight line. By varying the observer-object distance, we have on the left angular oblique and on the right angular perspective. In the bottom row the screen is placed normal to the sight line. By varying the observer-object distance, we have on the left trimetric and on the right three-point perspective.

The problem of pictorial resolves itself into one of determining the view point and the type of projection to be made from that view point. The method used is as immaterial as it is varied. The one here used is a combination of the Method of Traces with the Method of Revolutions. It is a common method for determining vanishing points in perspective and has been discussed by various authors for a number of years in the past.

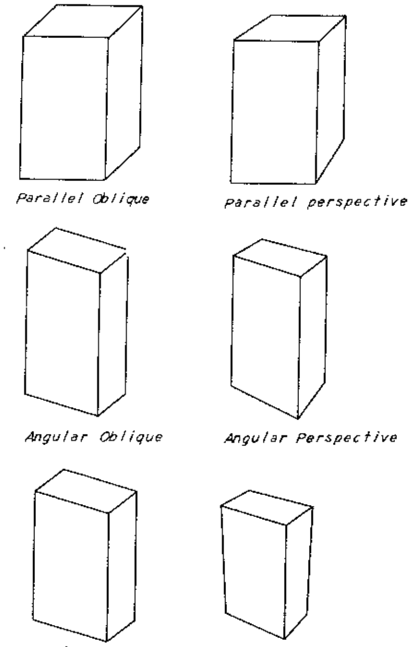


Fig. 5

(Continued from page 33)

heretofore had been very expensive and sometimes almost impossible.

Kodagraph Autopositive paper offers wide possibilities in reducing drafting costs. This paper is suitable for varied applications such as:--

Direct positive copies from paper tracings.

Blocked-out reproductions when design changes are desired.

Reclamation of old tracings.

Making intermediate tracings from manila drawings when blueprints or direct process is required.

This paper can be handled under ordinary tungsten lighting and can be exposed on any printer such as a blueprint or ozalid machine or in a vacuum printing frame where the exposure is made by means of carbon arc lamps. All exposures are made through a yellow or an orange filter and the paper is processed by means of commonly used photographic developers and fixing bath.

Frequently a drawing is required, a large portion of which is exactly like an existing drawing; or due to design changes it is desired to change portions of an existing drawing. This can be accomplished at considerable saving in cost by prints made on Kodagraph Autopositive paper. That portion of the drawing to be is removed by blocking out or by eradicators when making the print. The new design changes are then drawn in on the Kodagraph print which is then used as an original for making prints for field or shop use.

Manila or opaque drawings are reproduced by the reflex method. The drawing is laid face up in the vacuum printing frame. The sensitized paper is then placed on top of the drawing with the emulsion side down. The filter is then placed over the sensitized paper and the exposure made by arc lamp illumination. The result is an indirect autopositive which, in turn, can be reproduced by any conventional process.

Direct Process print will produce a reverse reading positive which in turn can be used to make direct reading prints. Part of the drawing can be blocked out or removed by eradicator when design changes are required.

About the first of October of this year, another product was introduced by the Eastman Kodak Company; Kodagraph Autopositive Matte Film. This material has all of the characteristics of the Kodagraph Autopositive paper and is processed in the same manner. The use of this material results in a high quality reproduction and should prove very valuable in the Map-making industry where it is essential that contour lines and other small details must be accurately reproduced.

In 1947, at the same time that Kodagraph Autopositive paper was introduced, the Eastman Kodak Company also introduced two other papers known as Kodagraph Contact paper and Kodagraph Projection paper.

Kodagraph Contact Paper is a darkroom paper and is exposed in a vacuum printing frame using arc lamp illumination.

The paper comes in two weights; standard weight and extra thin. The standard weight paper is used for making negatives preparatory to reproduction on tracing cloth and for positive prints from blueprints or other negative type prints where high quality is required. The extra thin weight paper is used for making intermediates which are to be reproduced by direct process or blueprint methods. In copying a blueprint, best results are obtained by making a an indirect copy on Kodagraph Contact extra thin.

Kodagraph Projection extra thin paper is also a darkroom paper and is very helpful when a reduction or an enlargement is required that can be reproduced on blueprint paper or one of the direct process papers. A process camera is required in making this type of a reproduction and it is necessary to first make a film negative.

In presenting this paper, it is hoped that you have gained some idea of the steps that are being taken by industry today, to speed up the release of engineering drawings and to reduce drafting costs.

(Continued from page 17)

What have we done to expect Joe to become an excellent instructor? Is he going to make it in spite of us, or because of us? Does he really know what the objectives are? Does he have a philosophy of life and teaching which will help make him a good instructor?

Is anything done to fill the gaps or holes in Joe's knowledge? Has he any idea what the common current practices are in industry and other engineering schools? Is something being done to give Joe a more comprehensive outlook? What chance is there for a sense of achievement and recognition for Joe?

Is there much chance that he gets to feel he is a part of the whole, by having a voice in things, and discovering that some of his ideas are adopted and used? Surely he should have a place on some committees, but thus far he has had neither chance nor choice. He has also received little help via observation of his teaching, and supervision of a constructive and helpful nature.

Has he had or does he deserve any help in getting summer employment that will be most helpful to a drawing instructor? Usually there are older men who have the contacts which might enable them to help Joe get the kind of job which would be most beneficial.

Does he know how broad our field really is, and how much it includes? Has he done much more than hear of nomography and graphical solutions of engineering problems, etc.?

When Joe is new in the department, perhaps he looks around to see what's what. He learns that there are many excellent texts, workbooks, etc. He sees that the courses have been pretty well worked out, and hashed and rehashed. When he is asked what research can be done in the field, it looks pretty much like a blank wall. What can a relative beginner do to improve on texts, tests, workbooks, etc., which have been worked out by authorities with a score of years experience behind them?

Had anybody ever told him (or hinted) that there is a common ground between our field, mathematics, physics, civil and mechanical engineering, etc.; and that perhaps he can discover some graphical methods of solving problems of an engineering nature which will be more practical than the past or present methods? Even electrical engineering makes use of graphical methods and solutions to an extent which would surprise many of us.

Joe has had but little training in such things as nomography, machine design, tool and die or jig and fixture work. He has often wondered, however, if mechanisms, kinematics, linkages, etc. should not be a part of the graphical field in an engineering school.

What about Joe's prospects for the future, and the department's prospects in the future? What chance is there for his improvement; for the department's status improving; for advancement of either of them? What about contribution to the progress of the world and more particularly to the field?

What possibility is there that the field of graphics and graphical solutions for engineering problems might be explored, developed, and coordinated into a major field? Could we train men for these activities?

Certainly there is a need for design engineers. Within the past month, a request came to my office from a Detroit, Michigan, manufacturing firm for engineering graduates who would like to train to become Design Engineers. The vice-president of this company told me "Tool and Die" men are a dime a dozen in Detroit engineering departments right now, but that Design Engineers are so scarce that they can practically name their own figure as a salary. I have corroboration of this condition from another friend familiar with the Detroit situation. Perhaps this condition is not general, but at least Design Engineering does not seem to be an overcrowded field in one of the greatest industrial and manufacturing centers in the country.

Why couldn't we graduate the Design Engineers? Admittedly, they would probably need several years apprenticeship in two or more plants, but much practical research and development might be done by these men.

What should we do about Joe and his kind? Do we need to pamper and coddle them? Must we do everything for them to make them into better teachers? No, emphatically, No! It doesn't take much to bend a willow just a little the other way. Oftentimes, it doesn't take too much encouragement, nor too much in the way of opportunity to start a trend in the opposite direction to that taken by Joe. Let's give him something to work for, to work toward; let's encourage him to get interested in doing a superior job. I think we could sell a man on the satisfaction of, and pride in, doing a better job than is being done by others.

He might get more interested in his job if he knew that it might mean getting somewhere. Almost any ordinary human needs some incentive to keep going at a better than average pace, and not many men are likely to continue doing a superior job in what looks like a "blind alley" position. Can Joe have reasonably good prospects for promotion if he does a superior job? Is his field growing or diminishing in importance and prestige in his college? Is the department developing new courses or branches, or even keeping up with present day developments? Are we keeping pace, in growth, with other branches of engineering.

Sure, Joe ought to join professional societies and become active in them, get his masters degree, exchange ideas with other men in the field, take some of the other courses in engineering graphics, go out and get practical experience, subscribe to technical magazines, build up his library (and use it), keep up with new development, etc.,---but what sort of encouragement or real incentive is there for him to do this?

But, even if he does this, there is much more he needs to know about teaching methods and psychology of groups and individuals to be a really top-notch teacher. Let's give Joe a good chance to get that training, too. Encourage him to get some college training in methods of teaching, educational and other practical psychology courses. Make it as easy as possible for him to take these courses and see that he knows it will be taken into consideration, along with the other factors, involved in salary increases and promotions.

REPORT OF THE BIBLIOGRAPHY COMMITTEE

by

Professor H. H. Fenwick
University of Louisville

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(To be continued in next issue)