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DIVISION ACTIVITIES

by

Professor Ralph S. Paffenbarger, Chairman
Division of Engineering Drawing
The Ohio State University

Having completed our mid-winter activities with a very fine program and excellent entertainment at Texas A.& M. College, we are now ready to enter wholeheartedly into our Summer School activities and the Annual Meeting to be held at Michigan State College, East Lansing, Michigan. Our program extends from June 21 to June 26 inclusive, and the activities of the Society continue through to the 29th.

The program has been completely arranged as of April 1 and is contained in this issue. There will be a few slight changes, but practically everything as listed is assured.

We are to be quartered in Shaw Hall Dormitory, and an advanced registration card is enclosed in this issue of the Journal for your convenience in arranging for school and dormitory reservations. The headquarters for the school will be Room 110, Olds Hall. Professor C.L. Brattin, Chairman of the Engineering Drawing Department of Michigan State College, heads the local committee. They are arranging the details for this session in East Lansing. The general sessions of the Division for the Summer School will be held in Room 111, Olds Hall. The exhibit of the drawing equipment, under the direction of Ralph T. Northrup's committee, will be located in Room 303, Olds Hall. The exhibit of student work and engineering drawing course outlines, under the direction of Dean Jasper Gerardi, will be located in Room 304, Olds Hall. The teaching aids exhibit, under the direction of Harold B. Howe, will be located in Room 309, Olds Hall.

Will you kindly cooperate with the committees in making the displays as complete and as interesting as possible, and either bring or send to East Lansing (1) bound copies of your course outlines and students' work (2) various teaching aids such as models, movies, filmstrips, etc., used in your instructional work (3) any unusual drawing equipment, new or historical. The displays add greatly to the success of the meeting since we have an opportunity to observe at close range what is being accomplished and used throughout the various engineering schools.

The record of the proceedings of this Summer School will be made available to only those who are in attendance. Assembled copies of the papers and other material will be presented at the closing banquet.

A program is being arranged for the ladies as well so that your family may enjoy the meeting along with yourself.

Printed copies of the program will be mailed to all members of the Engineering Drawing Division together with late instructions on June 1.

The program as worked out on April 1 is as follows:

PROGRAM

Theme:

IMPROVING OUR STATUS AS ENGINEERING DRAWING TEACHERS

*****

WEDNESDAY, JUNE 20

4:00 - 8:00 p.m. Registration

THURSDAY, JUNE 21

8:00 a.m. Registration

OPENING SESSION - DEVELOPING THE BACKGROUND

9:00 a.m. Presiding: Randolph P. Hoelscher, University of Illinois
Welcome:
Lorin G. Miller, Dean of Engineering, Michigan State College
Response:
Ralph S. Paffenbarger, Chairman Division of Engineering Drawing, A.S.E.E., Ohio State University
Training and Early Experiences of the Engineering Drawing Teacher:
James S. Blackman, University of Nebraska
A Study of the Effects of Drawing Training of High School Students:
Kenneth E. Parr, Purdue University
Panel Discussion:
C. Albro Newton, University of Tennessee
Fred W. Slantz, Lafayette College
Matthew McNeary, University of Maine
C.I. Carlson, University of Illinois, Navy Pier
Mark P. Harris, Georgia Institute of Technology

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TEACHER TRAINING

2:00 p.m. Presiding: H.C. Spencer, Illinois Institute of Technology
Training High School Drawing Teachers:
Earl Bedell, Vocational Director, Detroit Public Schools
Drawing Courses - Technical Institute Program:
Frank Avila, Purdue Technical Institute, Fort Wayne, Indiana
Teaching Techniques in Presenting a Basic Drawing Solution:
Lewis G. Palmer and Robert J. Moore, University of Minnesota
Panel Discussion:
Wayne Felbarth, University of Detroit
E.M. Griswold, Cooper Union
Arnold Bakaler, Illinois Institute of Technology
Robert R. Irwin, Oklahoma A.& M.
Stanley Hall, University of Illinois

6:00 p.m. Dinner. Ladies included - Shaw Hall
Speaker: Colonel H.W. Miller, University of Michigan "The Science of Learning"

7:30 p.m. Presiding: Dean J. Gerardi, University of Detroit
Tour of Exhibits:
Question Box Clinic - Course Outlines and Student Displays

FRIDAY, JUNE 22

8:30 a.m. Group Picture - Auditorium Steps

BASIC DRAWING

9:00 a.m. Presiding: Frederick G. Higbee, University of Iowa
Effectiveness of Teaching Aids:
Carl W. Muhlenbruch, Northwestern University
Color as a Teaching Aid for Engineering Drawing
Rex W. Waymack, University of Notre Dame
Lecture Demonstration - Foundry Practice:
P.M. Scodellaro, University of Detroit
Panel Discussion:
R.R. Worsencroft, University of Wisconsin
Robert W. Grant, Wayne University
Frank H. Smith, University of Michigan
Justus Rising, Purdue University
S.F. Cleary, Cornell University
Lecture Demonstration - Machine for Making Perspective Drawings:
Oliver M. Stone, Case Institute of Technology

DESCRIPTIVE GEOMETRY

2:00 p.m. Presiding: W.E. Street, Texas A.& M. College
Study of Descriptive Geometry Systems:
Irwin Wldaver, New York University
Lecture Demonstration - Use of Circular Blackboard for Presenting Auxiliary:
Frank H. Lee, Columbia University
Lecture Demonstration - Perpendicular Relationships:
Clyde H. Kearns, Jr., Ohio State University
Lecture Demonstration - Tangent Planes:
Eugene Pare', Illinois Institute of Technology
Panel Discussion:
Charles E. Rowe, University of Texas
B. Leighton Wellman, Worcester Polytechnic Institute
Ivan L. Hill, Illinois Institute of Technology
K.G. Shiels, University of Wisconsin
J. Howard Porsch, Purdue University

7:30 p.m. Presiding: Harold B. Howe, Rensselaer Polytechnic Institute
Ralph T. Northrup, Wayne University
Tour of Exhibits - Teaching Aids and Instruments
Discussion Clinic:
Philip O. Potts, University of Michigan
P.B. Moose, North Carolina State College
Melvin L. Betterley, Illinois Institute of Technology
Mary Blade, Cooper Union
Clifford H. Ransdell, Texas A.& M. College

SATURDAY, JUNE 23

ADVANCED DRAWING

9:00 a.m. Presiding: Charles J. Vierck, Ohio State University
Integrated Descriptive Geometry with Basic Drawing:
Lieut. Col. E.O. McDonald, United States Military Academy
Detailing Design:
Robert C. Bleikamp, Washington University
Pictorial Shading for Reproduction:
Ira Brichta, Sander Engraving Company, Chicago, Illinois
Industrial Application of Drafting Standards:
Leon DeMoss, Executive Engineer, Cadillac Motor Car Co.
Panel Discussion:
Guy H. Parham, Jr., University of Tennessee
O.W. Fairbanks, Michigan State College

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THIS IS MICHIGAN STATE COLLEGE

by

Professor C.L. Brattin

Michigan State College was a relatively small university before World War II, but it stands today as the eleventh largest institution of higher education in the nation. Not only does it have the student body, but it has the educational philosophy, breadth of curriculum, faculty and physical facilities to match.

Here are some little-known facts about Michigan State College. Enrollment of students reached a post-war peak of 16,243 during the fall quarter of 1949. In the fall term of 1950, enrollment stood at approximately 15,000. Total faculty, including teaching, research and extension, numbers over 2,000. Physical facilities on the Spartan campus have grown tremendously since the end of World War II through a vast building program. The Western Conference voiced its approval of MSC's athletic prowess when it voted in May, 1949, to accept Michigan State as a member of the Big Ten.

The institution has come a long way since 1855, when it was founded as Michigan Agricultural College, first of its type in the nation. Carved out of the pines in Michigan's Lower Peninsula on the outskirts of Lansing, this institution has a tradition in agricultural teaching and extension work that can boast no equal, for it blazed the trail for the land-grant movement which was to follow in the 1860's. These institutions drew upon the graduates, educational innovations and intellectual philosophy developed at MSC. Courses in engineering were opened in 1885, and by 1896 one third of the college enrollment consisted of those taking the engineering courses.

In the 1920's, the East Lansing College, boasting an enrollment of nearly 3,000 students, began to flex its muscles and prepare for bigger and better things. After curricula in liberal arts and applied science were added in 1921 and 1925, it was natural that in 1925, the Aggies of Michigan Agricultural College became the Spartans of Michigan State College.

Michigan State is proud of its heritage, and service to the people of Michigan has remained the guiding philosophy of the institution since its founding as the "state college." The 15,000 students in the college classrooms are but part of the broad service philosophy of Michigan State College, a program which extends in all directions to spread scientific knowledge to the far corners of the state.

Through the Agricultural Experiment Station, the co-operative Extension Service and the Continuing Education Service, an additional 100,000 Michigan residents each year are given assistance and training by the college.

Today, students have a choice of approximately 70 curricula, with 58 of these offering graduate degrees. Among the courses available are agriculture, home economics, hotel administration, chemistry, physics, engineering, medical technology, nursing, police administration, business, art, pre-medicine and pre-law. The administration of these courses is divided into eight main schools. They are: Agriculture, Home Economics, Engineering, Veterinary Medicine, Graduate Studies, Science and Arts, Business and Public Service, and the Basic College, a two-year program of general education.

The Engineering Drawing Department at the present time employes seventeen instructors on a full time basis. It has its main office in Room 312, Olds Hall. It has seven drawing rooms in Olds Hall, four in the Wood Shop, and two in building A-4 on South Campus. Ten instructors are officed in Olds Hall, two in the Wood Shop, and five in building A-4. The drawing room capacities are either twenty-four or thirty-two students. In addition to teaching drawing and descriptive geometry to engineers, the department services the departments of Forestry, Hotel Administration, Home Economics, Business Administration, Industrial Arts, and Landscape Architecture in their drawing requirements.

Although the school is in every way a university, officials of Michigan State prefer to keep the term "college" to avoid confusion with their sister Big Ten member, the University of Michigan.

MSC got the jump on most of the nation's colleges and universities in preparing for the post-war rise in enrollment. A self-liquidation program completed in 1940 added eight major buildings to the Spartan campus at no expense to the public.

In 1946, Michigan State launched another building program, designed not only to provide educational facilities for the returning veterans, but also to adequately serve the increasing demands of Michigan people for college educations and numerous other services.

Now nearing completion is a post-war building program which has added 17 major buildings to the East Lansing campus. Also included in the project were modernization of the MSC Union and Macklin Field Stadium, and erection of 11 apartment buildings for married faculty and students. Six large classroom and laboratory buildings, including a new Agricultural Engineering building and an Electrical Engineering Building, a steam generating plant, seven dormitories and a dormitory food service building have been constructed since the end of World War II. Approximately 60 percent of these structures were built on a self-liquidating basis, at no cost to the public.

Scheduled for completion early in 1951 is the modern seven-story Kellogg Center for Continuing Education. It is being constructed primarily to accommodate more than 100,000 Michigan citizens who come to the campus each year for the college's broad program of adult education. The structure is being financed largely through a grant from the Kellogg Foundation of Battle Creek.

Also included in the post-war building program is an addition and extensive renovation of the college's veterinary medicine facilities. The structure, being built through legislative appropriation, is scheduled for completion in the fall of 1951.

(Continued on page 27)

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PERSONALITY SKETCH OF GEORGE J. HOOD

George Jussen Hood, Professor Emeritus of Engineering Drawing at the University of Kansas, is an example of a person who has succeeded in two major fields--teaching and inventing. Which of these channels has produced the most beneficial results, is difficult to ascertain. The Padgett-Hood dermatome, a skin-grafting machine, has made it possible for doctors to perform operations regarded as impossible thirteen years ago. During World War II, the army and navy used hundreds of these instruments in order to give best possible treatment to battle wounds. Professor Hood's descriptive geometry text, The Geometry of Engineering Drawing, was the first to utilize the direct method. Now, in its third edition, it is widely used.

A Dermatome

Born December 31, 1977, in Chicago, George Hood moved to Kansas with his parents at an age early enough to attend school in Clay Center. In 1902 he was graduated with a B.S. degree in Mechanical Engineering by the University of Kansas where he was immediately employed as a teacher. In 1917 he earned the degree of Mechanical Engineer and was awarded a full professorship. Before graduation his ambition was apparent. As an example, during the summer vacation between his freshman and sophomore years, the student Hood borrowed a calculus book, worked all the problems it contained, and in the fall convinced the mathematics department that he had successfully completed the calculus requirements of the engineering curriculum. He also earned his college expense money by organizing a dance band, renting a dance hall and putting on Saturday night dances. That he was able to use his ambition for the benefit of the graphic arts is now history.

During his earlier teaching days Professor Hood often alternated between teaching descriptive geometry and designing machines. When working at his drafting table, he visualized the function and shape of each machine part, thinking of each view of the drawing as if it were the actual object itself. Then, during the following hour he switched to teaching projections, according to the Mongean system then in use. Here the drawings became lines projected on a flat surface, and the projected object was considered as existing separately from its projections.

Professor Hood recognized that this resulted in an indirect way of thinking and was inconsistent with the attitude of mind of the engineer. The projection of three-dimensional objects onto a plane by the use of distracting planes of projection, ground lines, and traces of planes all constituted an indirect approach. It was this line of reasoning which led him to write his textbook on the direct method which

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TECHNICAL DRAWING CURRICULUM AT ILLINOIS INSTITUTE OF TECHNOLOGY

by: H.C. Spencer

The idea of the degree curriculum in technical drawing developed from three main thoughts - that there is a need for better trained drawing teachers, that the drawing department in an engineering college is the best place to get such training, and that it is good for the drawing department to provide the training.

First, there has been no real college curriculum in existence for the specific and thorough training of technical drawing teachers, either for high schools or colleges. The high school mechanical drawing teacher has received a training in industrial arts, which includes a general studies background, a group of various industrial arts courses including several kinds of shop work with some courses in drawing, and a specified group of courses in education. The quality of this work varies greatly in different institutions, and is often very weak, especially in the teachers' colleges. However, excellent courses are available in some institutions, including Texas A.& M. College, and the training is good for all-around industrial arts teachers who may be called upon to teach woodwork, metal work, general shops or any one of a variety of industrial arts subjects, including mechanical drawing.

I am not concerned with the general industrial arts teacher, for whom adequate training is already available. But in the medium to large high schools, the technical high schools, the vocational schools, trade schools, and technical institutes, the mechanical drawing teacher teaches nothing but drawing except in an occasional emergency. In such schools he may teach everything from elementary drawing to architectural drawing, machine drawing or tool and die design. Here, the teacher needs to be a specialist - a man thoroughly trained and experienced in the broad field of the graphic language. Needless to say, this type of teacher is hard to find and much in demand. These schools are quite proud when they can employ a drawing teacher who has a degree in engineering, and some of these teachers are engineering graduates. But it is difficult to obtain graduate engineers because they did not prepare themselves to be teachers, and of course they are not teachers. It is necessary for them to take a considerable number of education courses to satisfy certification requirements, and this prevents many engineers from entering teaching in the public schools - as it should.

The engineering graduate is not only deficient in methods of teaching, and I think this goes for college teaching as well as high school teaching, but he is woefully short on training in drawing. In Chicago, high school drawing teachers frequently come to us for additional courses in drawing so that they can qualify for permanent employment. This is particularly true of engineering graduates who want to enter teaching.

The engineering graduate may know something about soil mechanics, the theory of indeterminate structures, ultra high frequency waves, electronics, thermodynamics, jet propulsion, or spectroscopy, but he probably has had no more than 6 or 7 semester hours of drawing. His knowledge of axonometry is limited to a few simple isometrics, and he probably had nothing on topographic drawing or structural drawing, to say nothing of machine design or architectural drawing. If he is a chemical or an electrical engineer, he may not have had more than 3 or 4 semester hours of drawing. He might not have had any descriptive geometry which is absolutely basic to all drawing courses, and probably he wouldn't know a topographic drawing from a nomographic chart.

This presents an embarrassing situation in recruiting young teachers for our own college drawing staffs - Most of our teachers are necessarily engineering graduates, while some are industrial arts majors or architects. It is difficult to find a young engineering graduate with more than a B.S. degree, because if a man goes beyond that in his chosen engineering field, he is likely to be interested in that field and not in drawing. We usually take them as young instructors with the B.S. degree and then encourage them to get a Master's degree as soon as possible. In the meantime we encourage them to take some courses in education, to take courses which will broaden their knowledge in different aspects of drawing, and to get some industrial experience. Finally, this process may produce really excellent men, but it does not alter the fact that it would have been much better if they could have taken a college course which was specifically designed to train them to be drawing teachers.

My second reason for suggesting a specialized degree curriculum in technical drawing is that engineering colleges are ideally equipped to provide the basic engineering training required, and the drawing department is well equipped for such a job. It is the business of the engineering college to train technical people on a high level, and the first two to three years of that basic technical training is just what the drawing teacher needs if he is to be really well-grounded in fundamentals. For example, if he is to have machine design, he must have the mathematics, mechanics and mechanism that precede it.

My third reason for suggesting that a degree curriculum in technical drawing would be a step forward is that such a curriculum is just what the college drawing department needs for its own professional development. We believe that drawing should be taught in a separate department - separate from the ME, CE, or any other department - wherever the size of the school will permit it, or where the administration can be convinced of it. It is argued that when the department is set up as an independent unit, it has a chance to obtain salaries and expenses especially for its work, and not as a step-child of some major department. The department can then be fully represented in the high councils of the university where its needs and aspirations may be presented, explained, and if necessary, fought for.

However, if such a department receives equal treatment, it does so as a result of unusual aggressiveness and against certain obstacles that are inherent in the set-up. The drawing department finds itself classified as a tool-subjects department, like chemistry, physics, economics, or mathematics. It is not quite in the same class, prestige-wise, as the major engineering departments. In fact, the drawing department may even find itself at a disadvantage compared to other tool-subjects departments, as well as the major engineering departments, because the drawing department alone does not grant degrees and in fact usually teaches little if anything beyond the freshman year. In mathematics, chemistry, physics, economics, mechanical engineering, and all the rest, the student can specialize in his chosen field and obtain a bachelor's degree or even continue to the Ph.D. degree.

Some illuminating reflections can be made from this situation that are again a little embarrasing to us. The teacher of chemistry, biology, English, electrical engineering, mathematics, or any of the rest, must be a specialist. They are expected to have, not just the B.S. degree, but at least the Master's degree and often the Ph.D. degree.

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(Continued from page 10)

Recently I checked the degrees of the staff of our Chemical Engineering Department and found that seven out of ten had Ph.D.degrees. I haven't checked other departments,and this may not be representative but it is clear that as regards degrees our drawing teachers are at a definite disadvantage - simply because other departments regularly grant degrees and we do not.

This is not to belittle the job performed by the drawing department in teaching the graphic language to all engineers,or to say that this function should not be regarded as important by our colleagues and administrative officials. But we are equipped to do a greater job,and I believe we can do it.

In addition to the service we can render in training teachers of drawing,and in addition to the administrative advantages to the department itself, such a curriculum is of great value in the professional development of our staff members. In drawing,it has been the rule to teach over and over two or three basic general courses. We enjoy teaching them,and they are very important. We have organized them to such a degree that other engineering teachers point to them as models of organization and presentation. However,we have time for only a few periods of technical sketching, a few more on multiview projection,a few on pictorial drawing,a few on dimensioning,and so on. You know how the time adds up. We have time only for a brief sampling of basic fundamentals,and many important things must be omitted altogether. Since it is not necessary for instructors to learn a great deal more than they teach, many are inclined to "get in the rut" as we say. Let us hope there are not too many in that category.

On the other hand,if the drawing department can offer, in addition to the usual brief and elementary courses,a complete curriculum including a comprehensive variety of drawing courses,the teachers in that department will have opportunity to teach not only some <u>different</u> courses,but <u>advanced</u> courses as well. This is bound to have a broadening and stimulating effect,and should make teaching drawing more challenging and interesting.

So much for the general line of reasoning that led to the degree curriculum in technical drawing. Most of these ideas had been in my mind for many years,and it was with some surprise when it occurred to me last spring that at our institution we were in a peculiarly favorable position to start something. The question, "Why don't we offer a degree in technical drawing?" had been asked many times by students who didn't know any better, and by teachers when they were in an imaginative mood.

We already had in our catalog a rather extensive list of courses in technical drawing. In the Chicago area,there is practically every kind of industry and there is a considerable demand in our evening classes for a wide variety of courses. Consequently,most of these courses have been offered in the evening,with relatively few students taking them in the day classes,except for the three major required courses. It occurred to us that it might be possible to build a curriculum in technical drawing which would make use of the courses we already had,plus a few additional new courses as needed. We already had in the college of engineering all the basic engineering courses needed in such a curriculum, and we had a department of education which could supply all the education courses needed to meet certification requirements.

This general idea was fully discussed at one of our weekly departmental staff meetings,and everyone was enthusiastically in favor of trying to put it over. A committee was then appointed composed of Professors I.L. Hill, Eugene Pare',and R.O. Loving,to prepare a tentative curriculum which would include the first two basic years of engineering,the sequence of courses leading to machine design,a wide variety of technical drawing courses,and all the necessary courses in education. This was quite a job, involving not only many courses in other departments,the creation of four new courses in technical drawing,but also state and city high school and junior college certification requirements. The curriculum they prepared is essentially the one finally adopted,as shown in the folder. Incidentally,the folder was issued by our Public Relations Department,and I hope you will not be frightened by my picture or offended by the flowery statements which publicity men seem to think necessary.

The next step was to contact the Chicago Supervisor of Drafting with whom cordial relations already existed,and ask him to sit in with us in Staff meeting and give us the benefit of his advice. He made several good suggestions and whole-heartedly approved the curriculum. I had the privilege of presenting the proposed curriculum before the Chicago Drafting Teachers' Section which met with us as our guests,and the idea was very favorably received. Chicago school authorities assured us that our graduates would have no trouble finding employment in the Chicago school system.

The next step was to contact the State authorities at Springfield to see if they would approve the curriculum. The Secretary of the Board of Examiners paid our department a personal visit and assured us of state certification for the high schools of the State of Illinois.

You might think that we were through by this time,but actually the big test was yet to come. We still had to get the approval of Illinois Institute of Technology,which means the powerful Curriculum Committee composed of the President, the deans,and all department heads. We had done the spade work,the curriculum was in as perfect shape as we could get it,and we had the advance approval of city and state authorities. The Curriculum Committee approved the curriculum unanimously,and directed that it be published in the next issue of the catalog.

Although the next catalog does not appear until next April,the program was started last fall with about a dozen students. Of course it is too early to predict the demand for this new curriculum,especially in view of unsettled world conditions. Nevertheless, we are going ahead.

It is a 4-year curriculum leading to a B.S. degree in technical drawing. The first two years are practically the same as mechanical engineering,including the mathematics through the calculus. In the last two years,the mechanical engineering courses are continued that lead to machine design,including dynamics,mechanics,mechanisms,and metallurgy.

Outside of the machine design sequence, specialized courses in mechanical engineering,such as thermodynamics,for example,are omitted and a wide variety of drawing courses are added,including technical sketching,lettering,architectural drafting,pictorial representation,advanced technical drawing,product design,structural drawing and topographic drawing. Also,to provide basic methods of teaching and to meet certification requirement for high schools,certain courses in education are given,including methods of teaching in high school,public speaking,practice teaching, visual aids,and methods of teaching technical drawing.

The curriculum is intended primarily to train technical drawing teachers for high schools,junior colleges, technical institutes,trade schools,and universities. Secondarily,since the curriculum contains about two thirds of the work for a B.S. degree in mechanical engineering,the graduates are expected to be in demand in industry in the areas of drafting and design,and in company training programs. If a graduate decides not to go into teaching he can,with about three semesters' additional work,obtain a B.S. degree in mechanical engineering.

The curriculum is now available in both day and evening classes during the year and in summer school. At present it is given entirely on a continuous basis where the student continues in school until graduation. Beginning next fall,the curriculum will also be available on the co-op basis in which the student may earn his way through school by working in industry one semester and going to school the following semester. This will take about five years to graduate,but he will have over two years of

(Continued on page 25)

Photo courtesy Westinghouse Electric Corp.

For communication outside normal channels

THERE are times when communication via ordinary channels is inadvisable or even impossible, and extraordinary means must be used. During war for example, secret ship-to-ship or ship-to-shore conversations are held by means of an infrared lamp which gives off invisible light. Its beams are modified by the current set up by a voice speaking into an ordinary microphone. These "modulated" but invisible beams are picked up by a detector photo tube as far as 10 miles away and transformed back into the voice again!

There are times when educators have to use extraordinary means to communicate with their students. Most of the work of education consists of just such "communication outside normal channels." This is the communication of ideals, enthusiasm, ambition, the idea of disciplined work toward a goal. Not in the curriculum, yet the most vital part of the educational process, when you have given a boy *these*, you have given him the *tools* to work with and all else is but the material he will work upon.

How give him these tools of the spirit? Not by saying: "Boys, let's be enthusiastic; let's have high ideals." Instead, example does it. One way is to make sure of the *material tools* that will be provided him . . . to make sure for example that the drawing tools used by a student of mechanical drafting suggest, reflect and *do not contradict* the ideas you are trying to communicate to him. Let careful craftsmanship *here* communicate the idea of careful craftsmanship *there*, in classroom work. Let the realization . . . that *these* instruments *if of professional quality* are used by great engineers . . . communicate the idea of greatness to the youngster. Example, *not contradiction*. And anything less than *fine* tools will contradict all you are trying to say.

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EVERYTHING FOR
DRAFTING AND SURVEYING

GRAPHICS IN RESEARCH

by

A.S. Levens[2]

It is well recognized that graphics is one of the important languages of the engineer and scientist. One need not dwell upon the usefullness of graphics in the preparation of engineering drawings, vector diagrams, charts, industrial illustrations, pictorials for texts, commercial brocchures, etc.

Many scientists who were engaged in the last world war effort have realized the importance of developing facility in preparing good, understandable, freehand sketches. Research personnel also appreciate the important part that graphics plays in the analysis and presentation of experimental data, and in the preparation of idea sketches for the design of equipment and measuring instruments.

It is therefore most essential that instructors in the field of engineering graphics should participate actively in research projects and seek every opportunity to demonstrate the effectiveness of graphic methods in solving problems that arise in this field.

If this is done, a broader interest in graphic methods and a fuller appreciation of their uses will be stimulated. And what is equally important, a much better job of teaching will result. Both students and instructors will experience greater enthusiasm for graphics and a desire to explore the wider scope of the application of fundamental principles and the further development of analytic power.

Recent research studies at the University of California have afforded the writer an opportunity to participate in problems concerned with the determination of magnitudes of rotation, displacement, velocity and acceleration. Reference is made to the Prosthetic Devices Research Project[3] which was discussed in a paper "New Horizons in the Field of Graphics"[4] presented at the summer school for engineering drawing teachers during the S.P.E.E. meeting at St.Louis in 1946.

This research project, which is still active, embraces the following:

(a) studies of human locomotion - the mechanics of motion of the legs, measurements of the ranges of motion in space, including rotations of the major segments of the legs during locomotion, and in particular, the study of the action in the major joints of the lower extremity, e.g., the hip, knee, and ankle joints;
(b) studies and analysis of the phase and action of the misculature;
(c) studies relating to factors contributing to the comfort of the anputes;
(d) muscle energy output in relation to locomotion, energy characteristics for design of artificial limbs.
(e) structural analysis, design, and accelerated testing of various types of leg prostheses.

A number of problems that arose in the studies of locomotion were best solved graphically.

Example 1.

The paper referred to above included a description of the technique used in determining the horizontal transverse rotation of the tibia (larger shin bone) and the femur (thigh bone) at the knee joint. Briefly stated, this consisted of placing 2½mm. stainless steel pins into the bones, attaching targets to the pins, and then photographing the motion of these pins during locomotion by means of three 35 mm. motion picture cameras, so positioned as to obtain horizontal, vertical and profile views. Fundamentally the problem reduced to "the determination of the angle between two skew lines."

Example 2.

Another problem consisted of the determination of the "tibio-femoral" angle. It was found necessary to measure the magnitude of the angle between the "tibia-plane" (defined by the axis of the tibia and the pin in the tibia) and the femur. This problem was solved by finding "the angle between a line and a plane." The solution is shown in Fig. 1. The tibia-plane is defined by points c,e,d, and the femur by line ab. Line ef is introduced parallel to plane II and in triangle cde. The true length of line ef is shown in the projection c_2f_2.

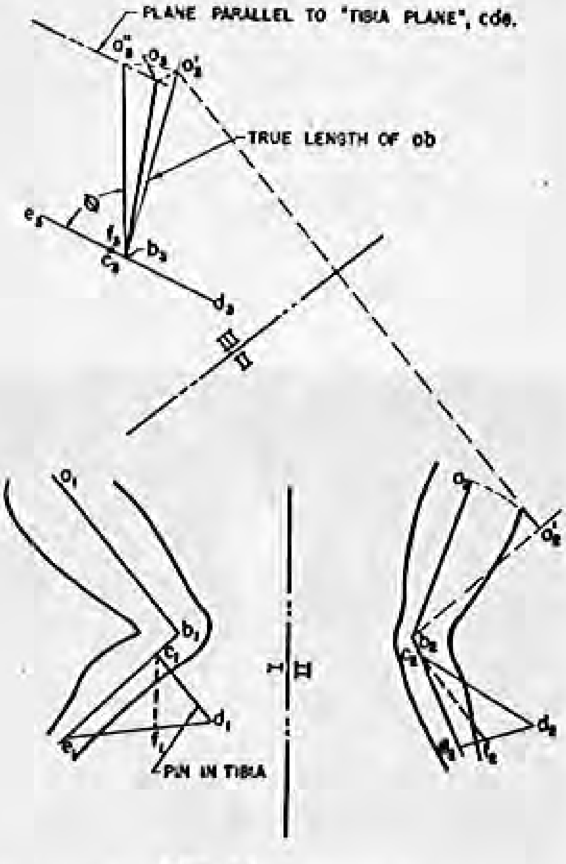

Figure I
Determination of Tibio-Femoral Angle

(Continued on page 14)

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[1] Paper presented at A.S.E.E. meeting, Seattle, Washington, June 19-23, 1950.

[2] Professor of Engineering Design. In charge of Engineering Graphics, University of California, Berkeley.

[3] The author is grateful to the Technical Director, Professor H.D. Eberhadt, for permission to use photographs and certain charts that appear in this paper.

[4] Published in the May issue of the Journal of Engineering Education, 1948. A more complete coverage appears in the Proceedings of the Engineering Drawing Division summer School, McGraw-Hill, 1949, pp 586-600.

(Continued from page 13)

Now, if plane III is introduced perpendicular to both II and line of, the "tibia-plane", ced, will appear as a line, and the projection of "femur" ab, will appear as a_3b_3. The required angle will be seen in the projection on plane III, where line ab appears in true length and point "a" is in a plane parallel to the "tibia-plane", ced. The true angle, ϕ is $a_3b_3e_3$. The method employed in the solution is well known, yet it is a striking example of the application of the fundamentals of orthogonal projection, coupled with correct analysis, to a problem quite remote from those ordinarily experienced in engineering.

Example 3.

During the early stages of the prosthetic devices research program, it was realized that studies of gait both in normals and in amputees would throw some light on walking patterns. It was felt that these studies would help determine normal or average gaits, and deviations from the normal.

Displacements in the vertical plane of progression of salient points of the leg were determined by an "interrupted light technique". The subject walked in front of the open lens of a camera which photographed small light bulbs placed at the iliac crest, the great trochanter, the centers of rotation of the knee and the ankle, and the heel and toe of the shoe. The field of view of the camera was interrupted by a slitted rotating disc so that the displacement pattern appeared to be small lights moving along the paths of the joints. A Kodatron speed lamp was used to obtain an exposure of the subject at mid-field for purposes of identification. Fig. 2 shows the results of this technique, and also, points joined to delineate the pattern of walking.

Figure 2
Normal subject, level walking - Locomotion Study using interrupted Light Technique.

Once the displacement-time data were available, it was then possible to compute velocities and accelerations. Velocities were calculated by measuring the distances between consecutive dots, correcting for the scale factor, and then deciding by the time interval 1/30 second. Accelerations were calculated by differentiating the velocity-time curve, i.e. by dividing the difference between consecutive velocities by the time interval. Fig. 3 shows resulting curves for horizontal velocities and accelerations of joints of the leg.

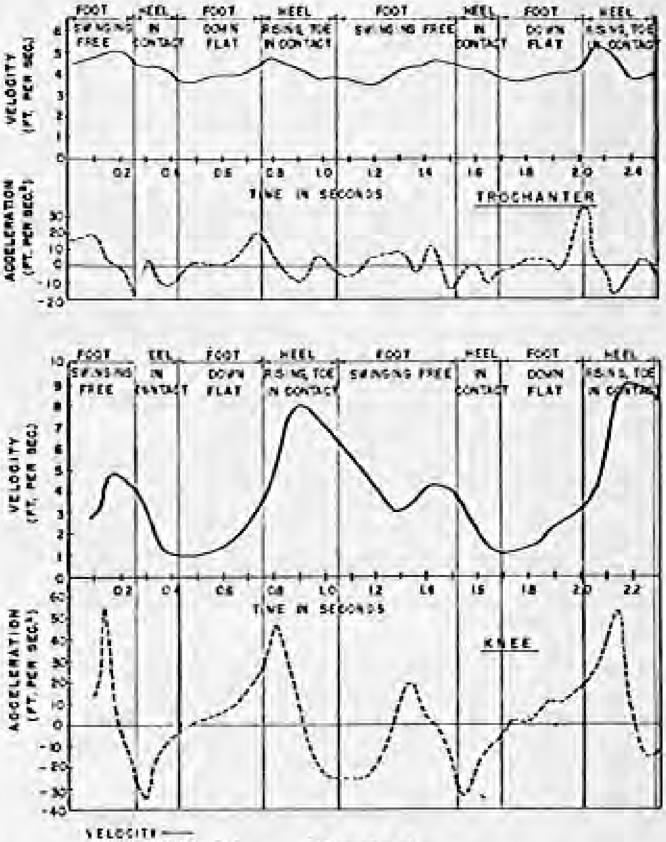

Figure 3
Horizontal Velocity and Acceleration of joints of the lef - normal level walking.

Another technique used consisted of photographing the subject with a 35 mm. motion picture camera while the individual progressed with small targets attached to salient points of the leg. In this case the targets consisted of solid black circles glued to a one inch square white adhesive tape. This is shown in Fig. 4. It was quite apparent that because of the relatively large targets, the numerical method of differentiation could not be employed satisfactorily. The displacement data, therefore, were plotted as a function of time, and a smooth curve drawn through these points. The method of graphical differentiation was then employed to obtain the velocity-time curve which, likewise, was differentiated graphically to obtain the acceleration-time relationship.

Essentially, the method of graphical differentiation consisted of the following procedure:

(a) Suppose a displacement-time curve were given as shown in Fig. 5.

(b) Assume a pole distance, OP, of four units (or any convenient distance).

(c) Introduce relatively short chords which closely approximate parallels to the tangents to the curve at points midway between the ends of the chords; e.g., chord AB closely approximates the direction of the tangent to the curve at point C. It should be noted that the chord length selected is a function of the radius of curvature.

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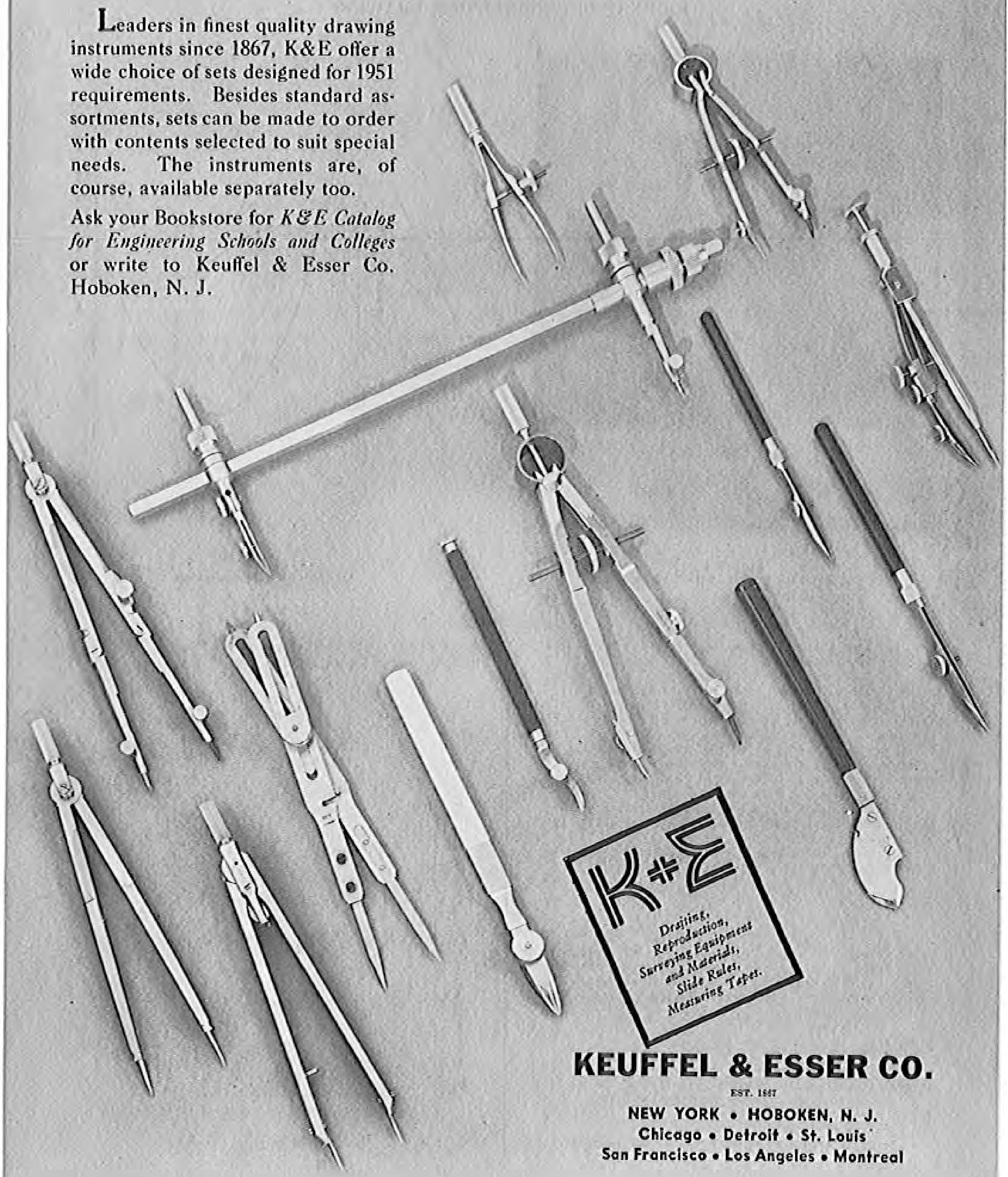

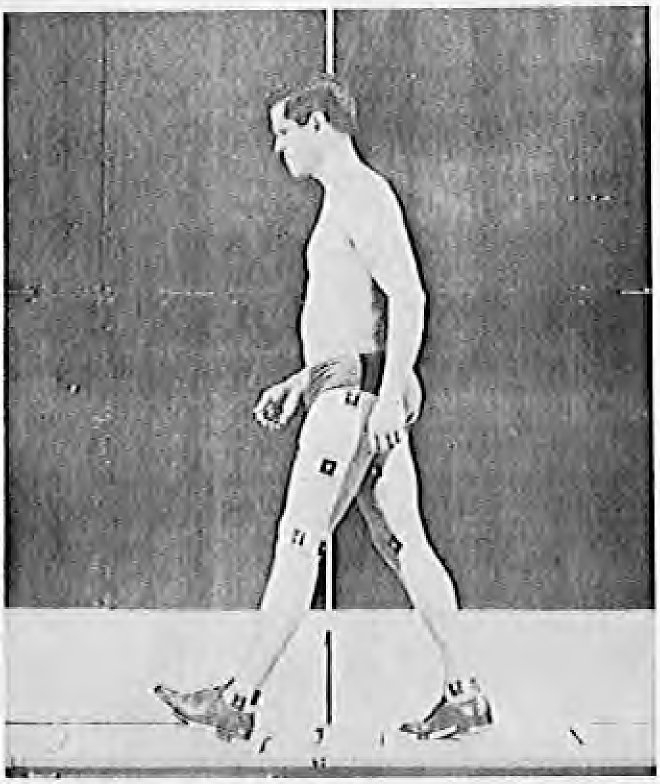

Figure 4
Subject with targets attached to salient points of the leg

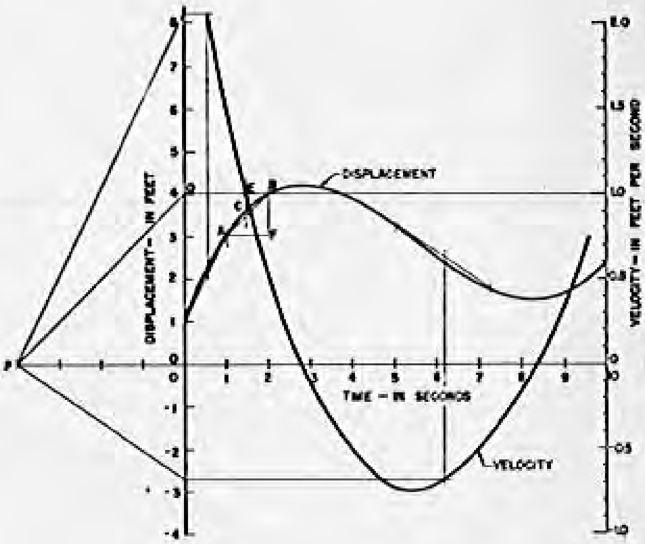

Figure 5
Graphical Diferentiation

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(d) Now, a line is drawn through point P parallel to chord AB, intersecting the ordinate axis at point D.

(e) The intersection of a horizontal line through point D with a vertical line drawn through point C locates point E, a point on the velocity-time curve. The slope of the curve at point C is one as read on the right hand scale. Graduations on this scale are equal to the values of the graduations on the displacement scale divided by the pole distance. As a check on the value of the tangent at point C, note that in triangle ABF, the tangent of angle B A F is one.

(f) Other points are located in a similar manner, and a smooth curve drawn through them to establish the velocity-time curve.

If the velocity-time curve were differentiated we would then obtain the acceleration-time curve.

Example 4.

The relationship between ankle angle, Θ_A , and angular velocity is shown in Fig. 6. Data were plotted for ankle angle vs. time. The curve drawn through these points was differentiated graphically to establish the velocity-time curve. The method employed was the same as shown in example 3.

Example 5.

The employment of the method of graphic integration is well illustrated in the determination of the vertical and horizontal components of acceleration were obtained from a force plate record of vertical floor reactions, and fore and aft shears.

Vertical acceleration is equal to the vertical floor reaction minus the body weight divided by the body mass. Mathematically the expression is

$$a_v = \frac{F_v - W_B}{\frac{W_B}{g}} = g\left[\frac{F_v - 1}{W_B}\right].$$

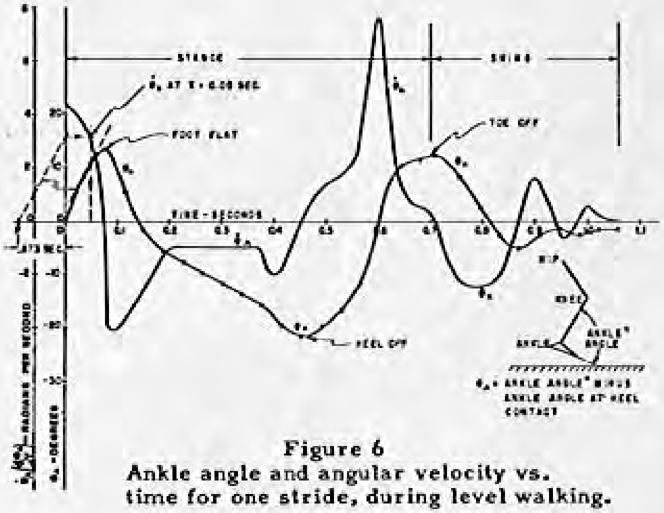

Figure 6
Ankle angle and angular velocity vs. time for one stride, during level walking.

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Points on the vertical acceleration curve were obtained from the vertical force curves shown in Fig. 7. At point A of the vertical force curve, the value is approximately 185#; and the body weight is 160#. The value of point A' on the vertical acceleration curve is

$$a_V = 32.2\left(\frac{185}{160} - 1\right) = 5' +/\text{sec}^2.$$

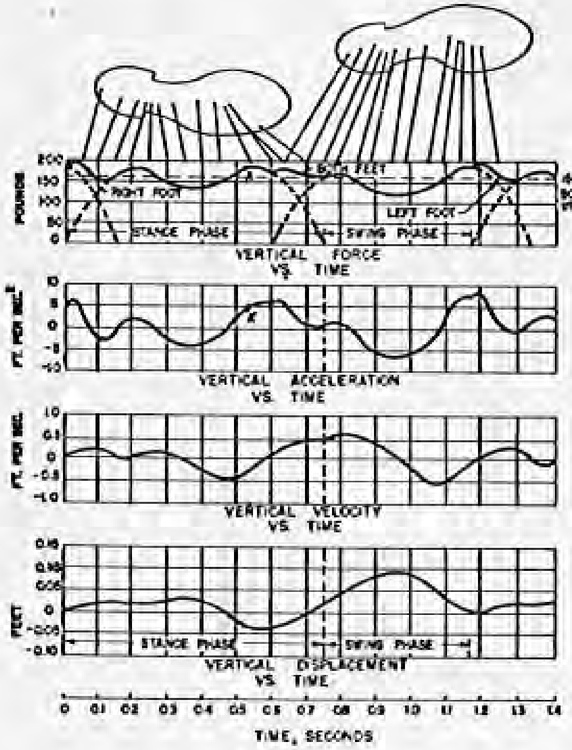

Figure 7
Motion of center of gravity of a normal subject during level walking. Data obtained from vertical floor reactions.

In a similar manner other points were located on the vertical acceleration curve. The third and fourth curves - vertical velocity and vertical displacement - were obtained by graphic integration; i.e., the velocity curve was determined by integrating the acceleration curve, and similarily, the displacement curve was attained by integrating the velocity curve.

The horizontal acceleration curve was developed from the fore and aft shear curve. See Fig. 8. Horizontal acceleration is equal to the horizontal force divided by the body mass. Mathematically the expression is

$$a_H = \frac{F_H g}{W_B}$$

At point B of the "fore and aft" shear curve, the value is approximately 10 lbs. The value of the corresponding point B' on the horizontal acceleration curve is

$$a_H = \frac{10 \times 32.2}{160} = 2'/\text{sec}^2$$

Once the curve for horizontal acceleration has been established, it is a simple matter to develop the horizontal velocity curve by integrating the acceleration curve. This is the third curve of Fig. 8. The latter could be integrated to determine horizontal displacements; however, this was not required in these studies of locomotion.

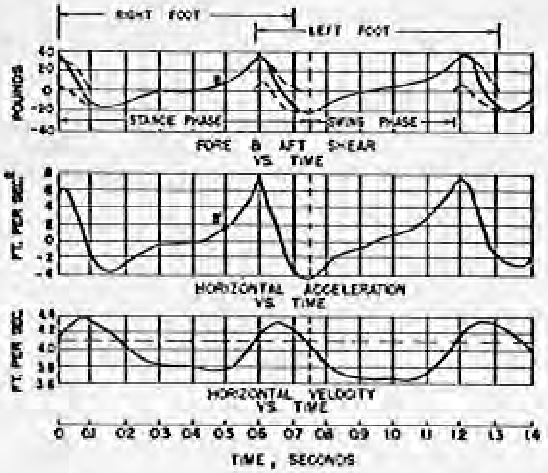

Figure 8
Motion of the center of gravity of a normal subject during level walking. Data obtained from fore and aft floor reactions.

Example 6.

A very interesting phase of the project dealt with studies[1] relating to below-elbow amputees.

"For many years it has been considered logical and ideal to power and artificial hand or hook by means of voluntary contraction of residual muscles of the arm rather than by body movements such as the shoulder shrug. The problem of a durable and efficient linkage between the muscle and the moving mechanism of the prosthesis appears to be solved by the construction of a muscle tunnel. This is a surgical procedure to provide a skin lined tunnel through the muscle, into which a pin is inserted with cables attached. Contraction of the muscle displaces the tunnel and the pin transmitting force for prehension to hand or hook."

"The biceps muscle tunnel is of greatest value in the below-elbow amputee. In this type of amputation the entire length of the biceps is available and provides adequate excursion to activate the prosthesis."

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[1] Details appear in a brochure, "Biceps Cineplasty and Prosthesis for Below-Elbow Amputations," prepared by Prosthetic Devices Research Project, University of California, Berkeley or Los Angeles, California.

DRAFTING PROBLEMS ENCOUNTERED IN STRUCTURAL STEEL FABRICATION

by

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The title of this paper "Drafting Problems Encountered in Structural Steel Fabrication" lends itself to more than one interpretation as to the context of this writing. I shall treat this subject from the standpoint of the drafting department of a structural steel fabricator considered as a definite unit of the business and shall discuss the many problems involved in the operation of this unit. In preparing this paper, I want to acknowledge the helpful advice and council of Mr. M.R. Van Valkenburgh, whose many years of experience in this field have made him a recognized authority.

Since structural steel in its final fabricated form is almost invariably incorporated in structures wherein public safety or public health is involved, it becomes necessary to provide that its design,fabrication and erection be done by or supervised by Professional Engineers. All forty-eight States have statutes which generally place this responsibility in the hands of Registered Professional Engineers. In this three-step process of design,fabrication and erection,the structural steel fabricator holds a key position. It is his responsibility to faithfully carry out the requirements of the design drawings through his own processes,which substantially consist of two steps; the making of shop details and actual shop fabrication. For fear of over-simplification of this process, let it be stated that the entire structure of a structural steel fabricators organization is complex and intricate, requiring major financing,much experience and the application of professional knowledge and special skills.

The purpose of the preceeding observations is to place the making of shop details - the drafting department in this organization - in its proper and vitally important place in this process of design,fabrication and erection of structural steel. In its own organization, the drafting department,to quote from the recent handbook on Structural Shop Drafting published by the American Institute of Steel Construction,is "the hub around which all operations turn".

The one purpose of the drafting department is to intelligently interpret plans and designs prepared by practicing Professional Engineers and to convey these interpretations into structural shop details,which when used to process structural steel shapes,will result in a structure which will be a faithful reproduction in steel of the designing Engineers plans.

The conventional organization usually consists of a Chief Engineer, a Chief Draftsman,checkers and detailers, wherein the Chief Engineer is the general executive director of the drafting department as well as the Engineering Executive for the entire organization,with the Chief Draftsman in direct charge of the management of the drafting department and scheduling the work so that orders are processed in the proper sequence and in such a manner that the talents of his men are used to the best advantage. It is under the direction of the Chief Draftsman that all shop details are made and it naturally follows that he is responsible for the accuracy of the drawings,maintaining of standard procedures,and the solution of technical and mathematical problems.

It would appear that a drafting department,to operate with the most efficiency,should be manned by Engineering ing graduates with years of experience. However,from an overall standpoint,the tasks to be performed vary from the most menial and relatively simple to the most intricate and involved, and therefore, under professional supervision, it is possible from a standpoint of economy to use men of lesser education and experience in the lower bracket and men of more experience and education in the upper bracket. One of the problems of a drafting department is proper balance of experience to inexperience and a balance in the various levels of education.

It would be possible to operate a sizable structural drafting department composed of draftsmen whose education extended very little past high school,provided the experience factor was in the proper proportion,but very few fabricators would want such an organization. Structural steel is purely an engineered product and one of the most important points of control,the preparing of shop details, cannot be entrusted entirely to the laymen. Therefore it becomes necessary to have in the drafting department organization a sufficient number of key personnel who are Professional Engineers and who have sufficient experience to give them an easy and ready knowledge concerning the engineering plans with which the department is working. These men are usually assistants to the Chief Draftsman or are checkers or squad leaders. The importance of engineering knowledge and experience in the drafting department cannot be overestimated,for it is easily possible for serious weaknesses in the finished structure to develop through ignorance of engineering principles while the shop drawings are being made. It is true that it is customary for the designing Engineer to check the shop drawings upon completion to see that all connections are safe and that all framing is handled properly before the drawings are placed in the shop for fabrication. Such checking, however, is a tedious chore, and many designing Engineers only give the drawings a rather rough check and rely upon the fabricator to have a drafting department of high enough professional level to eliminate connection and framing errors and at the same time possibly catch some errors the Engineer himself might have made. Such practices are probably frowned upon by the elite in the Consulting Engineering field who operate large organizations,but still a large number of smaller operators to some extent rely upon the professional knowledge and integrity of the steel fabricator. Since the steel fabricating business as an industry is solidly founded and relatively free of "in and outters", most fabricators have built their drafting departments along such lines that they are capable of assuming the responsibilities just described. The exceptions are small shops which have sprung up with the advent and universal use of electric arc welding wherein the equipment needed, if the projects are chosen for the purpose,is hardly more than acetylene torches and electric welding machines. This is not at all intended to be a criticism of these processes but shops capable of fabricating only by these methods have a relatively small financial investment and have generally been operated without professional services. If the element of engineering is eliminated, such organizations are wholly incapable of being entrusted with the fabrication of structural steel.

In order to maintain such an organization,many steel fabricators follow the practice of employing young College graduates just out of school to begin work in their draft-

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(Continued from page 18)

ing departments. Experience and the normal turnover in personnel which occurs in any organization generally allow these men to advance to positions of responsibility in a few years. At the same time, it is generally necessary to employ young men of lesser educational background who generally come under the direction and supervision of the Professional Engineers in the organization. Engineering graduates who eventually intent to go into the Consulting field can find no better background for their future professional life than a number of years in the drafting department of a structural steel fabricator. One consulting Engineer known to me, who maintains a sizable organization, will not employ a young engineering graduate unless he has served several years with a structural steel fabricator, and this point is made to further emphasize the existence of engineering practice, responsibilities and atmosphere that exist in the making of shop drawings.

The structural steel fabricator does not object too strenously to providing a training field for engineering graduates who intent to go into Consulting Engineering work and other allied fields provided he can have these men long enough to recover some of the investment he puts into them during the first year or year-and-one-half of their employment. It is difficult to set a time limit which differentiates between inexperience and experience in the field of structural drafting and naturally opinions vary. However, it is generally felt by many steel fabricators that a college graduate after one years employment is then ready to absorb good solid experience at a rapid rate and could be considered an experienced detailer at the end of two or three years when under the supervision of Engineers who have been in the business a considerable length of time. For the non-college graduate, the time schedule would have to be multiplied by two or three plus outside study and such personnel would generally not be capable of rising above a certain level. Heads of Engineering Departments in colleges and universities sometimes advise their students in structural design to get their first experience with a steel fabricating company. I know of one individual in his capacity who has followed this practice for many years.

In training engineering graduates, the fabricator is confronted with a number of problems. One of them which is almost immediate is to eliminate from the mind of the new employee any idea that he is expected to know anything about the steel fabricating business in general or about structural drafting in particular. I have found that it is a good idea to advise him that his engineering degree is evidence enough that he has studied and has been found proficient in the basic courses of mathematics, physics, mechanics and the basis courses of this engineering major. It is also well to advise him that these courses comprise his formal education and that the fabricator is not equipped to carry these on any further on a formal basis, but that his education has given him the capacity to properly absorb and benefit by the experiences which will come to him. A surprisingly large number of graduates will become discouraged and change to some other field if they are not given assurance such as described, that their inability to produce immediately after graduation is natural and expected. As an overall average, a young engineering graduate can be expected to turn out structural shop drawings profitably at the end of one year. Even so, he would be limited in the type of detailing he could do. If the work of the fabricator with whom he is connected is of a general nature and covers most types of structures, he can be expected to become rather expert at the end of four or five years. To the uninitiated, it does not seem reasonable that so much time should be required, but as pointed out earlier, the steel business if of a complex nature and in order to reach mature experience, it is necessary to absorb many intangibles in addition to mastering the concrete operations. Although I am sure that the engineering schools endeavor to teach their engineering students something about the steel business as a whole, I still run into graduates now and then who do not have a very clear conception as to the difference between a steel fabricator and a steel mill. Of course, misconceptions such as this might be corrected by a word or two, but there are literally hundreds of such situations and minutiae where only time and experience can give to a person a quick and easy knowledge. Field trips in the senior year in college are a great help in fixing in the students mind the results of engineering practice and its contribution to society, but it is equally important that these trips be planned very carefully. The time alloted to these trips, from my observation, is usually short and as a result, plant or project visitation is hurried and somewhat ineffective. Plant or project officials are usually willing and cooperative in giving their time to these field inspection trips, but I know of several individuals including myself, who have felt that the hurried atmosphere caused by a crowded and tight time schedule, did not permit a thorough briefing on the project or process and as a result, the knowledge gained was too cursory to be of much value. It is of great interest to structural engineering students to see engineering structures in the process of building, but since steel is the basic material with which a structural engineer works, I feel that it is most important that a structural engineering major have in his field inspection schedule an unhurried trip through a steel mill to see where and how steel is made into usable shapes, and then go through a steel fabricating shop including the drafting department, spending enough time to actually see how these shapes are made into usable structures. I feel that such inspection trips as just described are actually more important to the structural engineering student who does not intend to work for a structural steel fabricator, for if he does not avail himself of this opportunity while in engineering school, the chances are that he will not do so later.

In starting an engineering graduate in structural drafting, one of the problems is to teach him to read engineering and architectural plans. Unfortunately this cannot be done in three easy lessons, and as a matter of fact, this might be the crux of the whole matter of structural drafting, for if a person can interpret accurately and in detail engineering and architectural plans, it is much less difficult for him to convert these interpretations into shop drawings. Some of the most costly errors made on shop drawings and not discovered until the steel erector has endeavored to put the steel together on the job, have been caused by a misinterpretation of the engineering plans. Sometimes this is carelessness on the part of several people, but many times it is due to ignorance of plans. Mark Twain is said to have remarked that "a man endowed with ignorance and self-confidence is sure of success". This of course was said facetiously and may even have some degree of truth for some lines of endeavor, but in structural drafting such a philosophy is certainly false. In fact, ignorance or inexperience will come out quickly in the drafting room, and the man who tries to bluff his way will be caught before sunset. Starting at the beginning of an engineering education, the foundation of reading plans and making understandable drawings is laid. I speak of such courses as engineering drawing, descriptive geometry and the basic courses in mathematics. Often these courses are touched upon only lightly during the remainder of an engineering curriculum and as a result are largely forgotten by the student by the time he graduates, only to suddenly find upon obtaining employment, that the ghost he rid himself of many years before has miraculously come to life again.

(Continued on page 23)

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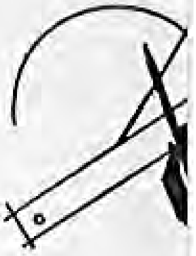

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This volume is a collection of charts found by the author to effect considerable savings in time in routine work. Not intended as a handbook or a text, this book instead offers the engineer valuable charts in many topics which eliminate the necessity of looking up in tables the values of the various items that enter into a problem. Charts cover: Function Scales-General Charts-Hydraulic Charts-Mechanics Charts-Thermodynamics Charts-Electrical Charts.

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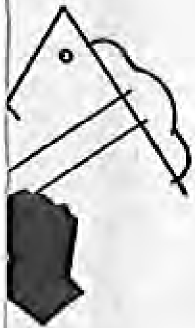
GEOMETRY OF ENGINEERING DRAWING

By George J. Hood, University of Kansas. Third Edition. 365 pages, $3.50

Two decades of widespread distribution and use have definitely established this pioneer work as one of the leading standard texts in the subject. It was the first text to introduce an entirely new method of teaching descriptive geometry. This was the "direct method" as opposed to the older method using projections and planes of projection. The "direct method" adopts the procedures, vocabulary, and attitudes of mind used by the engineer when he visualizes and designs structures. This book explains the basic theory and principles of the relations between adjacent views, and of the geometrical relations between the elements of structures. Essential techniques are also explained, rules avoided, and the need for visualization continually is stressed. Problem sheets for the text are available for $2.00.

TECHNICAL DESCRIPTIVE GEOMETRY

By B. Leighton Wellman, Worcester Polytechnic Institute. 508 pages. $4.50



This popular book provides students and industrial draftsmen with a complete up-to-date treatment of the important subject of descriptive geometry. Written in simple language and generously illustrated, the book covers the subject thoroughly, beginning with the most elementary concepts and progressing by easy stages to the complex intersection and development problems found in modern applications. The whole approach to the subject is new. By classifying all views simply as "adjacent" and "related," and emphasizing the direction of sight for each view, the author develops the entire subject simply and logically without reference to imaginary planes and projections.

APPLIED DESCRIPTIVE GEOMETRY

By Frank M. Warner, University of Washington. Third Edition. 238 pages, $3.00

This widely used standard text is well liked because it presents descriptive geometry from the point of view of practical drafting-room use; because it emphasizes the direct view method; and because it includes a wealth of illustrative problems covering all branches of engineering with engineering settings and data as they occur in actual practice. This edition also incorporates a new and improved method for finding an intersection of cylinders. An *Applied Descriptive Geometry Problem Book*, containing over fifty excellent work problems, presented in an oversized format with folding sheets to fit the standard-sized notebook, is available.

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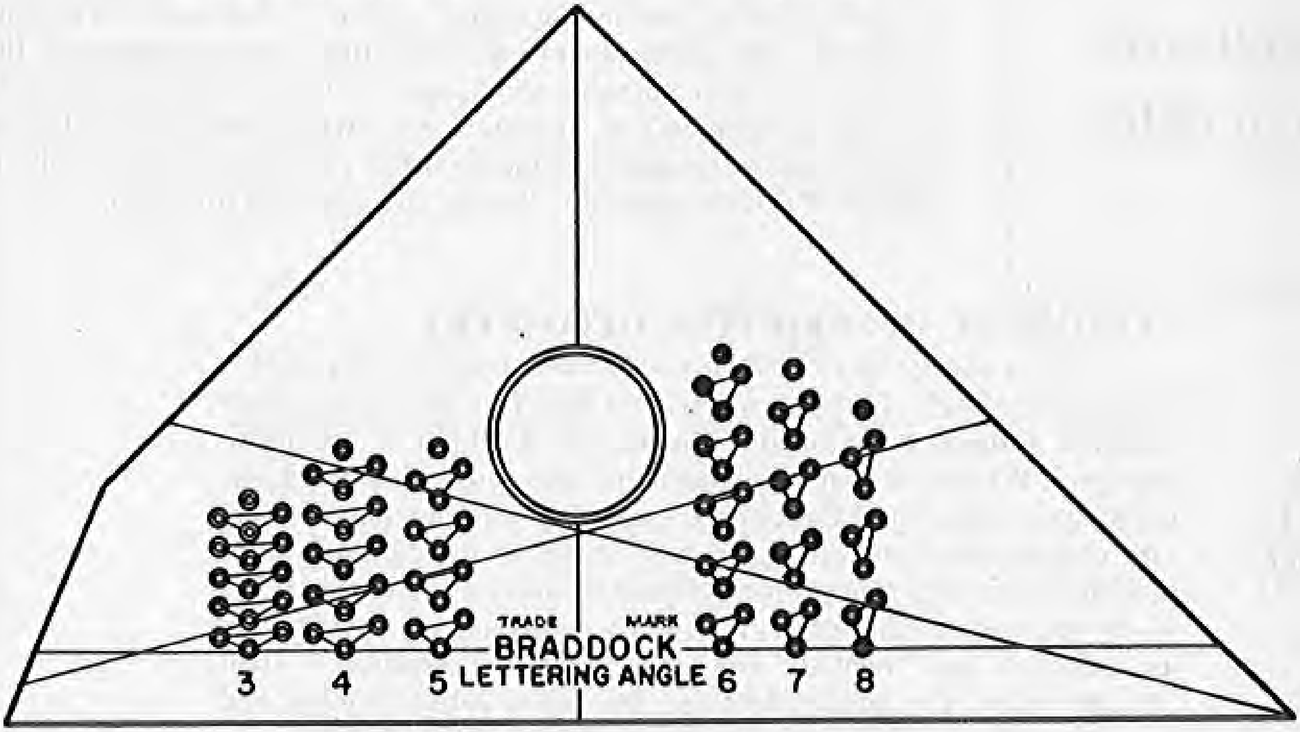

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(Continued from page 19)

I know that educators are hard put to squeeze into four years the bare necessities of an engineering education, but some means should be found to keep fresh these basic courses.

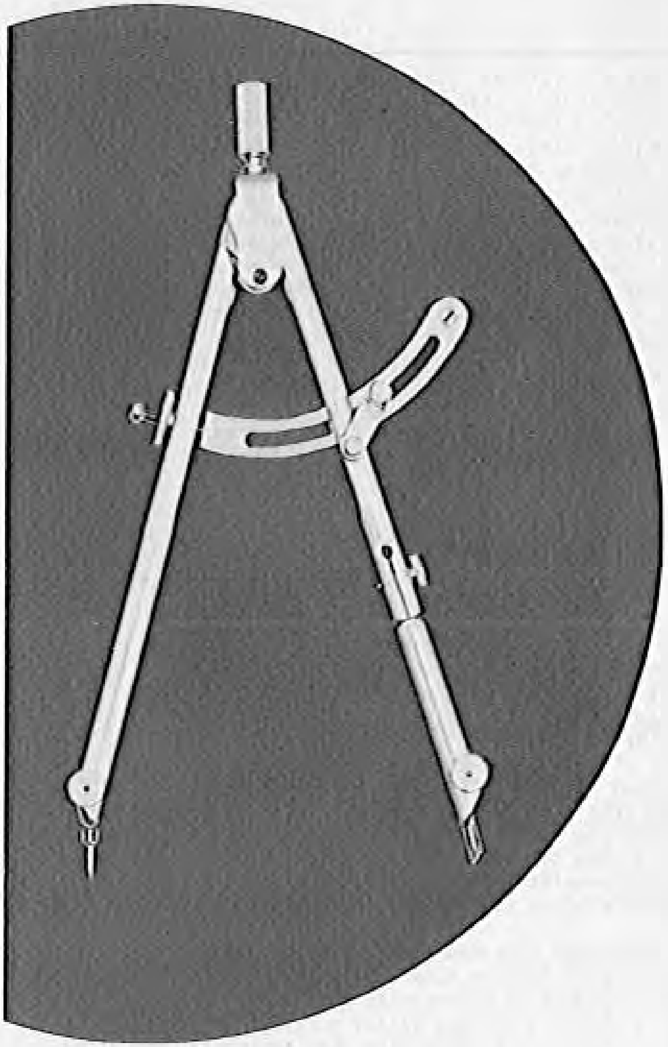
A steel fabricator has a problem when it comes to interviewing with reference to employement a young man who is about to graduate. I have interviewed many of these students,who at the time of the interview were finishing their senior year and were involved in intricate engineering problems which later would only be entrusted to those of long experience. I am then confronted with the unpleasant task of informing them that to begin in the steel business it is necessary to go back four years and take up drafting again. I am serious when I say that this comes as a shock to four out of five students,and more often than not causes the student to search in other fields for employment. Some people consider drafting one of the menial tasks of engineering and if followed without professional knowledge,the person may be no more than a stenographer of the drafting board,merely putting down what others dictate. If this be true,it must be stated however, that such dictation is not done orally,but is transmitted through drawings,and I submit to you that an engineer who cannot express himself through intelligent and legible drawings is in no better position than a doctor who could not put down in writing one of his prescriptions for others to fill,but would have to go to the drugstore and mix it himself.

In training for structural drafting,the best teacher is experience although books of standards and outside reading are aids. One of the most prevalent shortcomings in individuals in this work centers around those things taught in descriptive geometry and similar courses. The Encyclopedia Britannica in dissertating on the subject of descriptive geometry states that "it is the means by which the designer conveys his ideas to the builder or mechanic,and has been called the universal language of the engineer". Further than that,it tends to develop in an individual a sense of perception which makes it possible for him to form and visualize in his mind three dimensional objects taken from what he sees drawn on two dimensional paper. Some people have this ability as a natural aptitude and others have to develop it through study and practice,but whether acquired or natural,the structural draftsman must somehow achieve an easy and comfortable use of this faculty.

The more advanced structural shop drawings are considered such because they incorporate some of the more intricate phases of descriptive geometry. Under this heading is included hip and valley work,bins and hoppers, various types of storage tanks and numerous other situations where steel members are framing at angles with each other and in several different planes. The usual procedure in training draftsmen is a block on top of block process beginning with the simple and elementary and progressing towards the intricate and complex. Some fabricators however who do a specialized line of work, are able to get out rather involved workutilizing draftsmen of limited overall experience by having experienced engineers to break the work down into component parts which are then detailed along formulated lines. Detailers thus trained are often of very little value except to those specific types of work.

The larger steel fabricators,especially those of national scope, have very definite standards which form and control the method of preparing shop details. These standards will vary from one company to another, and although none of the basic principles of engineering drawing will be violated, certain conventional methods will be set down which cannot be found in any textbook. Smaller fabricators have generally taken one of three routes; followed the standards set out by one of the larger fabricators; developed at quite some expense a book of standards of their own; used a hodgepodge of methods with every newly employed draftsman who has experience bringing ideas of his own. Smaller fabricators in the last category are quite numerous and the hardships worked on their shops by not having definite standards is considerable. The business of operating independent detailing offices for the purpose of preparing shop drawings for a number of different fabricators is on the increase. Fabricators who use these services generally maintain a basic drafting department, and then "farm out" to these independent agencies such shop drawings which are above the capacity of their basic drafting unit. Such services are a convenience to the fabricator as it keeps him from having to expand and contract his drafting department according to the volume of business he is able to secure. Such "farming out" however, brings up the problem of standards and method of detailing. The independent detailer may be working for a dozen different fabricators and he is faced with the dilemma of using his own standards or conforming to a particular fabricator's standards either through study or conference. All of this brings me to the point of making the statement that the time is full ripe for the establishment on a national scale of a standard practice of detailing structural steel and the conventions pertaining thereto. The American Institute of Steel Construction has recently published a book entitled "Structural Shop Drafting, Volume I" which is a step towards standardization on a national scale. This book is called a "textbook" and it is intended to assist in training men in the field of structural drafting, but it does not set down detailing practices except in a general way. It is my understanding that a Volume II is to be published later which will establish standards and procedures. The success of such a move will depend largely upon the degree of acceptance by the industry, and especially by those who have for years followed well established standards of their own. Volume I is authoratatively written and contains enough material on structural design to warrant it being used as a supplementary textbook in senior structural design courses.

In conclusion it can be said that the steel fabricating business occupies one of the pivotal points about which the construction industry revolves and it is good that the fabricators have organizations directed largely by Registered Professional Engineers who are capable of taking fine engineering designs prepared by Consulting Engineers and converting them faithfully into steel structures. Such work is very satisfying and challenges the best engineering talents. The steel fabricating business offers the young graduate an authoritative continuation of his engineering education,and though it does not promise him a disproportionate compensation,it does hold for those with ability and a desire to work many opportunities for advancement into the executive field. The steel business needs and deserves the sharpest men the engineering schools can produce and although the industry can compete for these men on an equal basis with other fields,students have too often been advised that other divisions of engineering were more lucrative. It is hoped that through the medium of such groups as this one, that authoritative information concerning various branches of industry can be disseminated to the students so that they might make their decisions without prejudice or false impressions.



SLIDE MAKING AND ITS USE AS A VISUAL AID

by

Thomas Hingsberg
New York University
New York, N.Y.

The full use of the slide is never attained unless the teacher "makes his own". The film and camera manufacturers have made the process very simple. The 35 mm camera is most efficient for it has quite a depth of field. To the 50 m.m. lens many supplementary lenses may be added for close work.

A device to support the camera and lights, which also frames the picture may be made of furring strips or of stock ½x1¼ or so. All joints may be housed or half lapped, glued,nailed,and fastened with screws and strengthened with metal straps or angle irons.

A "u" frame is made. To the ends of the "u", two strips are fastened at right angles. A crossbar is added to the ends of the strips to support the camera and lights. The "u" frame is made the field size or object size to be photographed. The strips attached to the "u" are made long enough to provide for the camera to object distance. The crossbar is built out to bring the center line of the camera in line with the center of the object photographed. A circular mirror may be used to check this alignment. If it is placed on the object center it reflects the barrel of the lens above it. When the image of the barrel is concentric with the mirror edge, the alignment is complete. The camera is held with a ¼+20 thumb screw which will fit into the Camera's tripod socket. Two lights one on either side are clamped to the ends of the crossbar. The lamps are reflector floods or 100 watt bulbs placed in reflectors. The subject, whether light or dark, will dictate the type of illumination needed. The lights are pointed at the object at about 45° to the camera axis to avoid reflections into the camera lens. They are hung at or above the camera level.

The "u" frame is made equal a bond sheet 6½x11. A supplementary lens of 2+ diopters is placed in a Series VI ring over the camera lens. The lights and the nearside of the supplementary lens are placed 18 inches from the object. The camera is focused at 15 feet. If Panatomic X film is used, black and white line work is exposed for 1/10 sec. at F8, and developed in D11 for five minutes and fixed and washed as usual.

A kit for a half a bond sheet, 6½x8½,may be made to fit within the "u" frame. Typing done on this size will show up well on the screen. It is well however,to back the sheet with a carbon paper to make the typing more opaque. A 3+ lens is needed for this size. The face of the ring is set 12" above the object taken. A separate crossbar may be made to hold the camera. Keep focus at 15 feet, stop at F8, and expose for 1/10 second.

If two supplementary lenses, a 2+ and a 3+ are combined in an adapter ring,the object size is a quarter bond sheet,or about 4"x5". The camera is placed with the adapter ring at 8" from the object taken. The dimensions given are to be used only as a guide. A test film should be made to make necessary adjustments in exposure and distances.

Many lecturers repeat the text assignment so well that the brighter students need never "crack the book". All except the interested student wait until an examination is scheduled and then "plug".

It is better to motivate the student to an active participation with "heart and mind" in the subject matter. There can be no genuine learning without an emotional settling. The inherent qualities which motivate the learning process are, the desire for approbation, to excel, prestige, social approval, curiosity and discovery,and that interest which begets work and that successful work which begets interest. The student must be encouraged to plan, to seek, discover for himself, to challenge and to be challenged in his reasoning and conclusions.

The slide as an aid can help. It can poise a problem to stimulate interest and curiosity. It can picture the historical development of the subject showing the challenges which led to trial and error approaches establishing hypotheses and why some proved false. It can demonstrate with step by step procedures. Charts, graphs, formulas and their derivation worked out and hand book uses in design may be shown. In fact much of the blackboard work usually done during the lecture may be done better and in greater detail on bond paper and photographed. Much class time is saved thereby.

The thoroughness of the student's preparation on the text assignment may be tested with objective test methods. A few questions may be flashed on the screen and answered on squared paper. Time for answering the questions may be considered a factor of success. A slide may be prepared showing the correct answers with which the student may check his. Usually a lively discussion period will follow this procedure.

The slide may be used to show how lecture notes should be taken, how the notes stress essentials for review, how the student should note his own critical reflections to the points given, as well as doubtful points which he will look up or question in the discussion period.

The instructor may show his own notes which he may arrange in a logical or psychological order, giving aims, objectives, procedures, and the timing set for each phase, together with supplementary reading and sources of his own experiences, or that of others used to illustrate the work. This will show the student how he is to prepare his text assignment and written summary of his work.

If the instructor can draw freehand with an ordinary thick point fountain pen loaded with black ink, can make sketches in perspective or isometric,or can illustrate a point with a cartoon; and this is not difficult to learn or to do, and will make his drawings on a half bond sheet and photograph them, will have a lot of fun doing them. He will find his students enjoying the work more.

The slides may be projected in strip film or singly. A daylight screen in a necessity for the best use of the slide.

(Continued from page 11)

industrial experience which we think the drawing teacher needs perhaps more than anything else. All jobs are arranged and supervised by the Co-op Office,and will include drafting,elementary design,machine shop work,and others directly related to technical drawing.

It is our plan to add graduate work in the very near future, but first we want to firmly establish the undergraduate program. Once this is done, we feel that it will be comparatively easy to add graduate work leading to a Masters degree.

MINUTES OF THE EXECUTIVE COMMITTEE OF THE DRAWING DIVISION OF ASEE

by

C.H. Springer, Secretary

At dinner was held at Bryan,Texas,near College Station,previous to the Executive Committee meeting.

The meeting was called to order by Chairman R.S. Paffenbarger at 9:05 p.m., January 18, 1951.

Those present were Professors Askhus, Hoelscher, Lee, Spencer, Brattin, J.G. McGuire, Porsch, Vierck, J.S. Rising, Lagaard, Heacock, Svenson Rowe, Luzzadder, Potter, Hill, Springer, and Paffenbarger.

Chairman Paffenbarger discussed the possibility and desirability of electing a vice chairman.

It was moved by Askhus and seconded by Hill that the following amendment to the rules of procedure be submitted at the annual meeting:

Article IV. Executive Committee. The affairs of the Division shall be administered by an executive committee consisting of:

(Change) 1. Chairman of the Division-advanced from position of vice chairman.

(Add) 2. Vice Chairman - elected for one year.

Article V. Duties of Officers.

(Add) 2. Vice Chairman

- a. He shall serve as vice chairman of the Division and Executive Committee for the year following election.
- b. He shall preside over meetings of the Division and Executive Committee in absence of the chairman.
- c. He shall assist the chairman in the operation of the Division.
- d. He shall keep informed on the current problems and operation of the Division so that he may continue to carry out the work when he becomes chairman.
- e. He shall assume the chairmanship of the Division for the year following his term as vice-chairman.

The motion was passed unanimously.

Chairman Paffenbarger announced the appointment of the following committees:

Policy Committee

Prof. F.G. Higbee
Prof. R.P. Hoelscher
Prof. Justus Rising

Local Committee for the 1951 Summer School

Prof. C.L. Brattin
Prof. C.W. Fairbanks
Mr. N.R. Sedlander
Prof. R.O. Ringoen
Prof. P.O. Potts
Prof. J. Gerardi
Prof. R.T. Northrup

Teaching Aids

Same as current,Prof. H.B. Howe,Chairman

Display of Student Work

Prof. J. Gerardi
Prof. J. Rising
Prof. H.P. Skamser
Prof. J.G. McGuire
Prof. T.C. Brown

Instruments and Display of Instruments

Prof. R.T. Northrup
Prof. R.W. Grant
Prof. Freidman
Prof. J.H. Porsch
One other from Michigan State

Chairman Paffenbarger announced that our budget is ample to cover the expenses for the summer school so that no additional fee will be necessary.

Prof. Brattin reported on conditions at Michigan State for the summer school and annual meeting. There will only be one registration and registration fee for the summer school and the annual meeting.

There will be ample accommodations in dormitories,one of which will house 1400 and another 900.

The displays will be in large drawing rooms.

Edwards Bros. will give a price on reproducing proceedings,but the consensus of opinion was that everyone presenting a paper should provide enough copies for everyone. Prof. Svenson suggested that these copies be sent in advance so that they could be collected into sets to be passed out at the end of the meeting. This was informally approved.

Approval was given to send copies of the Journal to all Vice Presidents of the Society.

Professor Luzzadder presented a financial report for the Journal which is attached to the minutes. The report showed all bills paid with $1,107.34 in the bank.

Considerable time was spent discussing the program for the summer school and annual meeting. It was decided to have panel discussions of the papers definitely limited as to time. It was also decided that there should not be more than two or three papers at any one session.

Professor Street moved that Professor Paffenbarger be empowered to proceed with the arranging of the program,which was seconded by Professor Porsch. This was approved.

The meeting adjourned at 11:55 p.m.

(Continued from page 7)

College officials point that the current construction program, impressive as it is, only makes good in part the accumulated deficiencies of years. Until the current state-financed program was undertaken in 1946, not a single classroom or laboratory structure had been erected on the Spartan campus at state expense since 1931.

There is an urgent need for many additional structures, among them a new library building, and an animal industries building.

Although Michigan State has greatly expanded its physical facilities since the war, the natural beauty of the Spartan campus, known the world over, has been maintained. Visitors to the campus are immediately impressed by the careful planning which has preserved the full beauty of such natural landmarks as the Beaumont Oval--its many varieties of trees and expanses of rolling lawn; the Red Cedar River, which divides the main campus from South Campus; the Beal Pinetum, just east of the campus proper; the Beal Botanical Gardens; and the Horticultural Gardens.

Along with its natural beauty, the Michigan State campus has a cosmopolitan personality. Its students come from every walk of life and from every part of the world. Included in its enrollment each year are students from every state in the nation, and from more than 50 foreign countries and U.S. possessions. Even with this wide-spread geographical distribution, Michigan students still constitute about 80 per cent of the campus enrollment.

Michigan State College has always endeavored to maintain a top-flight teaching faculty to administer these courses. The Spartan faculty is studded with national authorities in almost every field.

An important factor in Michigan State's growth has been the dynamic leadership of President John A. Hannah. He has served the college since his graduation in 1923, when he became an extension specialist. He was named secretary of the State Board of Agriculture, governing body of the college, in 1935, and president in 1941. President Hannah is also recognized as one of the nation's top educational leaders, having served as president of the American Association of Land Grant Colleges and Universities during 1949, and as chairman of the organization's executive committee in 1950.

Macklin Field Stadium has a seating capacity of more than 50,000. Jenison Fieldhouse, largest non-commercial building in the State of Michigan, provides approximately 13,000 seats for basketball games, in addition to housing athletic offices and training facilities for other sports.

The State of Michigan is noted as a tourist paradise. Plan to spend at least a part of your vacation period in the state either before or after the Annual Meeting of the A.S.E.E.

(Continued from page 17)

"Two facts should be borne clearly in mind when considering the actions of muscles. An individual muscle has a limited useful excursion which is proportional to the total length of the muscle. A shorter muscle has less excursion than a longer one."

Many details concerning "Properties of the Muscle Essential to Mechanical Design, Terminal Devices - Hands and Hooks," the transmission system, etc. are discussed in the brochure.

The mechanical design involves muscle force, muscle shortening, force ratio, hook force and hook span (opening).

$$\text{Force Ratio} = \text{Eff.} \times \frac{\text{muscle shortening}}{\text{hooks opening span}}$$

(The force ratio is the mechanical advantage of the control and hand or hook system).

Another relationship is,

$$\text{Muscle Tension} \times \text{Muscle Shortening} = \frac{\text{Hook Force}}{\text{Efficiency}} \times \text{Hook Span.}$$

The nomogram shown in Fig. 9 is valuable in solving problems dealing with the relationships expressed above.

Suppose the muscle tension is 20#, the hook span is 1.6", and the efficiency is 70%. It is desired to find the force ratio, hook force, and muscle shortening. Using the nomogram, we proceed as follows:

(a) Join 1.6 on the Hook Span scale with 20 on the Muscle Tension scale (line 1).

(b) The point of intersection of Line 1 with the diagonal Length Ratio scale is joined with 70 on the efficiency scale and extended to intersect the Force Ratio scale at point 0.35 (Line 2).

(c) Point 0.35 on the diagonal Force Ratio scale is joined with 20 on the Muscle Tension scale (Line 3).

(d) Read 7# on the Hook Force scale and approximately 13/16" on the Muscle Shortening scale.

So much for a few examples in this area of research.

Another interesting research project dealt with an investigation of concrete runways with regard to capacity for handling very large aeroplanes.

(Continued on page 30)

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Both of Kansas State College of Agriculture and Applied Science

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REPORT OF THE BIBLIOGRAPHY COMMITTEE

by
Professor H.H. Fenwick
University of Louisville

Author	Title	Ed	Publisher	Year	Pages	Price
Adams D.P.	An Index of Nomograms	1	John Wiley & Sons	1950	174	$4.00
Benson J.H.& Carey A.G.	The Elements of Lettering	2	McGraw-Hill	1950	...	...
French T.& Svensen C.L.	Mechanical Drawing	5	McGraw-Hill	1950	440	2.80
French T.& Turnbull	Lessons in Lettering Books I & II	3	McGraw-Hill	1950	40 each	.60
Hull J.W.	Perspective Drawing	1	Univ. of California Press	1950	125	2.50
Katz H.	Technical Sketching and Visualization for Engineers	1	Macmillan	1949	163	5.00
Kenney J.E.& McGrail J.P.	Architectural Drawing for the Building Trades	1	McGraw-Hill	1950	128	3.00
Levens A.S.& Eistrom A.E.	Problems in Engineering Drawing. Series III.	Rev.	McGraw-Hill	1950	130	4.00
Reid A	Freehand Drawing Manual	3	Prentice-Hall	1950	208	...
Smutz F.A.& Gingrich R.F.	Descriptive Geometry.	3	D.Van Nostrand	1950	230	...
Turner W.W.	Projection Drawing for Architects.	1	Ronald Press	1950	120	3.00
Turner W.W.& Buck C.P.& Ackert H.P.	Basic Engineering Drawing.	1	Ronald Press	1950	669	4.50
Watts & Goodrich	Problems in Descriptive Geometry	1	Prentice-Hall	1950	64	...

MAGAZINE ARTICLE

Author	Title	Magazine	Vol.	Page	Date
Abbott W.E.	Blueprint holder	Ry. Mech. & Elec. Eng.	124	207-8	Apr. 50
Dunham F.S.	Reproducing drawings to meet increased production demands.	Mach.	57	175	Sept. 50
Frommer H.G.	How to reduce unnecessary drafting time.	Tool Eng.	25	31	Aug. 50
Hicks T.G.	Graphical Solution of press fit calculations; data sheet	Mach. Design	22	125-9	Jan. 50
Hill L.R.& Schmidt P.L.	Graphical statistics,an Engineering approach.	Westinghouse Eng.	10	120-3	Mar. 50
Hinton W.R.	Graphical statistical methods.	Wireless Eng.	26	400-8	Dec. 49
Holliday F.	Selection of junior grade draughtsmen. Bibliography	Engineer.	190	342-5	Oct.6,50
Hummel B.L.	Cartesian-Coordiante dimensioning for precision components.	Product Eng.	21	124-9	Apr. 50
Lipson C.	Why machine parts fail; failures originating on the drawing board.	Mach. Design.	22	158-62	Nov. 50
Lane T.L.	Dimensioning parts for economical production	Products Eng.	21	134-5	Oct. 50
Markley E.H.	Saving drafting time with photography.	Product. Eng.	21	135-8	May 50
Martin Co.	Martin cuts costs by cutting blueprints	Aviation W.	52	34	Apr. 17, 1950
Moyd L.	Simple method for making stereoscopic photographs.	Mining Eng.	1	383-4	Nov. 49
New S.A.E. STANDARDS	New S.A.E. Automotive Drafting Standards aim at unified Industry Practice.	S.A.E. Journal	58	68-9	Sept. 50
Oetting R.L.& Potter W.E.	Improved seeing improves drafting.	Mach. Design	22	234	Sept. 50
Product Engineering	Images are projected on drawing board for copying.	Product Eng.	21	178	Dec. 50
Quist, W.W.	Constructing arcs tangent to circles.	Mach.	57	185-6	Nov. 50
Rules	Rules for dimensioning; Reference book sheet.	Am. Machinist	94	127 129	July 24, 1950

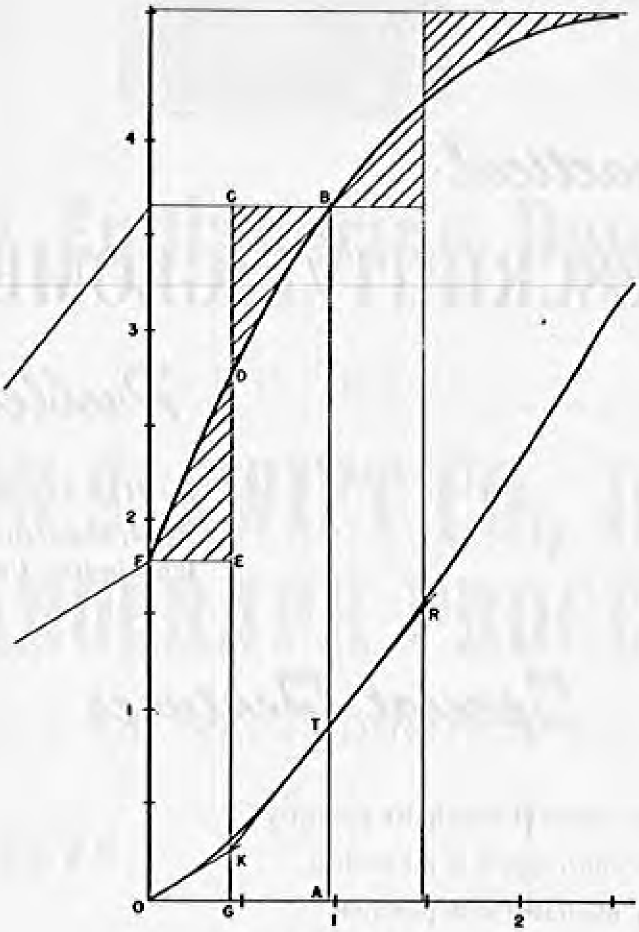

Figure 12a
Graphical integration - method "B"
(Fig. 10 enlarged)

(Continued from page 33)

include an introduction of problems employing graphic calculus and also to include some material which will illustrate the advantages in applying graphic methods to the solution of problems arising in mathematics, physics, chemistry, mechanics, and strength of materials.

During the past several years the writer has made several changes in the direction indicated above and has obtained results that are most gratifying-both in the training of engineering students to become "graphic literates" and in opening up a much broader field of application. Many opportunities present themselves in working with staff members who teach statics, dynamics, strength of materials, and design courses.

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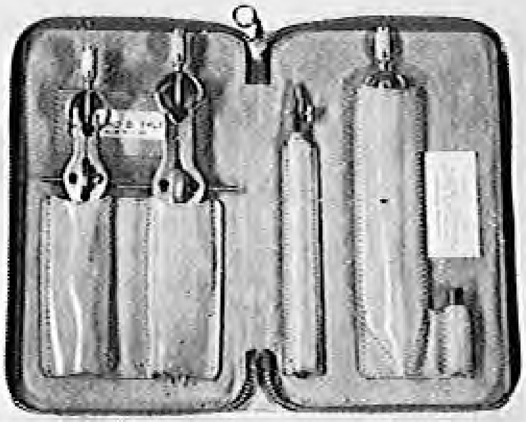

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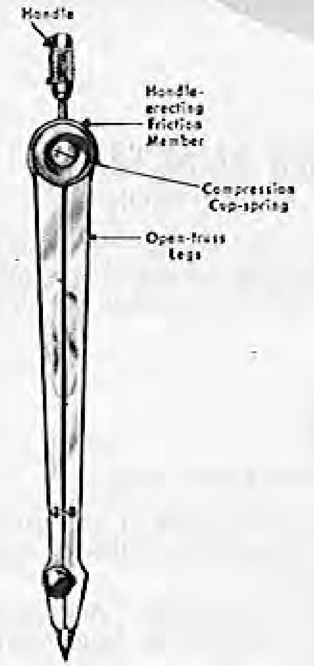

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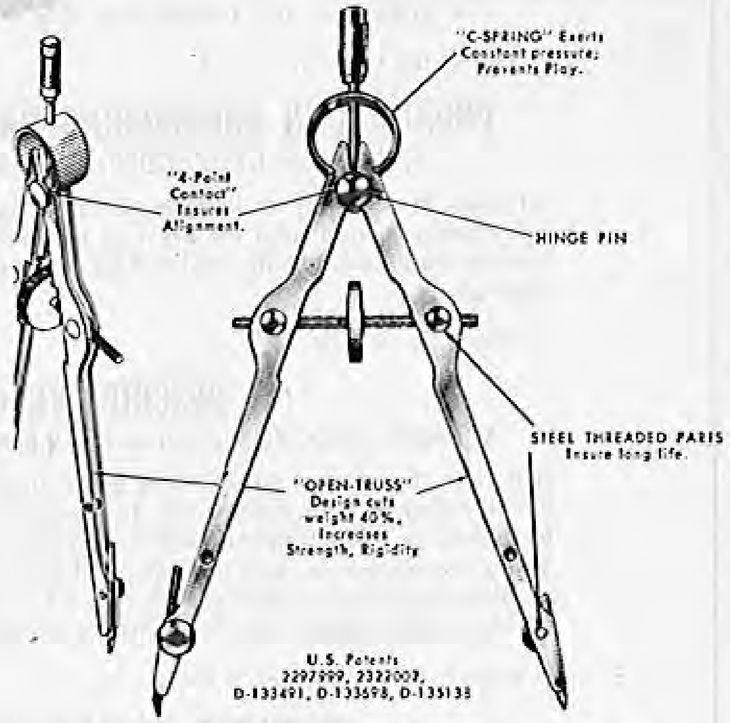

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