THE JOURNAL OF
ENGINEERING DRAWING

CONTENTS

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Published by the Division of Engineering Drawing and Descriptive Geometry of the American Society for Engineering Education

TWENTIETH ANNIVERSARY ISSUE

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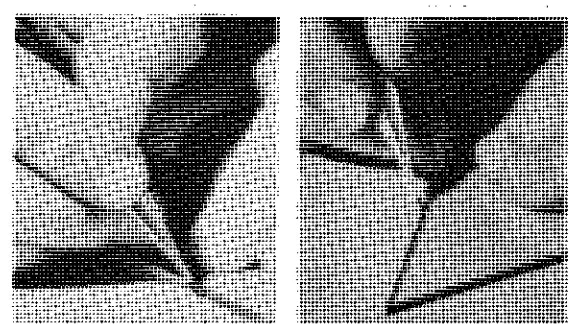

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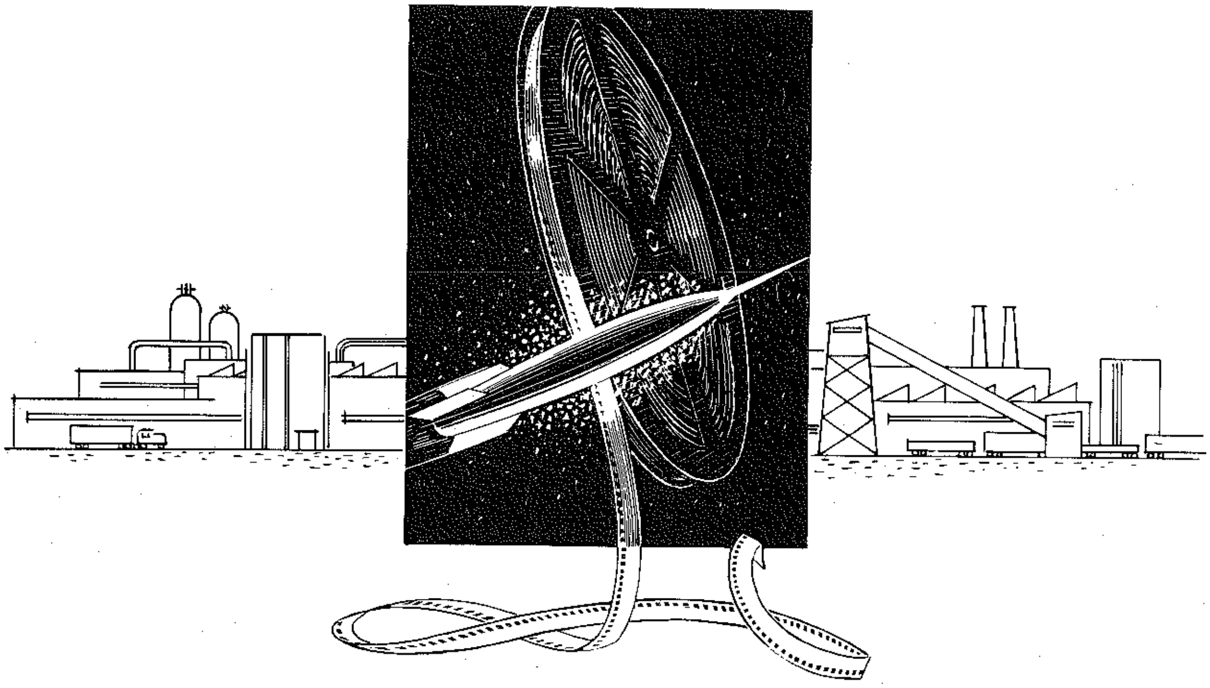

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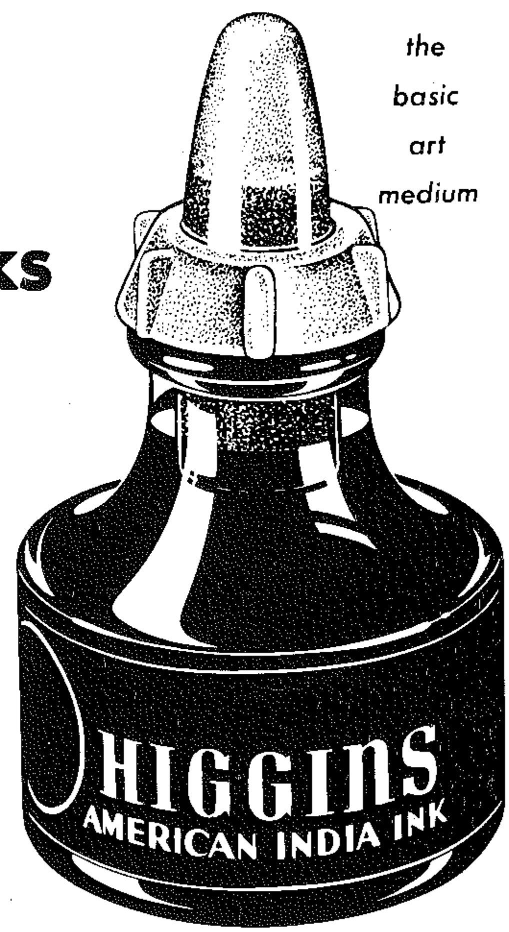

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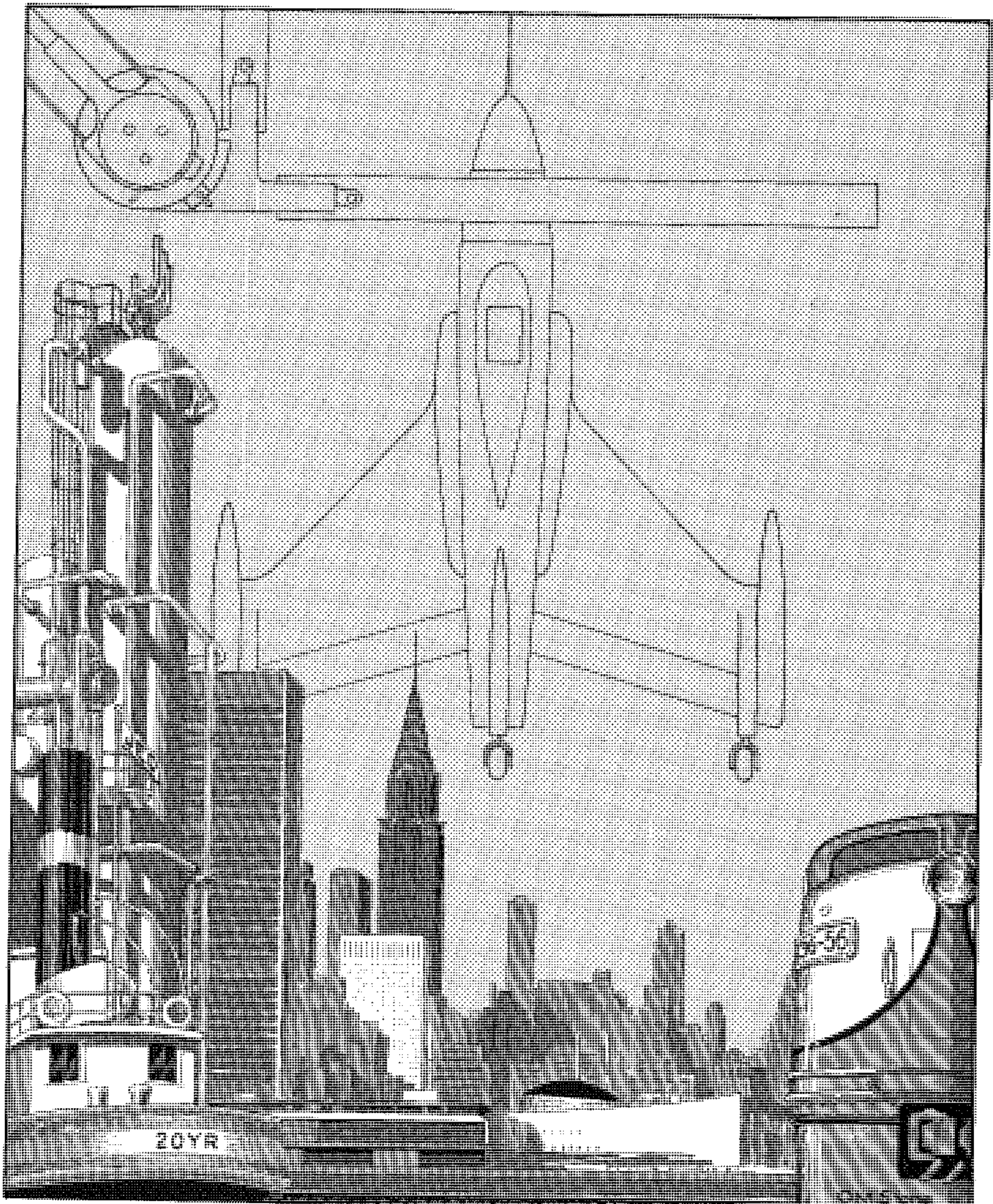

BACK OF THEM ALL-THE DESIGN DRAWINGS.

Editorial Page

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Published in the Interest of Teachers and Others
Interested in Engineering Graphics

TWENTY YEARS HAVE PASSED

Is it really twenty years? Yes, it must be, for a whole new generation of students and of teachers, too, has entered our classrooms since 1936, the year the JOURNAL OF ENGINEERING DRAWING was born and delivered. Just when was it conceived and who fathered the infant? The progenitors themselves reveal the details in the pages that follow.

But there are many things they won't tell us. We shall never know the despair of the earliest editors (although it's true that even the more recent editors suffer the same malady) when it came time to make up an issue and there weren't enough papers to print. We shall never know how worried were the early circulation managers and treasurers when subscribers neglected to renew their subscriptions. And we shall never know the gnawing concern of the early advertising managers when advertisers delayed sending in their space reservations — and then the relief when contracts arrived and the delight when a new advertiser or two came through.

The first Publication Committee was made up of Professor Frederic G. Higbee, Professor John M. Russ, and Dr. Clair V. Mann. All of them have contributed to this issue, as they have to many issues in the past, but this time to commemorate the twentieth anniversary of the JOURNAL. To this triumvirate the Division of Engineering Drawing and Descriptive Geometry owes a great debt. With each issue, part of the debt is repaid. But strangely enough, the principle always remains the same: Higbee, Russ, and Mann will feel amply repaid as long as the interest remains high.

In this way, the members of the Division express their thanks to Professors Higbee, Russ, and Mann, and to unnamed others for their pioneering struggles in bringing the JOURNAL to life. And also thanks to the many editors, circulation managers, and advertising managers who followed during the twenty years since the first issue in 1936.

And let's not forget the editor who is going to have the exhilarating task of writing an editorial something like this one in 1976 — twenty years from now!

FRONTISPIECE

The frontispiece facing this page is the work of Professor O. M. Stone, of The Case Institute of Technology. Professor Stone has caught exactly the right tone and spirit in his magnificent drawing.

Speaking for the Division, the editor expresses gratitude to Professor Stone for the many hours of painstaking work that followed the original inspiration.

THE SUMMER SCHOOL

The Drawing Division Summer School at Ames last June is now part of the history of our Division. Congratulations to the officers for a well planned program and thanks to Professor J. S. Rising and his staff at Iowa State College for exemplary hospitality.

Two papers in this issue deal with certain aspects of the event. We trust that the motives of the writers will not be construed as derogatory criticism pointed at any individual. We trust that their motives will be understood rather to be attempts to improve future summer schools and to make them more meaningful.

OUR ADVERTISERS

Some of our advertisers have been with us since our very first issue. Some have joined us only recently; for example, today we welcome three new advertisers to our select company. Because of their loyalty to us — and ours to them — it is possible for us to put out the kind of magazine we have. If our meager Latin does not betray us: "Haec olim meminisse juavit."

The Birth of the Journal of Engineering Drawing

(A Letter to the Editor)

By Clair V. Mann*

505 East 6th Street
Rolla, Missouri
August 17, 1956

Dear Professor Wladaver:

It is a keen delight to me to learn from your letter that the JOURNAL will commemorate its twentieth anniversary in November. A delight, also, that BOTH of us – the JOURNAL and myself – have survived the years between. How thankful I am, too, that the two other members of that "First" publication staff of the JOURNAL's first year still survive – Fred G. Higbee, and John Russ. The JOURNAL was the very first one of its kind – as the Drawing Division was in its turn the FIRST of the DIVISIONS of the old "S.P.E.E." – now the "A.S.E.E." And throughout these twenty years the Journal has been "tops" in every way – in appearance, make-up, content, staff. Let me voice my fervent prayer that the JOURNAL will go on for many, many useful years, to keep the drawing teachers on their toes and up-to-date in all that is new and good in their field, and in the fields with which they do and should come in contact.

I can't think of "beginnings" of the JOURNAL apart from names of those "Drawing Giants" of the 1920's and 1930's on whose work and shoulders the Drawing Division and its JOURNAL rested.

... Thomas E. French, dean of them all, now at rest. ... H. H. Jordan and R. P. Hoelscher ... Fred G. Higbee ... Harry McCully, Farnham ... Hood ... Warner ... Tozer ... Rising ... Russ ... Porter ... there were so many more! What GENTLEMEN they were – and what MATES they had ... Mesdames Higbee, Hoelscher, Jordan, Rising, Porter, Hood, McCully ... and my own "Bonita," who is going to celebrate our 50th wedding anniversary on August 29th here in Rolla!

It was in the old "Society for Promotion of Engineering Education" (SPEE, now ASEE) that I "got my start" with the Drawing Division and the JOURNAL. A bit of background is interesting, I think, for out of it came our JOURNAL, and all those "tests" that are now universally used in drawing and other engineering departments.

The year 1922 was when the idea of the great "study of engineering education" originated in the SPEE. All engineering colleges of the land were asked to assemble all pertinent facts concerning their schools and their graduates and faculty. I was made chairman at Missouri School of Mines – and we certainly "plowed the ground." But for that investigation, I would today probably be a professor of civil engineering somewhere – would have left DRAWING. But the "Iowa Placement Tests," originated by Professors Stoddard and Seashore, were sent out on trial. These tests covered most college subjects – but DRAWING was left out. I thought I saw an opportunity to do some original, new work, in a most worth while field – making up tests in many engineering lines – drawing and descript particularly. It worked out that way! I cooked up an "Engineering Drawing Placement Test" – and, by George! it "picked" the potential engineer and successful engineering student fully as well as did the whole battery of Iowa tests – which was something!

For some reason, in making up its general outline for the great study of engineering education, the head staff left out the matter of "what degrees are held by engineering teachers" – in engineering proper – in the allied sciences (physics, chemistry) – in math – in English – in economics – in the social and economic fields. I discovered this omission, got catalogs from 143 colleges and made that study – for 5,000 engineering teachers. When the national staff heard of it, they sent a wire asking me to "rush" the study to them. This was in May of 1925. Our college head, Dr. Fulton, then said I had to attend the SPEE meeting at Schnectady, N. Y. – which I did. You cannot possibly know how high my head was in the clouds when the eminent Professor Scott, of Yale (top manager for the national study) and Professor H. P. Hammond (Asst. Director of Investigations) grabbed me by the arms, one on each side, and walked me about the campus of Union College! In the general session, Dean A. A. Potter called me up from the audience and insisted that I should tell something about our "study of degrees." (Since that date, so many of our deans and head professors have rushed to get "doctoral" degrees in engineering!)

The whole point of this is – that in the session which followed, I was elected to membership on the SPEE Council! And this was the First session of SPEE I had ever attended. That is how I happened to be chosen to go with Prof. Tom French to the Council, three years later, to plead for the Council's permission to establish the Drawing Division. My being a member of the Council was presumed to carry some weight.

We next met at Iowa City in 1926. There was as yet no formal organization of the drawing teachers – in fact, they met with the machine design men. Tom French presided. There were fifteen or twenty present – not too much interest. Higbee was the host.

I do not recall the 1927 session – think I did not attend. But the fall of 1926, my "boss," in conference about my chances of doing graduate work in the line of

*Dr. Mann was one of the members of the original Publication Committee, 1936.

testing, said, "Mann, if ever you are going after a Ph.D., do it now -- and I'll help you." He took me with him to an important session of the SPEE deans at Washington, D.C. – then said, "Professor Mann, before you go back to Rolla, you go up to Columbia University, New York and see Dean Leonard of the College of Education. I think he can fix a program for you." I went, and a program was arranged. ... But, on the road home, I stopped off at Michigan, and before I knew it, the graduate dean, encouraged by the eminent Dean Colley (on the SPEE Council with me) had not only a program ready, but on the spot chose my supervising committee! They were wonderful to me, and I think it's worth telling!

I got back to Rolla, head in the skies. But when I looked at my purse, I couldn't figure out just how I would keep my family alive at Rolla and pay the expenses of the graduate program.

Somehow Fred Higbee and Tom French became curious to know just what sort of a game we were playing down at Rolla – and Fred came down to see. When he heard what my predicament was – he did one of the most wonderful things any man ever did for another. ... "I'll fix it for you, Mann – you just give me your dope, then wait." He DID fix it with Deans Williams, Packer, Seashore – and by June of 1928 I was a graduate student at Iowa, in "Engineering Education," all my research properly evaluated and credited, on my way to a Ph.D., and sending my family part of a liberal teaching stipend Prof. Higbee arranged for in his department. My Ph.D. was conferred in June of 1929 ... everlasting thanks to Fred G. Higbee and the Iowa staff. No graduate student anywhere ever was shown the courtesy and given the chance to "do it" that I was at Iowa. Dr. George D. Stoddard was in immediate supervision of my work, under graduate Dean Seashore. Deans Packer and Williams also supervised my program. WHAT A YEAR!

Now this whole business of the national study of engineering education was strong in the college air --in this program of which I have just spoken. The late Dr. William E. Wickenden came to take a very deep personal interest in the thing I was trying to do -- with tests, with tests and study of the power to visualize. My files contain many of the finest of letters from him. He even came to Rolla to visit me and my department – and so did Dr. Hammond. ... Therefore it was no wonder that Fred Higbee, Tom French and I planned to go to Chapel Hill, North Carolina, for the 1928 (June) meeting of SPEE. WE HAD BUSINESS TO DO! ... I read two papers, both reprinted in the general Journal of Engineering Education. The first was on "Placement Tests," and before the general session. The second was a digest of what we had done in testing in the "drawing" field, and that was before the drawing teachers.

On the way to Chapel Hill, on the train, we were in session as a group of teachers; somebody had typed up the "incorporation papers". I recall that I made the motion that we do now organize as a division of the SPEE". It was adopted. Tom French and I were delegated to appear before the SPEE Council and ask that the "Division" be recognized and approved – and as I was a member of the Council, as I have said, we were able to overcome the objections raised by other members – and we had come through with the birth of the Drawing Division!

But now for the JOURNAL. ... By attending this meeting, I had missed a very important "quiz" at Iowa U. ... managed to think up the right answer in the last 30 seconds of the hour!

Prof. Higbee and I had talked some of the need for a "medium of exchange of ideas" among the drawing people. In those first days, there seemed to be two or three very closely knit "cliques" or "groups" – and this was because each group contained authors of competing drawing or descript texts. "Mediums of Exchange" did not sound too good to some of these authors, at the first. However, let me now insert a paragraph I find in a letter I wrote home to my family from Iowa City on October 2, 1928 – and I quote it verbatim:

"Prof. French writes me in reply to my suggestion that the Drawing Departments try to publish and circulate among themselves an eight or ten page monthly magazine, in which we publish results of our researches. He likes the idea. ... When I spoke of it to Higbee, he smiled a bit, then said, "CALL IT THE TEE-SQUARE". That would be fun! I wouldn't wonder if the idea goes over. We might get McGraw-Hill to print it, for they print French's Drawing Text – and French thinks that, on my suggestion, McGraw-Hill might print the magazine free of charge."

I guess that is where the first "seed" of the JOURNAL OF ENGINEERING DRAWING popped up. It lies here on a typed sheet on my desk, as I write.

But the idea was NOT an immediate "push-over." The idea lay dormant until that great Drawing meeting at Madison, Wisconsin (University of Wisconsin) in June of 1936. We had been through the great Summer Session of 1930, at Pittsburgh (Carnegie Institute of Technology). Ideas too many to ignore were floating around. The general "Journal" did not have room to spare for our urgent "drawing" notions. There came that historic session of the Drawing Division, now firmly on its feet. We had banqueted – and gazed in delight at the many beautiful Drawing Division ladies, led by the queenly Mrs. Higbee, as they joined us at the banquet – all so colorfully and beautifully gowned! And we had listened for a hilarious hour to more "Paul Bunyan" stories than I ever found in any book. We were ready for a big step.

I think, as I recall it, that I leaned over to Prof. Higbee, and urged him to get up and propose the "borning" of the JOURNAL. With or without my urging, Higbee got to his feet, moved the "borning" – and the child was in our arms! Higbee was named chairman, John Russ and I the associates on the JOURNAL's first publication committee. My files are hidden somewhere about the house – I have recently built a new home at 506 East 6th Street, Rolla – come and see us, all of you at the Drawing Division! ... But for that reason I can't scan and comment on the first issue. In due process of time I became chairman of the publication committee – which was a top honor among the many fine things life has brought to me.

What do I say of the years that intervene? So filled with precious memories of the finest of friends who made up the Drawing Division. ... I seem to recall that the mid-year sessions of the Division were started when I was Chairman of the Division — beginning with the 1938 session at Texas A & M, Bryan — or was it the 1939 session at Penn State? ... Anyway, those mid-year sessions have proved to be most instructive and valuable. ... And the "Division" has gone on, without some of its former top leaders (French and McCully and others) who have either retired, or have left for their eternal rest. I think there never were, anywhere, a finer "bunch" of men — and so many of them who back there were "young" — now the "veterans" — like Svensen, Aakhus, Street, Hill, Rising, Tozer, Griswold, Howe, Wladaver ... well, just consult the roll of the Division itself! And I won't forget Northrup, from whose hand I took the tiny gavel at the Division's 25th anniversary at Illinois!

I must close. I have not words to say what I have missed these last ten years, since I left the Drawing field, and quit attending the Division's meetings! My days and hands have been full, I fought hard that our beloved School of Mines might have a half-million dollar mechanical laboratory building — and with it an end to the restrictive policy that had hampered it for fifty years. I served with delight as resident engineer (1949-51) on our three-quarter million dollar county hospital here in Rolla — and what a joy to watch as it ministers to the bruises and diseases of stricken fellow men — or brings new-born babes into the old world! ... From 1951 to now I have served as county highway engineer and county surveyor — and in both have the satisfaction of being able to change old "rule of thumb" methods into modern engineering procedures. I have been busy as a swarm of bees in June — but so very happy. ... And as a side issue, with wife Bonita, ... we had a five-year broadcasting program featuring our local history story on our local radio station. And right now we are launching one of those "beard-growing" Centennials for our Phelps County, Missouri — and our radio broadcast stories will be the foundation for our "Centennial Book" (of which I am the editor-in-chief and also of our Centennial Pageant!

There is a great, warm chamber in my heart — filled with precious memories of all of you whom I knew. May God bless you, keep your eyes high among the stars, and your feet planted solidly on good old America's fertile soil! And a mail sack of letters from some of you who could write them would be so fine to receive!

With utmost high regard and affection, I am

Yours most sincerely,

Clair V Mann

CLAIR V. MANN.

Twenty Years Ago

By Frederic G. Higbee*

State University of Iowa

In June 1936, four or five or us sitting around a conference table at the Madison Engineering Drawing Summer School agreed that the Drawing Division did not have adequate means of presenting and preserving the vast bulk of ideas being annually presented.

The result was the establishment of the JOURNAL OF ENGINEERING DRAWING.

We — and being a member of the original editorial board, I am able to use an editorial "we" — then had no funds whatever; we had no advertisers; we had no store of copy to draw from. We had merely a conviction that a "Journal of Engineering Drawing" would be a good thing for the Division and that we could somehow make a go of it.

We — and now I am speaking for all of us — are exceedingly proud that the JOURNAL, now entering its majority, has been so successful — successful beyond the dreams of its founders. Like the Engineering Drawing Division itself our JOURNAL has set a pattern — has pioneered in an unexplored area of journalism in a distinctive and creditable fashion. And best of all it has done so, while at the same time it has stood squarely on its own financial legs!

*Professor Higbee was Chairman of the first Publication Committee, 1936. Professor Higbee was the recipient of the A.S.E.E. Engineering Drawing Distinguished Service Award in 1950, the first year in which the Award was made.

IF YOU DISAGREE

If you disagree with something you read in the JOURNAL OF ENGINEERING DRAWING, don't take it out on your students. Write your objections down and send them in to the editor. Controversy is a good thing, they say, especially for our circulation!

The fact is, if we had had a letter from you it might have been in this very spot in place of this innocuous effusion, otherwise known as a stuffer or filler.

Twenty Years Later

By John M. Russ*

State University of Iowa

Yellowstone National Park
August 16, 1956

Your editor has asked me to comment on my articles in the JOURNAL OF ENGINEERING DRAWING of twenty years ago.

Now that the fishing is getting tougher -- I had to cast the second time this morning before I took my first fish —I'll take some precious time to confirm the indictment that I am an Ole Timer.

I do not think I would change a word or phrase if I were to re-write those same papers today. I do not have them with me -- but I think I remember my classroom philosophy of years ago. Time, observation of my old students since graduation, and the trend and progress of the engineering profession, have all combined to fix more firmly than ever, my opinion that Engineering Drawing (call it Graphics if you have to!) is the most basic vehicle in the engineering curriculum for teaching ENGINEERING THINKING; The many detailed disciplines of the drawing board should not be neglected or overlooked, lest the student's "vehicle" will limp home on a flat tire.

John M. Russ.

*Professor Russ was one of the members of the original Publication Committee, 1936.

An Expression of Appreciation

By Frank A. Heacock*

Princeton University

On the occasion of its twentieth anniversary the JOURNAL OF ENGINEERING DRAWING merits an expression of appreciation for its valuable service to the Drawing Division and for its noteworthy success as an educational magazine dedicated to the interests of a particular group of readers.

For twenty years the JOURNAL OF ENGINEERING DRAWING has grown in stature and improved the quality of its published material. In recognition of this growth and progress we congratulate all of the editors and members of its business staff who have so generously given the JOURNAL their time, skillful effort, and good management, in addition to their regular duties as teachers of drawing and descriptive geometry.

The interesting articles and illustrations published in the JOURNAL cover various forms of graphic expression and many useful applications of graphic methods. All of this material is effectively and attractively presented. Much credit is due the circulation and advertising managers who have made the JOURNAL a self-supporting business enterprise. The Drawing Division is justly proud of the JOURNAL OF ENGINEERING DRAWING.

*Professor Heacock joined the Publication Committee in October, 1937.

ANYBODY KNOW?

In the February '56 JOURNAL we posed a problem. No one has sent in a solution, graphical or analytical. The problem was:

The sum of the angles Alpha, Beta, and Gamma, which a straight line makes respectively with the top, front, and profile planes varies between what limits?

The JOURNAL OF ENGINEERING DRAWING is constantly searching for material suitable for publication. If you have any reservations about the suitability of your ideas for JOURNAL readers, put your ideas into writing and send them along for the editorial board to judge. Every communication will be acknowledged promptly with appropriate comments.

Twenty Years After

By Justus Rising*

Purdue University

If someone had told me twenty years ago that history repeats itself every ten years, I would not have believed it. But the record speaks for itself.

In 1936, the second issue of the JOURNAL OF ENGINEERING DRAWING contained an article** describing "The Ideal Drawing Room." The Proceedings of the 1946 Summer School for Engineering Drawing Teachers contains an article, "Physical Plant and Equipment for the Instructional Drafting Room" supplemented by excellent discussions by Professor W. W. Preston and Professor A. L. Thomas. And now, in 1956, here we go again.

The presentations of 1936 and 1946 consisted to a large extent of summaries of questionnaires received from the members of the Drawing Division with many of the radical and/or impractical proposals of 1936 improved or eliminated in 1946. Because time is not available for another questionnaire, I, alone, am to blame for what follows.

Since 1946, and especially in view of the adverse treatment which engineering drawing is experiencing on account of the Evaluation Report of 1955, it seems to me that a comprehensive research program in engineering drawing and related subjects is in order. This research should undertake to determine objectively, the contributions which adequate training in these subjects makes to broad training in engineering; whether it should be taught before, during, or after the freshman year; and the best methods of instruction to provide the best training, in the least time, with the minimum of effort by both student and instructor. The instructional research program should provide for variations in (1) course content; (2) order of presentation of units of instruction; (3) class size; (4) methods of instruction; (5) the place the work occupies in the curriculum; (6) perhaps other factors.

When I first began to cogitate on this research idea, in order to provide complete flexibility of room arrangement and class size, I envisioned a single large drawing laboratory which could be divided into smaller areas by means of accordion-type partitions with each area completely equipped for use as a classroom including, besides the drawing tables, recitation chairs, blackboards, projection facilities, etc.; the large area also to be equipped with all facilities for mass instruction of the entire laboratory at one time.

Present and prospective developments of closed circuit TV for classroom use have made this concept practically obsolete. A series of drawing rooms similar to those described by Professors Preston and Thomas at the 1946 Summer School, each equipped with several standard TV receivers arranged for closed circuit TV, would permit all of the procedures adaptable to a large lecture room or large laboratory, but with everyone having a seat on the front row. By combining the small drawing rooms in groups of two, three, or more, separable by accordion-type partitions, studies on the effect of class size could be made. TV presentations could be made with students either in the recitation chairs or at the drawing tables and the differences, if any, determined.

Some departments teaching other subjects which make use of the traditional lecture method and have recently constructed new lecture room facilities, are advocating theater-type closed circuit TV, using large screen television. It seems to me that a more sensible plan would be to use a number of standard TV receivers scattered throughout the lecture room so as to provide each student with a front seat. Then, too, an equivalent amount of standard equipment will cost less than the specially built facilities and the standard equipment would probably require a smaller staff of experts for its operation. Interruptions due to equipment failure would be less serious because a defective unit could be replaced by a spare one with little or no interruption of the lesson.

Since the publication of the Evaluation Report, it has seemed to me that many administrators are reading into it things that are not stated or even implied, and overlooking things that are quite definitely expressed. Professors Spencer and Vierck in their papers at the 1956 Summer School for Engineering Drawing Teachers have presented excellent analyses of the place of "Graphical Expression" in engineering education, and I would recommend that every drawing teacher study them carefully and use the facts there stated to defend and improve the status of "Graphical Expression" as one of the basic engineering sciences.

It will unquestionably be necessary to make some changes in emphasis in our courses in "Graphical Expression" in order to fit into the "new look" in engineering education. Let us keep in mind as we consider modifications in our course content and methods of presentation that we are trying to educate individuals and not to develop robots; that society is best served by persons who are doing what they like and are fitted to do, and who derive from their jobs the personal satisfaction of accomplishment as well as financial remuneration; that in developing our educational procedures, sound engineering methods of analysis and synthesis be followed – in other words, that our program be designed to produce a desired result and not to fit a preconceived procedure. Let us be objective in our thinking and not base our decisions on "judgment" which is often a reflection of whim

*Professor Rising was the recipient of the 1952 A.S.E.E. Engineering Drawing Distinguished Service Award.

**Justus Rising was the author. (Ed. note) and/or prejudice. Let us not be afraid to violate tradition and not follow tradition for tradition's sake.

President Van Mote of Clarkson College of Technology presented at Ames what, to me, is a very excellent paper on "The College Faculty Crisis – What the Colleges can do." He offers a very realistic, down-to-earth discussion of his topic and his paper merits careful reading and consideration. I like especially two quotations: –

1. "A good area to examine is that sacred cow – the student-faculty ratio. It has long been held that the college with the lowest student-faculty ratio was doing the best job. But is it? It is interesting to see the gradual almost timid approach that educators are making in suggesting that this ratio problem be opened to scrutiny. Yet more and more are doing it."

   A dean writes, "I get the impression that quite a few faculty members and even the whole departments subscribe to the idea that the more time they spend with the student the better educational job they do. As a result, contact hours go up and hence more teachers are required. I feel that we can go a considerable distance in the opposite direction and do a better educational job on our students."

   President Mallot of Cornell writes in a recent article, "I have never myself been sure that we are correct in this academic hierarchy, in our worship of very small classes under all conditions and for all subjects."

2. "I am proposing that education become financially realistic and with eyes open to the economic facts of life, and closed to tradition and custom, attempt to practice what it prides itself in teaching."

It is my understanding that education is a learning activity, and only to a limited extent a teaching activity, and that the teaching activity which is most effective is that which guides and motivates as well as "instructs." Let us try to find the optimum number of contact hours and the optimum class size.

The American standard of living and material prosperity are due in large degree to the application of new and better tools and methods to the processes of production with output per man-hour multiplied many times and with increased financial returns to the producers. If those who establish fundamental policy in educational procedures would adopt even a part of the industrialist's attitude toward progress, the educational output per-teacher-hour could be multiplied and salaries increased accordingly. Audio-visual materials and methods (including closed circuit TV) provide the tools; progressive teachers will devise ways to use them with maximum effectiveness. When output per teacher hour has been doubled, salaries can be doubled without increasing the salary budget. Limiting the educational output per teacher hour and at the same time raising salaries could ultimately increase the cost of education to the point where society could not afford it.

Let us also be realistic about the educational facts of life. I am a firm believer in the use of audio-visual materials and methods wherever applicable as determined by objective criteria. In 1943, the Navy published a booklet entitled, "More Learning in Less Time," in which the following statements appear:

> "Tests show that students learn up to 35% more in a given time," and "Tests show that facts learned are remembered up to 55% longer."

Expressed graphically the first statement shows that a four year curriculum can be completed in three years (Fig. 1), or a five year curriculum can be completed in less than four years (fig. 2). Expressed graphically, the combined statements show that educational effectiveness is doubled by the use of training aids (Fig. 3).

I wonder what the next ten years will show.

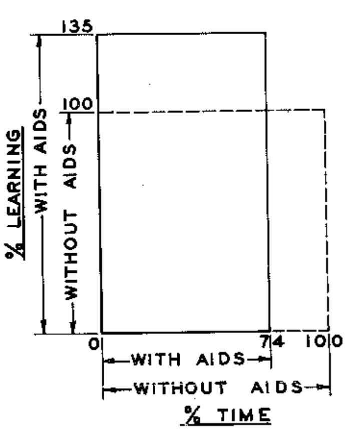


Fig. 1. Equal Learning—Less Time.

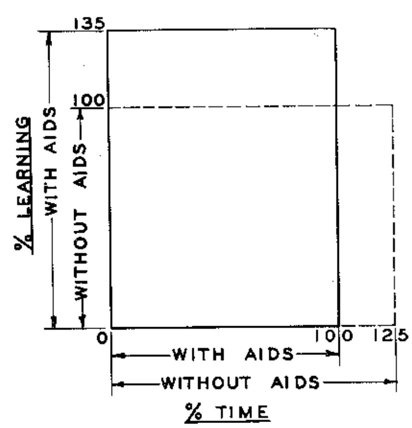


Fig. 2. More Learning—Same Time.

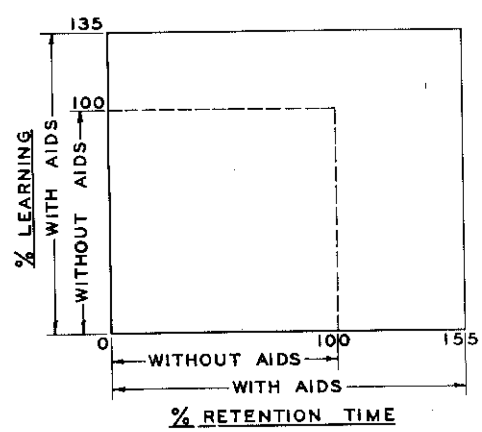


Fig. 3. Effectiveness of Aids.

Nearly 79, Always Busy, and Looking Ahead

(A Letter to the Editor)

By George J. Hood*

University of Kansas

1505 Crescent Road
Lawrence, Kansas
August 29, 1956

Dear Professor Wladaver:

Your letter of August 4 deserved a prompt answer. But I have delayed with the vain hope that I might be able to convince myself that I could find the time and energy to meet your request.

One would think that a retired professor had oodles of time, and should be thankful to have jobs assigned him to keep him from going to seed. But instead, I find myself rushed all of the time to try to do all of the things that have to be done, and that can't be put off much longer. Always and for years I have been looking ahead to the time when there would be plenty of leisure to sit and do nothing, or even to sit and think. And yet, at the same time fearing to reach a time when there was nothing waiting to be done.

I believe that I appreciate some of the problems you have to get the material necessary for each edition of the JOURNAL OF ENGINEERING DRAWING, and I would like to help. But what could I write that would be of general interest to those who read the JOURNAL? I don't know and just now I have neither the time nor the extra energy. Now, I am nearly 79, and again am in good health. Two months ago, I ended a stay of six weeks in a hospital, and have a six-inch scar by which to remember that experience. That is what kept me from going to Ames, where I had planned to again meet many old friends, and to become acquainted with the younger teachers.

And so, although I would like to take advantage of your offer if only I knew what would interest both the older and the younger teachers. But this time I cannot do the job.

I type my own. Cannot some of you get out a new typewriter on which it is impossible to strike the wrong key?

With best wishes to you and yours,

Geo. J. Hood,

If ever you come this way, be sure to look us up.

GJH

*Although it may seem incredible, some of the younger members of the Drawing Division may not have met the illustrious Professor George J. Hood. Professor Hood is the author of a most widely accepted textbook in descriptive geometry, in print over thirty years. He is credited with attributing the name "direct method" to the modern system of descriptive geometry. Professor Hood was the 1952 recipient of the A.S.E.E. Engineering Drawing Distinguished Service Award.

Engineering Drawing in Review

By Charles L. Skelley*

Vice President, The Dryden Press
and
Former National Treasurer of the A.S.E.E.

My earliest acquaintance with draftsmen and with some of their problems dates back to the time when the John Deere Company was making their first grain binder. I was then a "tracer" and general flunky in the experimental plant at East Moline, Illinois. The tempo there was always allegretto. Frequently a casting would complete its life cycle from drawing board through the pattern shop and foundry and end up on the reject pile all in the same day — sometimes still warm -- a victim of patent-infringement trouble. Between the legal office and the pattern shop the approved blue-print had managed somehow to sprout infringement features. This always left me wondering a bit; my correspondence-school drafting course was not too strong on such mysteries.

In more recent years, my experience in college text-

*Mr. Skelley's experiences during more than forty years of publishing technical books have given him a vast and affectionate acquaintance among members of the Drawing Division. (Ed. Note) book publishing has given me a rather broad acquaintance among teachers of engineering drawing, and it has also given me a good point of vantage from which to observe some of the changes that have taken place in engineering drawing during the past quarter-century.

Now in 1956, when the JOURNAL OF ENGINEERING DRAWING is celebrating its twentieth anniversary, perhaps some observations of an "outsider" may not be amiss. These twenty years have witnessed an extremely interesting parade of ideas, trends, and attitudes in the field of engineering drawing -- and they have also seen a lot of positive action and some reaction. Prominent in this procession of the years has been the banner of the many individuals who have been striving for a better standardization of American drafting practices, and following them have been changes in teaching trends, of which perhaps the most noticeable has been the increased swing towards integration of engineering drawing and geometry. Boosters of simplified drafting

(Continued on Page 66)

Faculty Pen

By John M. Russ

The State University of Iowa

(I wrote the following for the January 1945 issue of The Iowa Transit, our engineering student magazine. It is reprinted here with permission, with the thought that the philosophy is interestingly sound, even perhaps inspirational, particularly to our current generation of younger teachers.)

I sometimes wonder if I ever will, and I sincerely hope I never do, lose that thrill of anticipation with which I walk into the classroom to meet a new class for the first time. I doubt if any student has ever had any idea of the many questions which are reaching for their answers. I would like to tell you what is going on in my mind behind those glances hither and yon over the group assembled. This is difficult to do, principally because of the variety and variance, as you shall see.

One question has to do with the very human search for friendships. Many of my closest friends today were first met at the moment we are now considering. Most of them have graduated: successful in their profession, family men, towers of strength and influence in their civic and industrial communities. Momentarily, they are scattered all over the world, but they find time to write and to keep in touch. So, this is one question I am silently asking, as I meet you eye to eye, "Will it be YOU?

Every man who has ever attended one of my classes has heard me imply, or quote from a distinguished colleague: "Look well to your right and to your left. When you graduate, neither of these men will be with you." How many of you, and who, will leave? And who will carry on? And of those who leave, why, oh why, will it be necessary? The actual difference is really very, very small between the man who leaves at or before the end of his first semester, and the man who graduates with signal honors. That it happens at all, is one of the tragedies of Life. It is frequently a matter of luck, or a job at a living (studying) wage, or an accident or disaster at home, or the application of just a wee more intellectual stamina.

How many, and who, will blow up under pressure? Perhaps during an exam in spite of having carefully learned the material. I use examinations copiously. To inquire? Yes, but more fundamentally as a teaching vehicle! I capitalize heavily on the psychology of that fearful word "Exam." But why should it be fearful? Why rather, should it not be a finger (faltering perhaps) that wipes away the film of dust from the polished surface of knowledge? Why not think of examinations as being slyly strewn stumbling blocks along your intellectual path, that will eventually pave the way to future highways? In industry, you know, every task will be an exam. You don't flunk on the job. You make good or you are fired.

How many of you and which ones will it be, who will plunge with ardor into extra-curricular activities? Who of you will take advantage of the fact that this is a UNIVERSITY campus, with its lectures, music and drama? Who of you will realize that your classmates on this campus will be the future leaders (perhaps with you) of your community, state, and nation? Who of you will seek, justify, and hold friendships with the now embryonic key men of your generation? These are the factors, these are the catalysts, which when blended with your technical training, will yield the priceless future of a full and balanced life.

How many, and who, will be able to supply or find the other ingredient which, when combined with opportunity, is inherently necessary to human development? The University is offering you the opportunity. You must furnish the incentive. Did you know that Ulysses Grant was unsuccessful for as late as four years before the incentive and necessity of impending catastrophe forced him to display the previously hidden qualities that placed him in charge of the Union Armies? Did you know that Abraham Lincoln was a happy-go-lucky country lawyer for as late as six years before the incentive and necessity of a National crisis placed him in the President's chair? As you do know, by four years later, he had become a leader in world thought.

How many of you, and which of you will have similar latent talent? And how many of you will ever know it? What can I do to kindle it? What can I do to help you discover it? What can I do to keep it alive and available and potential for the years that lie ahead?

These are the thoughts that are surging for response, behind the smile and the challenge with which I meet you on the occasion of our first class.

Integration

By Herman C. Hesse*

Valparaiso University

Two decades ago the writer contributed an article on this topic to the JOURNAL OF ENGINEERING DRAWING. At that time, the word integration did not have the political, social, and economic implications that are current today — the writer endeavored to point out the necessity of integrating a basic knowledge of shop processes and practices with the teaching of the important topic of size description in the field of engineering drawing. It was suggested that a brief, although effective, presentation of manufacturing and construction processes was essential to any study of dimensioning practices, and that only in this way could size description be taught as a science rather than as an empirical art. It was felt that such an exposition was necessary in 1936 because of the steady trend towards the elimination of machine shop and foundry laboratory courses in the engineering curriculum; a trend that has continued up to the present time.

The substitution of lecture and demonstration presentation for actual shop courses has steadily gone forward in the past twenty years; texts and reference works in graphics and engineering drawing have been expanded and have incorporated larger and more effective sections on shop practices and processes, and a number of auxiliary texts have been made available for these areas. No great harm, therefore, at least in the sense in which the graphic language may be affected, has resulted from the elimination of the conventional shop courses. Our engineering graduates can still handle size description effectively and adequately, and industrial acceptance of our pedagogy and methods is still as universal as it was twenty years ago.

It is my feeling, however, that we teachers of the graphic language will have to face a "new order," and may be confronted with a much more serious situation in the next twenty years. The present trend towards the newer engineering-science program, with its great (and essential) emphasis on mathematics and the physical sciences, will inevitably require more curricular time for these areas, and may result in a curtailment of the time alloted to the science and language of graphics. It is essential, therefore, that we recognize this danger and be prepared to state our position logically and unemotionally to those who are and will be responsible for the engineering curricula of the future.

A somewhat unorthodox definition of the area of engineering education might divide it into two broad fields — language and science. Mathematics, for example, is a language insofar as its symbolic terminology is concerned; the science of mathematics is built upon a foundation of familiarity with the language of numbers and symbols. Music is essentially a science, largely mathematical in nature, but its study also required a knowledge of a basic symbolic language before any excursions into its real nature can be made.

Basically the graphic language serves as a means of expressing or representing three dimensional concepts on two-dimensional surfaces. This concept may seem self-evident or over-simplified to "graphicists," but is not always recognized by our colleagues in other areas. With this essential foundation, further education in the language follows with an exposition of the symbology of graphics (sections, conventions, etc.) and a study of its scientific aspects, as exemplified in the field of descriptive geometry and size description.

Suggestions have already been put forth that the teaching of the graphic language be left to the secondary schools, that our laboratory work be reduced or even eliminated, and that we confine ourselves to interpretation, or "blueprint reading," rather than composition or drawing execution. It may be difficult to refute some of these proposals unemotionally, but it should be pointed out, with logic and clarity, that colleges do not and cannot accept most secondary-school mathematics as a substitute for college mathematics; that, in many instances, preparation in secondary school English necessitates remedial college courses in reading and in grammar and composition. The concept that the graphic language may be studied by "reading drawings" is equally invalid — no educator would ever endeavor to teach mathematics in this manner, nor would any English professor be willing to import the essentials of that art by reading alone. We must remember, and we must emphasize to our colleagues in related fields, that the study of the graphic language and science requires exposition and composition as well as interpretation.

It is possible that we shall have to strive for a new "integration" of the graphic language in the next twenty years — an integration in which graphics will maintain its proper and justified place with the sciences and the arts that comprise the engineering curriculum of the future.

*Dean Hesse's article entitled "Integration," printed in Vol. 1, No. 1, of the JOURNAL twenty years ago, is just as pertinent and interesting today as it was then. In 1936, Dean Hesse was on the teaching staff at the University of Virginia. Today's article gives a fresh outlook on a pressing, perplexing problem.

OIL'S WELL IN TEXAS

The mid-winter meeting of the Drawing Division will be at Rice Institute, Houston, Texas, in January, 1957. Will you be there? We hope so.

The German Drawing Instrument Industry History and Sociological Background

By Frank Oppenheimer

Gramercy Guild Group, Inc.

It is known that the early Egyptians and Romans, and other contemporary civilizations used a compass-like instrument. But the basic form of the compass as it exists today was known to be in existence in Germany since the year 1200. The Guild of Compass Makers is mentioned in the old books of the City of Nuremberg in the year 1442. These instruments were originally made of wood and later on of iron. The iron instruments were hand-forged and because of this, the literal translation of the name of the Guild in German was The Guild of the Compass Forgers.

The first brass instruments made their appearance in Germany at the beginning of the sixteenth century, and through the years, up to the end of the eighteenth century, brass was used exclusively. However, the instruments were no longer forged. They were die-cast. The oldest ruling pen known is the instrument used by the famous painter, Albrecht Dürer, who lived in Nuremberg from 1471 to 1528. This ruling pen was made of brass.

Statistics from the archives of the City of Nuremberg show that during the year 1590, 85 members of the Guild of the Compass Makers were at work; during the year 1658 there were 105; in 1670 there were 110; and in 1724, 107.

Despite this activity, the first precision instruments were manufactured not in Germany, but in Switzerland. Around the year 1770, a mechanic by the name of Esser started manufacturing in Switzerland, and in 1819, Kern, who had been an apprentice in the Esser factory, founded the firm of Kern & Co. in Aarau, Switzerland. The Swiss took over the basic forms of the old German compass as it was manufactured in Nuremberg, improving on the entire form, particularly the head. The material was brass and for the first time rolled sheets were used, from which the pieces were cut out. Up to around the year 1880, the Swiss instruments were made exclusively by hand.

For many, many years, the Swiss instrument manufacturers were the leaders in this industry until in South Germany in the Bavarian Alps a new industry developed. Around the year 1830 a mechanic named Haff was employed in the factory of Kern in Switzerland. In 1835 he founded the first factory in Pfronten, and it was through him that the Swiss system was transferred to Germany.

Shortly thereafter, in 1840, Clemens Riefler, who was an apprentice in this first German firm, started his own manufacturing in Nesselwang, about four miles north of Pfronten. He, too, started with the Swiss system, but in the year 1843 Clemens Riefler introduced his own invention, the pivot head. In 1854, Riefler exhibited these instruments for the first time, at the Industry Fair in Munich, under the heading Compasses with Pivot Heads and Ball Motion. With the exception of the head design, the form of the compass still was similar to the square system of the Swiss. In 1855 Riefler exported this type to the United the United States for the first time.

In the year 1870 Haff abandoned the Swiss type and took over the Riefler square type with pivot head and from then on this type was commonly referred to as the "Haff System."

In the meantime Riefler forged ahead, making various improvements in the whole form of the instrument as well as in the head design. This is what Theodore Alteneder found in the years 1841 to 1848 while he was working as an apprentice in the Riefler factory. In 1848 Alteneder emigrated to the United States and started to manufacture instruments in Philadelphia. They were the same square type with the new pivot head which he had first learned to make in the Riefler factory in Nesselwang in the Bavarian Alps.

In 1875 the Riefler firm introduced its new invention, the round system. The name round system is derived of course from the tubular form of the compass legs and attachments. The success of the round system all over the world was tremendous and the name of Riefler was established. By the way, the round system never became too popular in the United States.

During the same year, 1875, a young watchmaker in Chemnitz, Saxonia, by the name of Otto Richter, had started the production of drawing instruments according to the Swiss system. It was not until 1892, however, that Richter's new invention, the flat type, was patented. This system, originated by Richter, has set the pattern for drawing instrument manufacture all over the world. In Germany, France, Italy, England — indeed all over Europe -- instrument manufacture was stimulated because the flat system lent itself better to machine production, eliminating the slow and costly handwork processes which the square and the round systems require even to this day.

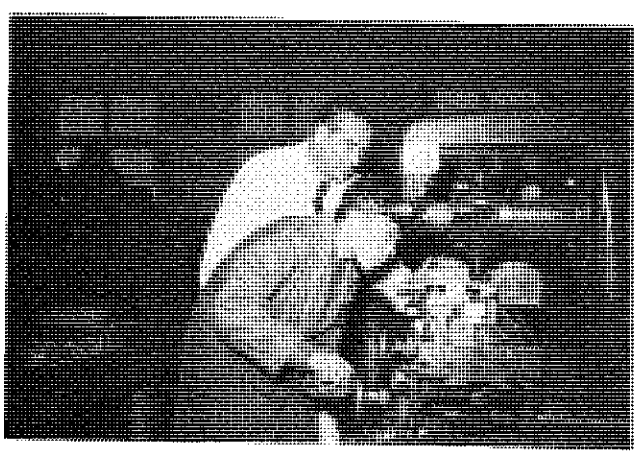
In the meantime, in the Nuremberg area, various factories came into existence manufacturing along the already well-established lines. One noteworthy exception was the firm of Johann Chr. Lotter. The Lotter firm introduced a gear-device that kept the head of the compass straight.

During the year 1900, in Nuremberg and the upper Bavarian area, approximately 675 workers were employed in about thirty-five factories. Although the different systems underwent great improvements during the fifty years following, the types remained basically the same until the recent development of the giant bow type with its friction head and centerscrew adjustment, and an entirely new beam compass. More recently, a so-called quick-action bow was developed. The necessity of obtaining correct distances on drawing circles with pencil, using pressure, led to the construction of these compasses with greater stability, easy adjustment and additional security in the obtaining of the desired distances. This was the first time that American ingenuity and modern technical experience were combined with the conservative methods and outlooks of the old country, to produce precision drawing instruments.

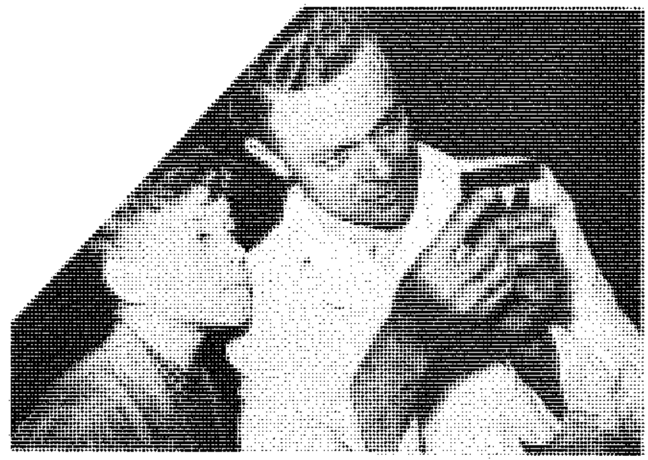
In the nineteenth century, the better instruments began to be made of nickelsilver. Nickelsilver is an alloy of copper, zinc, nickel. The nickelsilver originally came from China to Europe in 1820, and in 1825 was first manufactured by the firm of Geitner in Saxonia under the name of Argentan. It is generally known today under the name of "German Silver." Good nickelsilver should contain 18% nickel. The nickel content gives the metal its silver-like color, its non-corrosive capacity, and its better workability. Haff has used nickelsilver since 1850, Riefler since 1860, and Richter since 1890.

The unmistakable stamp, the singular character of the German drawing instruments comes from the attitude of the craftsman, their initial schooling, and their long experience at similar tasks under the same company's direction. The industry today is, of course, an outgrowth of the old Guild system, where specialists were slowly developed in their own right. It had its roots deep in a Crafts atmosphere where knowledge is handed down from father to son. The character of Hans Sachs in the Meistersinger of Richard Wagner typifies the sort of mysticism which enshrouds the worker who is at the same time perhaps a poet, perhaps a shepherd, wood cutter, or mountain guide.

In order to maintain the traditional workmanship, it is an old custom in many areas, that as soon as the boys are ready to leave school at the age of thirteen or fourteen, they are brought by their fathers into the factories where they themselves work, to start their apprenticeship. Skill is the basis for achieving the highest quality in instruments; and to obtain a staff of skilled workers at all times, the bigger factories have their own Apprentice Departments. Apprenticeship means at least three-and-a-half to four years of study and practical work, after which a rigid test, demanding practical and theoretical knowledge, must be passed. This test is administered by and under the supervision of the government. In every factory in which apprentices are educated, there are special foremen, supervisors and instructors just for this purpose.



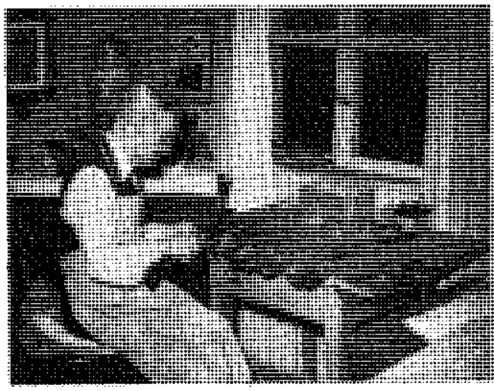
After passing their examinations, the ex-apprentices are then hired as regular workers and integrated into the labor staff. Thes men seldom make



make a change. Their entire lives are spent with the masters who gave them their original schooling. Their homes and their farms, which are handed down from generation to generation, add to the stability of this type of life. Thus they are fully integrated into the production family. This goes on and on, and there are families whose male members have been working with the same firm two and three generations.

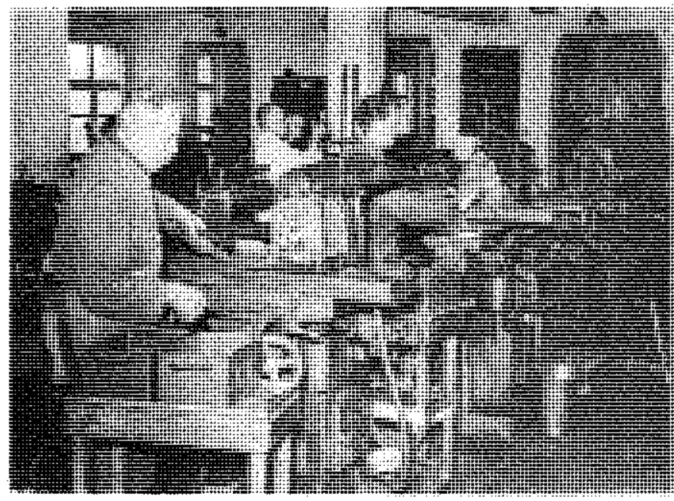
In factories and homes, men and women are busy turning out instruments according to methods handed down through generations. They feel free to work either in the factories which sometimes are built within old stables or to work in their own homes where they sometimes have small machines put up right in their living rooms or bed rooms. This gives the worker a feeling that he is his own boss and therefore he develops a sense of responsibility towards good work. The ethos or essentialness of the "work" itself is still apparent in Germany today. Especially in the rural districts there are a great number of men and women who still prefer to work in their homes. During the different seasons, it gives them an opportunity to tend their livestock and farms and do outside work, whenever necessary.

Despite the fact that many of the workers have small machines in their own homes, a great deal of work is still done by hand, particularly assembling and polishing operations on ruling pens, dropcompasses, the regular three-bow compasses, and other individual pieces. The atmosphere of the homeworker, however, is transplated into the factory and even though many of the larger factories have well-organized tool departments, milling machine, lathe, drill and benchwoork departments, there is no systematic mass production as we know it. Nowhere in a German drawing instrument factory can you find a ma-



chine that will take the raw material and turn out a finished piece. The individual worker is indispensable to craftsmanlike production. Certain operations like grinding, which play such an important part in American mass production, are almost non-existent in Germany. The ruling pens for instance are roughly cut out on a milling machine and then ground out by hand on a stone in a slow but very precise process. Assembling is typically called in German, "adjusting." The individual pieces are carefully looked over for their precise fit and if necessary reworked before being put together so that the final inspection operation is merely an additional check before putting the finished pieces in stock. Many old hands with long years of experience are employed at this adjusting operation, because it is considered one of the main operations.

Instruments manufactured under such painstaking conditions should last a lifetime, given the proper

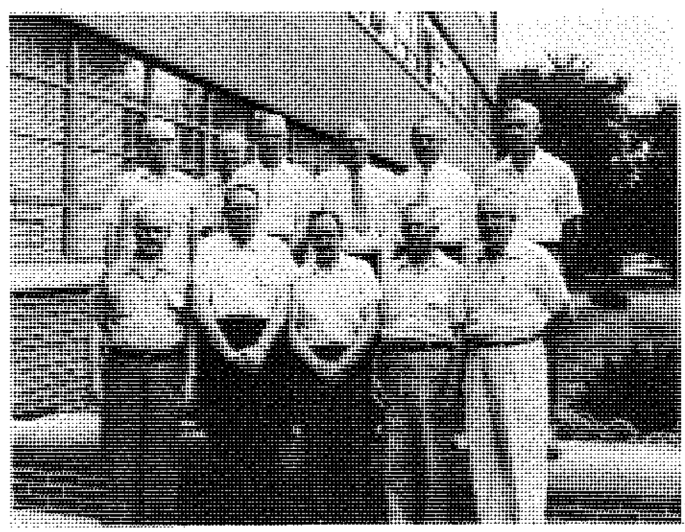


care and attention. If abused, drawing instruments like any other fine product, will cease to function adequately. Much depends on the good sense of the user, his appreciation of fine and beautifully crafted instruments, and the pride and respect which he brings to his profession.

Pittsburgh in 1930 to Ames in 1956

The eleven men in the accompanying picture were present at the Annual Meeting at Ames, Iowa, in June 1956, to attend the Fifth Summer School of the Drawing Division.

What is memorable about this occasion is that these eleven were also present at the First Summer School, at the Carnegie Institute of Technology, Pittsburgh, in 1930.



Rear row: Justus Rising, Willey, Hoelscher, Street, Russ, Springer;

Front row: Stone, Jorgensen, Porsch, Heacock, Smutz.

DIVISION OF ENGINEERING DRAWING

OF THE

AMERICAN SOCIETY FOR ENGINEERING EDUCATION

RESOLVED:

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

Ralph S. Paffenbarger

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

June 26, 1956

ASEE

W. E. Street
Chairman of the Division

H. P. Skamser
Secretary of the Division

DISTINGUISHED SERVICE AWARD

Recipients of Engineering Drawing Distinguished Service Awards

1950 – Frederic G. Higbee
1951 – Frederick E. Giesecke
1952 – George J. Hood
1953 – Corl L. Svensen
1954 – Randolph P. Hoelscher
1955 – Justus Rising
1956 – Ralph S. Paffenbarger

The A.S.E.E. Engineering Drawing Distinguished Service Award*

to

Ralph S. Paffenbarger

1956

Each year the Special Awards Committee of the Drawing Division of A.S.E.E. is asked to select a member of the Division who qualifies for its Distinguished Service Award.

To qualify, the recipient must have done outstanding work in the following areas:

(1) Success as a teacher and ability to inspire students.
(2) Improvement of the tools and conditions for teaching.
(3) Improvement of teaching through various activities.
(4) Scholarly contribution.
(5) Service to the Division of Engineering Drawing of A.S.E.E.

The candidates for this award are selected from individual nominations. This year your Committee had 13 nominees. Each of these was considered and we wish that each of them could have received the Award, but the instructions from the Division are to select one person. Hence your Committee tried its best to comply with the rules set by the Division.

As Chairman of the Special Awards Committee, it is my privilege to announce that Professor Ralph S. Paffenbarger is the recipient of the Engineering Drawing Distinguished Service Award for 1956.

It took two pages of fine print in the May 1953 issue of our Journal of Engineering Drawing to publish a brief biography of Professor Paffenbarger's professional, academic, and community activities. We present at this time only a few of the accomplishments which convinced the committee that "Paffy" is "Mr. Engineering Drawing" for 1956.

Ralph earned the degrees of Bachelor of Electrical Engineering, Bachelor of Industrial Engineering, and Master of Science, at Ohio State University. He began his teaching career at the Chillicothe High School in Ohio where he taught mathematics and drawing from 1915 to 1917 -- simultaneously he was employed as an engineer at the Mead Pulp and Paper Company. Following this he accepted an engineering position with the Ohio Fuel Gas Company of Columbus.

He terminated this employment to enter Military service in World War I and served as a Lieutenant of Infantry. At the close of the war, he accepted an instructorship in engineering drawing at Ohio State University. Promotions occurred regularly. In 1936 he attained the rank of full Professor of Engineering Drawing and in 1944 was appointed Chairman of the Department.

*This citation was delivered by Dean J. Gerardi, June 26, 1956, at Iowa State College, Ames, Iowa.

Professor Paffenbarger has served on many important Ohio State University committees. Among these he has served as a member of the Scholarship Committee, Audio-Visual Materials Committee, and Chairman of the Lamme Medal Committee.

He has given considerable service in several offices and various committees of A.S.E.E. He served as Chairman of the Ohio Section of A.S.E.E., Chairman of the Engineering Drawing Division in 1951, and that year directed our summer school. He is presently completing his fourth year as a member of the General Council of A.S.E.E. and is Chairman of the Westinghouse Awards Committee.

Probably one of Ralph's most important contributions to the engineering profession is his work as Secretary of the Executive Committee of ASA-Y14 on Standards for Drawing and Drafting Room Practices. He is also Chairman of the Editing Committee. He serves on Committee ASA-Y15 which is responsible for a Standard for Graphic Presentation. When these are published, we will have an idea of the tremendous amount of work involved in the preparation of the standards

His memberships and activities in honorary, professional, social, and fraternal organizations and listings include: Who's Who in Engineering, Tau Beta Pi, Alpha Pi Mu, Phi Kappa Tau, A.S.E.E., A.S.M.E. He is a Registered Engineer in the State of Ohio, served as Commander of the American Legion in 1945-6, President of the Ohio State University Faculty Club in 1949-50, and is a member of the Rotary Club of Columbus.

In the field of authorship, Professor Paffenbarger has prepared a number of articles and papers on the subject of engineering drawing and on the administration of a drawing department. He has contributed to textbooks such as "Mechanical Drawing" by French and Svensen and "Engineering Drawing" by French, and assisted extensively in the last two revisions of the latter text. He also served as a technical advisor in the production of a series of motion pictures and film strips used in the teaching of engineering drawing.

The man who achieves a high degree of success usually does so because rather early in life he realizes that he must have someone who not only will understand him as a person, but who will share in the sacrifices and problems of life. Ralph asked Miss Viola Link, of Sandusky, Ohio, to share in his future, and November 4, 1918 they were married. They are justly proud of their three children, Ralph, Jr., Tom, and Carolyn. Ralph Jr. is a surgeon with the U.S. Public Health Service and on the Research Staff of Johns Hopkins Hospital in Baltimore, Maryland; Tom is a practicing attorney in Norwalk, Ohio; and Carolyn is attending Ohio State University.

This year Ralph completes 37 years of continuous service at Ohio State. I quote the words of one of his colleagues which very clearly show the inspiration which Ralph is to his colleagues and friends: "Figuratively speaking, stepping into the shoes of the former Chairman at Ohio State must have required courage, inasmuch as the former Executive had been Dr. Thomas E. French". Need more be said about "Paffy" as a professional engineer, and his inspirational leadership in the Drawing Division of A.S.E.E.

For outstanding service in his profession and to society, the Drawing Division of A.S.E.E. is proud to present to Ralph S. Paffenbarger the Distinguished Service Award for 1956. The award reads as follows:

RESOLVED:

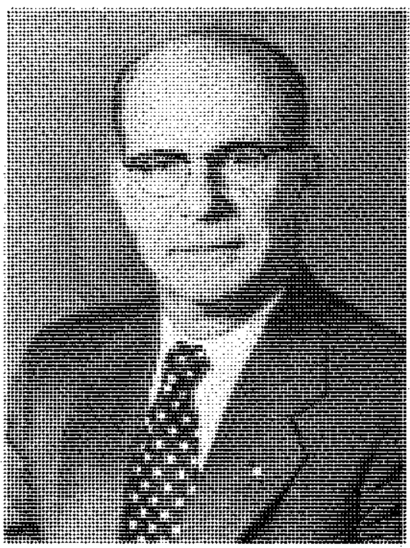
That, with the presentation of this award, the Engineering Drawing Division of The American Society for Engineering Education by this token acknowledges the many distinguished services rendered by

RALPH S. PAFFENBARGER

The Society expresses its deep appreciation for those services, and the great personal pleasure of the individual members in having his friendship

Conclusions I Have Drawn

Response by Ralph S. Paffenbarger
Receiving the Distinguished Service Award



Ralph S. Paffenbarger

I am indeed most grateful for this recognition and I thank you from the bottom of my heart. The receipt of the letter from Dean Gerardi announcing that I was to receive the Award was one of the most pleasant surprises that I have ever experienced. There has been no group of people in any organization with whom I have been associated that I have held in higher respect and greater esteem than the members of the Engineering Drawing Division. I have enjoyed immensely my years of service with this group and have felt that our contribution has meant much to the American Society for Engineering Education. Our activities and Division meetings have had the wholehearted support of all of its members. For the past several years I have looked forward to working with this group at each of our midwinter and annual gatherings.

As I start my 40th year of teaching, I would like to mention a few of the conclusions that I have drawn from my past years of experience -- three of which are: you never grow too old to learn; you should not overestimate yourself; and never underestimate the other fellow.

As far as engineering drawing is concerned, we are continually confronted with changing methods. It is the fact that new knowledge is constantly pulling the rug out from under the old. All life is a learning process that never ends. Because of changing procedures in standards and design, it has always been my policy never to be satisfied with the work that is being done but always look to better methods of instruction, for better qualified teachers, and be willing to make a trial run on things which have a possibility for improvement of our work.

We should never over-estimate ourselves. Those who are satisfied with their present accomplishments and lean back to rest on their laurels will soon become static and be passed by the more progressive groups.

I recall that after about five years of teaching experience and being assigned for summer school duty, I was approached by a student at the start of the quarter in the following manner. He said that he had just accepted a teaching position in an Ohio high school and they had assigned him to teach, among other courses, mechanical drawing. His approach was something like this: "I came in to see if I could get a course in drawing this summer. I would like to learn a little about drawing, not very much, just enough so that I can teach it." I promptly replied that I had been teaching five years and I still had a lot to learn about teaching the subject. Too frequently, drawing is thought of as a subject anyone would be able to teach after a little preparation.

We should never underestimate the other fellow. Anyone who has the background and the desire will always improve. Before I came to Ohio State University I was employed by the Ohio Fuel Gas Company and worked on transportation and measurement of natural gas. A young man came to the company, having been transferred from another division where he had been a service employee and had become an expert repairman in proportional gas meters. He had not been educated beyond the eighth grade. On one of the trips around the division I recall having explained to him the theory of the orifice meter. He questioned whether he would ever be able to fully understand this type meter. Because of his extreme interest and his continued application and thirst for knowledge, that man became in later years one of the foremost men in gas measurement in the United States. He now is the Vice-President of the Ohio Fuel Gas Company and a member of the Board of the Columbia Corporation.

One other incident which also remains vivid in my memories is that of a student who came to the Entrance Board of our University several years ago from West Virginia. This individual likewise had never gone beyond the eighth grade. He had developed an interest in pumps through his association with oil companies and was an expert technician in servicing all kinds of pumps. He studied by himself and finished several math books, as well as the subjects of physics and chemistry on his own. The Entrance Board told him that he could only be admitted as a special student and could not receive a degree because of his lack of entrance requirements. They sent him to the several departments for evaluation, and I recall his visitation to the late Professor Thomas E. French. He told Professor French he had read, among other books, his own "Engineering Drawing" and was interested in learning all about how to draw and design pumps. Placement tests showed that the student was capable of taking college mathematics. Professor French recommended him for admission as a special student while several recommended that he not be admitted because they felt that due to his rough looks and lack of high school background he could not make the grade. This boy completed all of the requirements for an engineering degree, was elected to all of the honorary societies in the course of his study, was graduated summa cum laude, and is now President of one of the leading pump companies in the United States.

I believe in giving a student every possible break if he has shown an earnest effort to acquire knowledge. He may surprise you; many of them do.

Be not the first by whom the new is tried,
Nor yet the last to throw the old aside.

I once heard of a person that had invented a new boomerang and then went crazy trying to throw the old one away. Speaking of boomerangs, I would like to close with this poem which I remember having first seen in my late father's scrapbook:

If a bit of sunshine hits you
  With the passing of a cloud;
And a fit of laughter gets you
  And your spine is feeling proud.
Don't forget to up and fling it
  At a soul that is feeling blue,
For the minute that you sling it,
  It's a boomerang to you.

Thank you again for the recognition.

The Esthetic Functions of our Disciplines*

By F. G. Higbee

State University of Iowa

Teachers of fundamentals such as the subjects represented here in this joint conference of teachers of English and of Engineering Drawing may well pause from time to time to remind themselves of the opportunities and responsibilities not infrequently overlooked in appraisals of such instructional obligations.

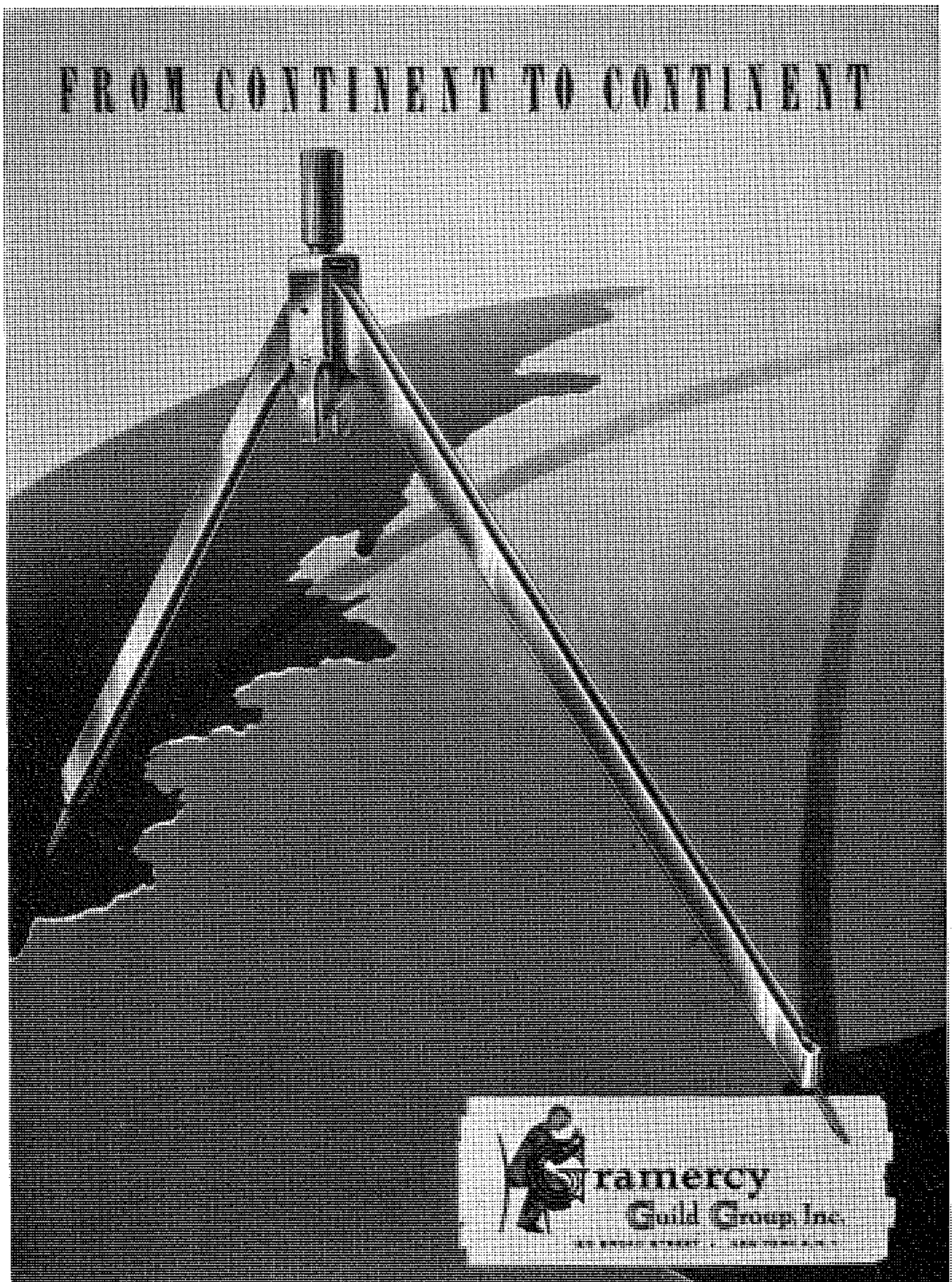
To emphasize what these important areas of engineering instruction are, let us take time enough for a look at the last fifty years of engineering education through the eyes of a veteran who has had the exhilarating experience of having been a part of this half-century of engineering education and who has acquired a viewpoint fixed by an intimate association now tempered and mellowed by retirement.

The very first of these several glimpses into the past reveals that very little indeed of the technology over which so many long hours of study and laboratory work were devoted as a student is now usable. As I look back on my college experiences to catalogue the subjects studied, I find but a small portion of that subject matter resembling the same subject matter as taught today. This disparity may be measured perhaps by stating that English, engineering drawing, mathematics, and foreign language are today the same basically as they were fifty years ago. But beyond that similarity ends. Both with respect to the content of subject matter and to the subject matter itself there have been great changes.

Another look at the past fifty years of engineering education discloses that the engineering college of that early period had a vastly simpler institutional organization than does its modern counterpart. Fifty years ago there were no student unions. Dormitory living was the exception rather than the rule. Deans of men were just appearing on the horizon, there were no counselors or official advisors. Placement problems were personal matters of no apparent concern to this college in any organized fashion. Limitation on the number of credit hours for which one enrolled was regulated more by conflicts in schedules and the hours

(Continued on Page 43)

*Presented at the Joint Conference of the Drawing and English Division ASEE, at Ames, Iowa, June 26, 1956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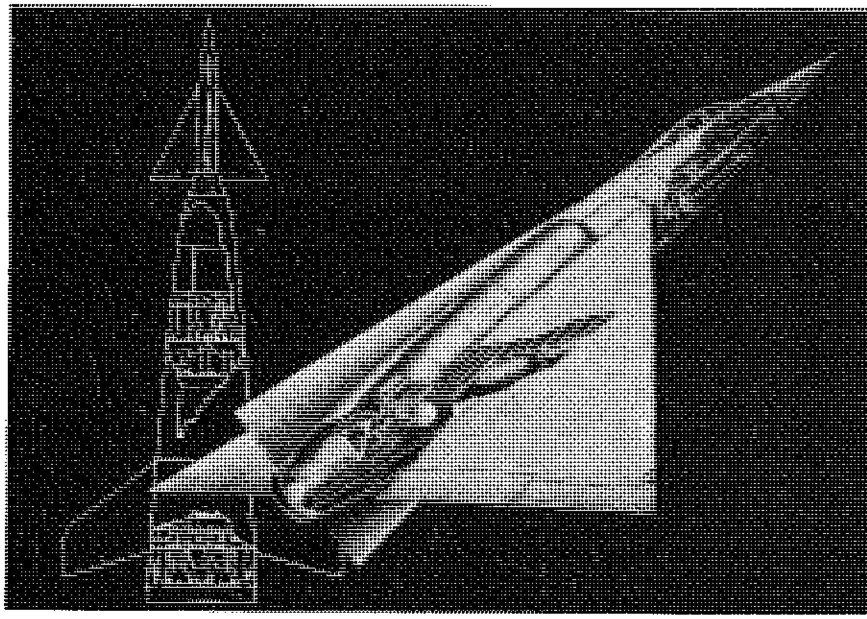
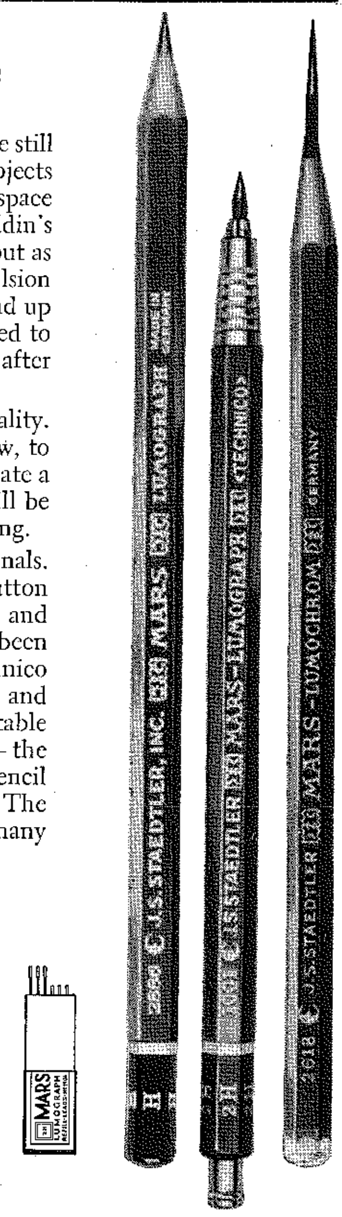


3 stages to space

The designs that will make news tomorrow are still in the "bright idea" stage today—or perhaps projects under development like this three-stage, two-man space ship. Drawn by Fred L. Wolff for Martin Caidin's "Worlds in Space," the rocket craft would start out as shown in the reverse drawing at left, shed its propulsion boosters in two stages as fuel is exhansted, and end up as the trim plane-like ship at right. Ship is planned to orbit a hundred miles above earth, return safely after one to two days.

No one knows what ideas will flower into reality. But it will be important in the future, as it is now, to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—sketch to working drawing.

Mars has long been the standard of professionals. To the famons line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and — last but not least — the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.



The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom colored *drafting* pencil, 24 colors.

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at all good engineering and drawing material suppliers

in the day than by rule. I carried twenty-two hours as a freshman and thought nothing of it.

The atmosphere and spirit prevailing among students and staff was one of serious endeavor. Engineering college was traditionally a place where work — hard, exacting, and extensive work — was accepted as a matter of course. As a result there was little college social life, but when and if the engineering student of that era let go and relaxed, he did so — shall I say — in a zestful and robust fashion!

If in those days some venturesome faculty member of an engineering college had opened a discussion on the value of a humanistic-social stem, or had proposed a bifurcation of the engineering curricula, I am sure I do not know what would have been the result. Yet even then engineering colleges were aware that general education had a contribution to make toward the development of an engineer. To that end the practice was generally the inclusion of at least two foreign languages and a course or two in what was then called political economy.

I have no intention of attempting an evaluation of engineering education of this fifty-year period. The engineers trained by the system so roughly sketched here stand as their own credit to that system and as an endorsement of the principle which continues year after year to be repeated and emphasized at A.S.E.E. meetings. And that principle is simply this: These men were given an excellent training in basic fundamentals among which were drawing and language. Training in what may well be described as the ability to read and record ideas in an appropriately descriptive language. These men were also trained in the ability to think and to learn. Without these basic and essential abilities there could have been — nor can there be today — no technological progress.

Lest there be created an idea that I am critical of the teaching of detailed technology, that since the teaching of detailed technology is always likely to be out of date and, therefore, time so spent is time wasted, let me remind you that in addition to other valid reasons the teaching of engineering technology provides the educational vehicle by which the development of mind and the ability to learn are carried to their destination.

A final glimpse into the past allows us to contemplate a technological revolution so extraordinary that an adequate portrayal of it in a discussion of reasonable length becomes next to impossible. Amazing developments are somewhat commonplace in the current day and age, but a survey of developments within my lifetime reveals changes almost beyond comprehension. Even were I gifted enough to devise a descriptive phrase for the scientific-technologic changes which have been taking place since the beginning of the century, such a description would still completely fail to indicate the extent to which our social, economic, and personal lives have been revolutionized.

Consider for a moment the national transportation systems. During my lifetime two systems have become obsolete and have been scrapped: the inter-urban electric railway and its companion the city electric trolley car, and the inland canal. Three entirely new transportation systems have been developed and on a gigantic scale: the airplane, the automotives, and the pipe line. Two of the oldest of our systems, the railway and the natural inland waterway, have undergone extensive renovations and improvements in motive power and equipment.

Consider also the generation and distribution of power. I can remember a well-known professor of mechanical engineering, who later became dean of a distinguished engineering college in the Middle West, expressing with some irritation the opinion that the gas engine was an invention of the devil. The remark was inspired because a student had just been sent sprawling to the laboratory floor as the hot tube ignition finally caused the explosion that turned the fly wheel on which the student had been climbing in the cranking process. I recall too feeling like a Rip Van Winkle as I visited recently a modern steam plant where the equipment was completely different from that used in my student days. It is no exaggeration to state now that the internal combustion engine has revolutionized farming, has made possible the development of the great automotive and aircraft industry, and has been an important factor in bringing electricity to the front doors of the people of this nation. Today we are constantly reminded that we are about to have a new source of power and new applications of this new source so far-reaching as fairly to stagger imagination.

What, we might well ask, has happened in our homes and in our daily lives by the application of technological advances? Thus we can recall that we have not always had running water, sanitation, electricity, telephones, radio, television, air-conditioning, food refrigeration, our own private transportation system, and all the many household aids for easier and more comfortable living. Technological advances have been so rapid and the acquisition of the benefits of these advances has been made so easy we are prone to overlook much approaching the miraculous. The appreciation of our many advantages is sometimes enforced only by the failure of one of them. We have fallen into an easy acceptance of technological benefits which we tend to take for granted.

To call attention to three noteworthy and awe-inspiring developments of recent years — instrumentation, atomic energy, and electronic computers — is to focus attention on the creativeness of modern technological and scientific thought. Because of such creativeness we can assert with assurance that even though technology and science as taught in college may lag behind actual developments, human minds trained to think and to learn have reached into the unknown for new discoveries and technological applications undreamed of before.

Despite these developments by scientists and engineers trained in an era before such creations were even on the drawing boards of the imagination, there has been a movement of late to re-design and re-organize engineering education into new patterns believed to be more likely to stimulate creativeness. But so long as the engineering curriculum includes a thorough training in fundamentals including basic sciences, and uses current technology as one means of training in thinking, in learning, in creativeness, one need not be unduly concerned over the detailed distribution of credit hours over an array of subjects assorted into the several kinds of engineering in which degrees are awarded.

So much then for engineering education. What can be said about engineering itself and about the profession largely responsible for the amazing and inspiring developments of the past fifty years?

Doubtless the most satisfying change — satisfying certainly to members of the engineering profession — has been the growth in public esteem and confidence in the profession which has become increasingly evident. That engineers are capable of solving great problems and of creating new devices for the comfort and convenience of mankind has become a common belief. Along with this gratifying public faith there has grown a conviction that engineers may be entrusted with responsibility to a high degree.

From a somewhat obscure figure in the background of public works and private enterprises whose job has been to put science and technology to work for the betterment of humanity, engineers have emerged as figures of responsible leadership.

Of engineering itself probably the most enlightening description of its progress during the last half-century is embraced in the single word "gargantuan." Just as Gargantua was the fabled giant of Rabelais so is engineering the giant of modern progress.

One hundred and fifty years ago engineering was described as either military or civil. A century later the civil engineering branch began to be subdivided into chemical, electrical, mechanical, and mining engineering. Today while these five major branches continue to include the overall fields of engineering activity, a glance at a recent issue of The New York Times discloses many new and recent engineering specialties. And all of these are demanding, almost begging for talent. In what amounts to headlines on "want-ad" pages employers are clamoring for electronic engineers, engineers for gyroscopics, digital computers, telemetry, guidance systems, servomechanisms, environmental research, radiographics, instrumentation, radar, executive posts, publication engineers, electronic engineering writers, technical writers. These new specialties alone are a measure of the progress in recent years of a technology undreamed of fifty years ago. That these new fields of engineering are actualities today is but proof of the pace in modern development. This development is a significant illustration of the truth that science both pure and applied in this atomic age is the work of men whose education began in an era of science and technology before fission was even known.

Thus even so brief a consideration of the past reveals a truth which engineering educators have had brought to their attention again and yet again: that engineering education must be based on fundamentals. With a knowledge of fundamentals and the ability to learn, engineers may professionally survive and grow in an age of rapid and extensive technological change.

Indeed there may be appearing on the educational horizon some indication that today engineering education has not been able to satisfy completely those employers who have been its staunchest supporters and greatest recruiters of its trained talent.

In a recent (January, 1956) article in Fortune magazine this significant statement is given special emphasis:

> "All of a sudden, industry has broken free of the shackles of applied technology, and has begun to foster basic science. It is also doing 'research on research' and finding new tricks to stimulate creativity.
>
> " ... research directors are sensing that empirical and closely applied research no longer provide an adequate foundation for a healthy business technology. We have to work on the frontiers of science -- if only to appraise the work of others. No company can hope to make all the discoveries, but if we are up on fundamentals we can quickly evaluate work done elsewhere ..."

According to the article referred to "The sharpening of competition has been accompanied by a swift expansion of industrial research and development, and over 4,000 business firms now maintain research laboratories. Estimates indicate that ten years from now the financial outlay for research and development will approach $7 billion a year."

Another article entitled "Management in Search of Man" in a magazine of quite a different type (Atlantic Monthly, March 1956) has this to report:

> "There has been a great deal of talk lately in universities and secondary schools about the vast engineering opportunities in industry, about embryonic engineers just out of school who, clutching their brand-new degrees, are collecting $7,000 or more a year for their services. Big city Sunday papers are filled with advertisements for a variety of technical talents.
> "Does this mean that young men with a liberal arts education find very little opportunity in modern industry? The answer is — emphatically, no. As a matter of fact, the basic question seems to be: How many parts Specialization to how many parts Generalization? An anecdote best points up industry's problem and its solution:
> "The president of a large steel company, at the end of a personal search for a bright young man for his office, had two equally impressive candidates — one a metallurgist, the other a liberal arts graduate who had majored in English Literature. He had them both to lunch — together. The next day he saw each of them in separate interviews.
> "The metallurgist came in with an air of resignation. 'I know I don't have a chance for the opening,' he said. 'After meeting the other candidate, it's plain to me that his broader background and his ability to size up all sorts of situations far outweigh the technical knowledge I have to offer.'
>
> "The English major also came in to bow out of the picture. 'A few minutes conversation at luncheon,' he said, 'convinced me that I couldn't hope to compete with a man who has such practical knowledge of the steel industry. I realize now what good equipment a study of the sciences is for business.' "

The steel executive solved the problem by hiring both men. Both kinds of abilities were essential to his business. And — the author of this article goes on to state, "I believe that is precisely the decision industry in general has come to. We surely have to have the technical men; but large enterprises are social organisms, aggregations of people, societies which must have their ethics, their values, and a sense of perspective as well as technology. They very much need a leadership with depth and breadth in understanding, for the ends of science and technology are human ends — and so are many of their means.

"Industry's sense of need for the broadly educated mind is reflected, I think, in an experiment being conducted by one company — which I am told has hired a liberal arts student with the express intention of turning him into an electrical engineer. The company hopes he will absorb enough information by osmosis from the other engineers and by extra reading to become a competent engineer himself. If the experiment succeeds, the firm will have found not only a new way of acquiring technologists but a way of acquiring technologists with uncommonly broad backgrounds."

There is no need in this presence more than to admit there exists a great shortage of engineers. Nor is there need to argue that what remedial measures have been taken to overcome this shortage have been none too successful. We know the shortage has been due to many factors among which the greatly increased ratio of technological talent to total employment, and the accelerated rate of drafting engineers into executive and administrative posts have played no small part. The time may come — and let us hope that it will come soon — when this shortage of technical talent may be recognized as one of the great dangers in what recently has been renamed the "hot peace" in place of the "cold war."

If history and present trends mean anything, at least they re-emphasize the necessity for a sound foundation of basic knowledge, for an inquiring mind capable of original thinking, and for sufficient breadth of background to meet ever-changing and significant social problems.

History and present trends seem to demonstrate that engineering education has done rather well for the training of engineers in basic knowledge and in the development of sound thinkers. But for more than ten years now engineering education has been struggling with the problem of breadth in technical education. How successful this struggle has been I shall not attempt here to discuss. The time has now come in this discussion to point out what one man believes teachers of English and engineering drawing may do toward improving engineering education and their own contributions toward that end.

I trust teachers of English will not misunderstand me when I point out that in recent years the ability to write has been discovered as being an important and necessary technical asset. That so many advertisements now appear asking for technical writers of one kind or another is but printed evidence of this discovery. Therefore, teachers of English in engineering colleges have now arrived at that desirable status in which what they are teaching is no longer considered as a sort of a step-child in engineering education.

Teachers of engineering drawing have so long enjoyed the recognition now just being accorded to English that there is some danger that engineering educators may take engineering drawing for granted. A sort of queer attitude that well, certainly you need to know how to read this language, maybe even to write it, but why take so long about learning how?

But the inescapable fact is that English and drawing are necessary fundamentals, are in fact complementary languages essential in technical enterprises. Industry has long recognized that by the use and practice of the skills acquired in the study of English and drawing, their recruits learn the business and their veterans are able to explore the unknown.

Teachers of these two subjects are fortunate indeed to be laboring in fields substantially established and so widely acclaimed as engineering fundamentals. That such teachers are meeting today in joint session is, I trust, evidence they have mutual problems, mutual purposes, and perhaps mutual ambitions to improve these closely related fields of technical communication. I have enjoyed a long association with teachers of engineering drawing, and during my long association with engineering education I have known and admired many teachers of English. I have nothing but admiration and respect for the contributions they have made and for their devotion to their disciplines.

But the very word discipline reminds me to call your attention to two important by-products of your teaching, by-products which in some respects are even more important than the disciplines themselves.

The first of these by-products is the creation in the minds of your students a passion for exactness, precision, completeness, and an uncompromising and unrelenting determination for correctness. Both of your languages lend themselves to that kind of discipline, and that kind of discipline makes for great men.

The second of these by-products may best be expressed in the language of the great educator who is president of the State University of Iowa who stated:

> "We forget that it is possible to become liberally educated by the teaching and study of professional and specialized subjects in a liberal manner."

In a strong plea for breadth in technical education President Hancher chose, interestingly indeed, engineering drawing as providing opportunity for teaching "in a liberal manner." Calling attention to the fact that the late Professor French "gave testimony to its cultural value by pointing out that apart from its practical utility, it can be used to develop constructive imagination, the perceptive ability to think in three dimensions, to visualize quickly and accurately and to building up a clear mental image."

"I am aware," President Hancher continues, "that much time has been spent on engineering curricula and that there have been argument and debate on the introduction of political science, history, economics, and many other subjects into the engineering curriculum. But, bearing in mind that the time engineering students can spend in college is limited and that the pressure for inclusion of additional technical subject matter is very great, has anyone considered how the normal subject matter of engineering can lead to the civilizations of the Nile and of the Tigris and Euphrates, to the construction of the temple to Jupiter at Baalbek, or of the Parthenon at Athens or of the Colosseum at Rome?..."

Surely enough has been stated here to establish the fact that breadth in education is not dependent upon subject matter alone. You teachers of engineering drawing and of English have a great opportunity. Your disciplines are needed in this expanding and developing technologic society, your subjects provide splendid vehicles for disciplining and developing minds, your subjects offer you rich opportunity to broaden and enrich backgrounds now top-heavy with a technologic content which may be obsolete tomorrow.

These are the opportunities and responsibilities referred to in the opening paragraph of this address. Perhaps if you do this well, your disciples someday will be mature enough to appreciate what Strindberg meant when he stated:

"Education is everything that is left after one has forgotten all that one has learned"

The Function of Drawing: Creativity*

By Wayne L. Shick

University of Illinois, Urbana

Some years ago, 142 semester credit hours were required for a Bachelor of Science in Architecture or Architectural Engineering at a midwestern university. Approximately 90 of these 142 credits were for courses in which the primary, creative, scientific method and also the means of expression and communication was drawing. An architect or architectural engineer looked forward to a dynamic life of creativeness by and through drawing. He also had developed a proper humility from that relentless test of creativeness, the visual test of drawing.

The present curriculum in architectural engineering is 165 hours in five years, with graphics still in the lofty position of 90 hours. I earnestly hope that this position will be vigorously defended and maintained. Yet in ECPD-approved engineering curricula, you will look hard to find graphics taught or used to any extent in more than fifteen percent of the courses. And you will find begrudging approval of what little graphics is permitted.

On the train of engineering education, the drawing people are not in the drawing room; we are not even coach passengers; we're in the baggage car. We have been segregated. But there is hope; somewhere on the train is a private car where drawing people are traveling in style; think of it, 90 credit hours in graphics! We would enjoy similar accomodations, but a dusty, old coach would look good now. There are no windows in this baggage car, so we can't see where we're going. Ironically, most of the folks riding in the passenger cars are not interested in looking out their windows; they don't care as much about what things look like as we do.

Individuality and creativity are the dignity and spirit of architecture. Every architecture student and architect sees each problem differently and achieves a different answer. An architect solves complex problems by sketching and drawing his inspirations; then he expresses his solution by drawing. The drawing must stand on its visual facts and merits. The drawing says for the architect: "I do not fear to see what I think; this drawing is what I believe; right or wrong, here I stand!" Does the engineer gain this fortitude or humility, inspiration and creativeness by experiments and mathematics which arrive at one, non-visual "correct" answer? Academically, such mathematical and laboratory routines are so easy to assign and grade! But how much spirit of creativity is there?

If you have never spent a day in an atelier with architecture students, then you have never experienced the fever-pitch of motivation, individuality and creativeness. The atmosphere is electric, compounded of the joy, the intense thought and graphic activity of several throbbing minds and skillful hands in the act of creativity. Later, all the drawings are displayed on a long wall, and what a time is had in seeing, explaining and judging all those different, exciting creations!

The great amount of drawing used by architects and architectural engineers has been explained by other engineers on the premise that architects are more concerned with beauty and appearance than engineers. This premise is not valid because it is based upon incomplete and obsolete concepts of beauty and the reasons for the appearance of a thing. Architects are not more concerned with "prettiness" than engineers. However, engineers should be just as concerned as architects with the realities of "beauty."

The dictionary defines "esthetic" as the quality of beauty as distinguished from usefulness; and "beauty" as that which gives pleasure to the senses or exalts the mind or spirit. But architects have long since revised these old meanings as being perverse and abstract.

In our contemporary culture of science and engineering, beauty is more than this. Beauty is the pro-

*Professor Shick's presentation of this paper, at the Joint Conference of the Drawing and English Divisions, ASEE, Ames, Iowa, on June 26, 1956, was followed by prolonged, spirited discussion.

duct, the expression of goodness, economy, logic and function. It is perhaps redundant to speak of "esthetic functions," for that which is functional is therefore beautiful.

The more useful a thing, the more beautiful it is. Even the beauty of a flower is functional: It attracts insects which feed upon and pollinate the flower; the flower reminds us that spring is here -- spring, when the fuel bill will be less and when the children go outdoors. The flower is a beautiful token of warmth, life and creation following a barren, cold winter.

In our country, it is a beautiful, poetic thing that each of us has a watch, a car, and other assembly-line goods. Is the mass-produced watch less beautiful than the precision timepiece? On a unit-quality basis it may be, but the quantity of pleasure and utility derived from the low-priced item exceeds that gained from the expensive. Quality is not the sole measure; beauty can be weighed by the quantitative scale of goodness.

Not always is the mass-produced thing less beautiful than the handmade luxury. When a corporation spends millions designing an automobile, it is often more functional, more beautiful than a custom model. It is a tribute to the automotive industry and to capitalism generally, that mass-produced items are repeated so many times at a low-price for all, and still sustain such a high esthetic response. Rarity is no measure of beauty.

It is beautiful when architecture and engineering satisfy human needs. Each thing created must be justified as "dollars well-spent." Which is more beautiful: A four-million-dollar, flamboyant building, with everything of special manufacture, or a two-million-dollar, classic building of the same capacity, built of standard units -- plus 200, $10,000 homes? When the same work and money is expended for each of two things, which thing achieves the greater good? It is far more beautiful to save 200 families from cold and slums than to rear an extravagant monument to some architect's ego.

Apply this sentiment to architecture or engineering in any age. Go back to the ancient pyramids, beautiful and astounding, but reflect upon the death and struggle, the nothingness of life for the mass of slaves who lifted those piles of stone -- then, are the pyramids beautiful? Building a great dam across the Nile river might have accomplished good commensurate with the labor expended, but not the pyramids. Questions of relative beauty and goodness are constantly with the engineer. His drawing, his creation, has a spirit; it is a means toward beauty, of human comfort and happiness.

There are few God-created or man-processed things which do not derive beauty from usefulness, or usefulness from beauty. Beauty is created when graphics or rhetoric function to accomplish a useful purpose, in a logical, economic way. But more than the measurable qualities of beauty, is the reaction when the drawing or essay has been read: "What a beautiful thing -- I understand fully," or "How ugly -- I don't know what it means."

Science has had a revolutionary effect on art and beauty. About a hundred years ago, the advent of practical photography shook the art world. Thousands of artists saw their livelihood being taken away by the all-seeing eye of the camera. A sort of psychosis gripped the artists as they strained to find new art forms and ideas, trying to do things which the camera could not do. This was the beginning of cubism, impressionism, surrealism, and the "what is it?" schools of painting. No longer would a true artist be so banal as to do realistic drawing or painting, the life-like portrait, the newspaper or magazine woodcut. The public had to be educated to the new schools of art -- if you didn't understand what the artist had smeared on the canvas you were not cultured, you were not of the intelligentsia. Oh, we still have artists, such as Jon Whitcomb and Norman Rockwell, whose faces and figures are recognizable -- but they are not really artists -- only commercial artists!

But the lowly commercial artist is not the major exponent of realistic art and beauty. Creative engineers are true, scientific artists! The realistic drawings of the engineer express the creative thought and inspiration of an orderly intellect. Things which exist only in the mind of the engineer can be seen by drawing; the finest photography is helpless to record one particle of an engineer's mental creation. Only the primitive expedient of model-making -- exorbitant in cost and time -- can partially supplant the engineer's scientific art: engineering drawing.

Perspective is the "poetry" of drawing, a creative "impression." Orthographic drawings prosaically show what a creation is, from the set of drawings for a large machine to the simplest form, a freehand rectangle.

A freehand rectangle with many words and numbers is sometimes called "Simplified Drawing." A better term might be "Simplified Drawing --Complex English," a combined form. If "Simplified Drawing--Complex English" is carried to the ultimate, the engineer will use a typewriter more than a T-square. He should also know several languages to replace the universal expression of drawing. Seriously, this ultimate will never be reached, for few things are more clearly described by words and numbers than by drawing.

Is engineering drawing a creative science and art; is it a means of effecting beauty and usefulness? Or is it just a skill, like penmanship, or typing -- purely a mechanics or technique? To help answer these questions we may compare Engineering Drawing with English for Engineers. A hypothetical and facetious outline of English for Engineers might be as follows:

> Learn a few simple rules of grammar and punctuation, and stress penmanship and typing skill. Copy and memorize a few classic examples. Use the dictionary to learn the spelling, pronunciation, and occasionally the meaning of words. Since specialists can be employed who speak and write well, it is necessary for the engineer to learn only the rudiments of English; therefore, too much time is spent in teaching English. It is really necessary that the engineer be able to give only a sketchy idea in his speech and writing, aided by sign-language and arm-waving, and then the writing-technician can better

express his ideas for him. Therefore, sketchy and fragmentary forms of English expression should be emphasized.

This outline is absurd and outrageous! But who has not heard similar words for engineering drawing? It is as intelligent to omit logic, science and art from English as from engineering drawing.

It has been repeatedly voiced that engineers should do creative work! I suspect that the creativity of engineers is limited by the method presently emphasized: laboratory experiment and mathematical analysis. The laboratory affords only the tangible, existing, "what has been done" facilities. The engineer can never create more than what is at hand; he will not create; will merely collect, juggle and assemble existing pieces. His mathematical analysis is creative, but affords no visual or tangible expression.

What is lacking from this effort to create? An item which has been classified as a non-engineering course. The engineer can create his mathematical, scientific inspiration by and through drawing. Drawing is a beautiful, functional process which enables the engineer to create tangible, visual forms — to check, to clarify, and to redesign. The science and art of drawing is for creativity outside the bounds of what has been done.

The architect and the artist feel this creativity in their souls as they work at their drawing boards and easels. They see their creations grow, see their thoughts take form and meaning, come to life! Is this spirit and hand of creativity to be shrunk or cut off from the engineer? Is the engineer never to see his brain-child grow under his own hand — by drawing? Is the child of his mind to be reared in an orphanage, the drafting room?

Technical illustrators are working for our corporations which employ engineers. Does the engineer ignore the pictorial drawing which the technical illustrator interprets from some draftsman's orthographic which is deciphered from some engineer's data? Perhaps the engineer's attitude is one or more of these: "That's the way I calculated it, and the way the laboratory tests supplied the data; it is infallible; no improvements or refinements can be made; no other approach is rational; that's the way it must be; don't bother me with details; don't let me see what it looks like — I might have an inspiration to do it another way; I might not like what I see." Thus the orthographic drawing and the pictorial view become by-products rather than means to creation. But architects constantly use pictorial and orthographic drawing to actually see and experiment with various elements as their creation develops, with no limit on creativity, no limit as to what has been done!

The recent Evaluation of Engineering Education emphasized freehand sketching ability. Could this be wishful thinking that this would require only superficial education in drawing? Does emphasis on "freehand sketching" minimize the need of rigorous teaching of the science of drawing? There are two distinct elements here: First, the science and art of graphics, and second, the hand-eye coordination skill of sketching. The engineer who would sketch scientifically and creatively, not in irrational scribbles, must first know the science of graphics, fully. The most proficient operation of the finest drawing equipment, or the most skillful sketching technique accomplish nothing without the science of graphics. This science and art will not be learned by some miraculous short exposure.

It is surely true in engineering, as it is in architecture, that the individual will not create a thing of which he cannot understand the form, anything which he cannot depict. Can the engineer design three-dimensionally-curved surfaces and complex machines by mathematics and science alone? How can he, without knowledge of the graphic, the real, the tangible depiction of his mathematical and scientific analysis? Will he have a mental block in attempting such analysis, if he cannot visualize or know that he can picture his analysis? Perhaps the engineer can design without graphics; I dare to suggest that he might do better and faster with graphics. And moreover, that he might be motivated to create if he could see his creation develop.

To create, the engineer will have full knowledge of all three-dimensional forms, and all means of graphic portrayal of any object, no matter how complex. Visualizing his creation, he will not fear to attempt any project or analysis. With comprehensive knowledge and experience in graphics, he will readily draw, see and modify his creation. He will communicate his creative ideas to others in engineering by graphics, for their rejection and approval of various elements and ideas. He will know that his creation in the graphic state is ready to be born — ready to be made by the laborer who can see and understand his graphic creation. He will not be frustrated and narrowly limited by superficial knowledge of graphics or any other science. The function of drawing is that of creativity.

Creative Problems for Basic Engineering Drawing

By Matthew McNeary

University of Maine

If a college course is to have a respected place in a college curriculum, it must be significantly different in content and presentation from a course in the same subject offered in a secondary school. It is true that basic drawing courses in college may delve more deeply into theoretical matters and may require the execution of more complicated drawings than many high school courses, but there is one element usually common to both: the laboratory work consists largely of copying. The work may require changing a pictorial drawing to a multiview drawing or vice-versa, but it is still copying. Herein, in my opinion, lies the greatest weakness today in engineering drawing educational methods at the college level. The remedy lies in introducing creative problems.

"Creativity" is a favorite topic in technical journals and even popular magazines these days. Scarcely an issue of the "Journal of Engineering Education" has appeared in recent years without some mention of the desirability of instilling a capacity for creativeness in our students. A few years back you will recall that the "humanistic stem" was in similar vogue. The difference for us is that the "humanistic stem", while important, is difficult to incorporate into drawing courses, but "creativity" is a natural adjunct of drawing and should be enthusiastically seized upon by drawing teachers as an objective in their teaching.

Creative problems may be time consuming. As has been pointed out by Professor J. D. McFarland in the February 1956 JOURNAL OF ENGINEERING DRAWING, the project-type problem is often impractical in a course such as engineering drawing where time is so short. One must be careful, then, to construct problems that require independent judgment on the part of the student and, at the same time, can be accomplished with reasonable speed. With some ingenuity this can be done. Here are some suggestions for devising such problems. These, in all cases, do not demand "creativeness," in the strict sense of the word, but they do minimize copying and encourage individuality.

1. The Design Problem. Ask the student to design some simple, well-known tool or part of a machine. For example: "Draw an outline of an open-end wrench for a 1/2" hexagon nut." The student must determine from a table the width across flats and should be asked whether an opening of exactly that size would do or whether there should be some clearance. He will then have to draw a circle, cut out a "U"-shaped piece, and attach a handle. Last year we gave this as one of our first exercises to 550 beginning students and got 550 different wrenches, some of them very interesting.

If a problem is given which requires the design of a device composed of several mating parts, it is important to start with a design assembly and follow with the detail drawing and the final assembly drawing. This is the procedure used in industry but seldom followed in basic drawing courses. Usually, in basic drawing courses, the design assembly is omitted and the details are drawn from a fully dimensioned pictorial drawing or assembly drawing. It is better to design from scratch a simple device having only three or four parts than to detail a more complicated machine that has already been designed. A stuffing box consisting of a valve bonnet, gland, and stuffing nut, or a flexible connector consisting of two end flanges and a floating disc are examples of suitable subjects for this type of problem.

2. Omitted Dimensions. Problems traditionally presented in the form of fully dimensioned pictorial drawings to be drawn in multi-view projection may be altered by removing non-cricital dimensions and leaving them to the judgement of the student.

3. Tabular Problems. Manufacturing catalogs are full of multi-view drawings of machine parts in which the critical dimensions are indicated by letters whose numerical equivalent may be secured by consulting an accompanying table. In this way, one drawing serves to describe several sizes of the machine part. Many non-critical dimensions and design details are omitted. The use of this type of problem permits the assignment within a class of several variations of the same problem and also leaves the determination of the non-critical dimensions to the individual student.

4. Verbal Instructions. Engineers as a rule are not verbally-minded and prefer to communicate with pictures or mathematical symbols. However, in engineering practice frequently they must follow verbal instructions and therefore need training in creating a graphic description from a verbal description. Here is a typical verbal problem:

A bank vault hinge is to be made by performing the following operations on a block of steel 8" wide by 4" high by 3" deep.

a. The upper right quarter is cut away.

b. The forward left quarter is cut off.

c. The right end is rounded to a half circle of 1 1/2" radius, and a 1 3/4" diameter bolt circle on the same center locates four 3/8" diameter holes, equally spaced, drilled from the top to a depth of 1 1/4".

d. The remaining left quarter is rounded to a 2" radius through 270°, and a 2 3/8" diameter hole is bored through on the same center.

Professor George J. Hood, in his book "Geometry of Engineering Drawing", to the best of my knowledge originated this type of exercise, and it seems to have a great deal of merit. There is no line drawing or photographic cut to aid the student: he must visualize the entire object in order to put it on paper in graphic form.

5. Curve Plotting. If students are asked to plot a curve from given experimental data, it follows naturally to ask for a determination of the equation of the curve. This ties in nicely with freshman mathematics. Of course, at the freshman level it is probably best to use straight-line data. Since the student uses his own judgment in drawing his curve through the average of the plotted points, most equations from the same data will vary slightly. It is this variation that makes this exercise interesting.

6. Creativeness in Lettering. Lettering exercises usually consist of copying letters and words beneath or adjacent to a given sample. As a supplement to this, a student may be given a blank exercise sheet on which he is to letter his name, major curriculum, and home town. All will be different. He also may be required to put some given information in the form of a title of his own design. Each element of the title may be centered about a center-line or initial letters may be aligned in

some manner, or a combination used. Here again most efforts will be individual and different.

The wide-spread use of workbooks in which the student completes partially drawn problems has the advantage of permitting wider coverage of subject matter than the blank paper approach, but the originality of the student is suppressed. An ideal course would be one in which the advantages of both methods are combined; some problems partially drawn and some created in entirety on blank paper.

Throughout the preparation of problem material, every effort should be made to incorporate material from all fields of engineering, and not to work exclusively with machine parts. Civil, electrical, and chemical engineering are usually neglected in our basic work. Broadening our scope in this way will enable us to do an effective job of student orientation. This is especially important if the freshman year is common to all curricula and choice of a major field is made in the sophomore year.

I have presented a few ideas that should make our laboratory work more interesting and challenging for both the student and the instructor. The number of problems that can be devised within this framework of ideas is infinite. With a little thought and ingenuity, and a willingness to depart from tradition, any instructor can become creative himself and enrich the basic work in engineering drawing through the origination of new and more effective problem material, — our most important and our most vulnerable teaching tool.

The 1956 Engineering Drawing Summer School
Some Reflections and Recommendations

By William B. Rogers

United States Military Academy

The prospects for the 1956 Engineering Drawing Summer School were good. Program material appeared timely and interesting and the speakers well qualified to discuss their assigned topics. Much credit is due those who worked long and conscientiously laying the groundwork for a successful Summer School. Prof. James Rising and his Iowa State staff members were ideal hosts. The setting was geographically located for optimum representation, and excellent facilities were provided.

Unfortunately, from the "student" viewpoint, much of the time at Ames proved to be wasted! Time spent in the society of the recognized leaders in engineering education is not time wasted. Mealtime conversations, impromptu gatherings in lounges, corridors, or dormitory rooms with such men as these proved a valuable and inspiring experience attainable in no other fashion. The non-productive time was most noticeable between the hours of nine and noon and two and five P.M. It is disappointing, to say the least, to travel halfway across the continent to attend a "summer school" listing among its "faculty" individuals of unquestioned attainment and well deserved fame only to be left stranded for the best six hours of each day in a state of physical inactivity and mental suspension while a speaker struggles through a monotonous reading of his paper. The platform performance of some of the patriarchs of our profession fell short of expectations!

There were notable exceptions. A bright beam of wit, the clear ring of a new idea, the sense of satisfaction when a private opinion was publicly confirmed, the quickened pulse at the opportunity to defend or refute a controversial statement, occasionally pierced the pall of tedium and their effects were refreshing.

But, must we pound ourselves on the head with a hammer just because it feels so good when we stop? Is the framework so rigidly constructed, precedent so firmly established, and subject matter so generalized that an educated man, whose natural habitat is the lecture platform, is hesitant about expressing himself freely and specifically and inhibited in infusing his presentation with his own peculiar personality when discussing facets of his life's work with a congregation of his peers? Must the Summer School sessions consist of the reading of papers prepared primarily as a display case for the author's erudition and designed for future written publication rather than for oral presentation?

What of future summer schools? What is to be gained by conducting an Engineering Drawing Summer School every five years? Toward whom are the efforts directed? The young engineering drawing instructor, the yearling just beginning to stretch his legs and look around a bit, is the man who needs help. He needs specific help! He wants to know about teaching aids, gimmicks or ideas which will assist him in putting across to his students a particularly difficult point. He is faced with sleepless nights before and after the preparing, the administering, and the grading of a final examination. Is it too difficult, too easy, is it reasonable, is it valid? What about grading? How are twenty daily problems, a two week project, six short quizzes, three one hour examinations, and a final examination evaluated and equated to a letter grade? What methods are available for reproducing problems and examinations which are locally prepared? How to draw for reproduction? Is it feasible to use color slides in teaching engineering drawing? What about movies? Are these items commercially available? If not, how can they be made with limited equipment and funds? And, that is not all that is troubling the young instructor's mind. With new and more advanced subject matter being introduced into graphics courses, he may be on uncertain ground when faced with even the most elementary principles of graphic solutions to engineering problems, nomography, etc. Ingenuity, industry, and liberal applications of the "midnight oil" will eventually provide the solution, but in the meantime a little assistance from the "old hands" would be most welcome. The Engineering Drawing Summer School is certainly the place to seek this help, and one of the principal objectives of the Engineering Drawing Division should be to instruct the young teacher in the art of teaching engineering drawing.

What should be included in the curriculum of an Engineering Drawing Summer School? Here are some suggestions:

1. Course Design
   a) Subject matter to be included and allotment of time to various phases of subject matter
   b) Size of sections
   c) Choosing a textbook
   d) The locally prepared problem vs. a workbook
   e) Choosing a workbook
   f) Homework and home study — How much out of class preparation should be expected?
   g) Examinations and quizzes
   h) Grading

2. Preparation of examinations
   a) Basic principles
   b) Types of examinations
   c) Preparing similar examinations for sections attending on alternate days
   d) Critique of examinations

3. Chalkboard techniques
   a) Hints on chalkboard sketching
   b) Chalkboard instrumental drawing

4. Charts, their preparation and use
   a) Permanent charts
   b) Drawing the chart
   c) Reproducing the chart
   d) Displaying the chart
   e) Hasty charts

5. Current trends in reproduction processes
   a) A demonstration of equipment by manufacturers
   b) How to prepare the original copy for optimum results
   c) Reproducing foil overlays and their application in engineering drawing instruction

6. The use of miniature color slides in teaching engineering drawing
   a) Preparation of the copy or model
   b) Making the slide
   c) A sample color slide presentation

7. The use of moving pictures in teaching engineering drawing
   a) Movies currently available from commercial sources
   b) "Home movies" in engineering drawing
   c) Introducing and critiquing films for students
   d) Post-film examinations

8. Elementary graphic solutions to engineering problems

9. Basic principles of nomography

10. Curriculum construction directed toward a baccalaureate degree in engineering graphics

What about scheduling and presenting the material after it is chosen? Here is a suggestion. Consider a curriculum of eight items or lessons, an enrollment of two hundred student members, and a three day period devoted to the Summer School exclusive of the days concurrent with the Annual Meeting. First, provide eight suitable meeting places or classrooms and assign one to each lesson. Then, during the registration or at the opening session, divide the two hundred students into eight groups of twenty-five each. Divide the first two days into eight periods of say seventy-five minutes each. (9:00-10:15 and 10:30-11:45 in the morning and 2:00-3:15 and 3:30-4:15 in the afternoon. This allows fifteen minutes for changing classrooms.) Each lesson will be presented eight times, one to each group of twenty-five students. Assign two or more instructors to each lesson to assist each other and alternate in the presentation of the lesson. These relatively small groups should permit discussion not possible in a lecture hall filled with two hundred perspiring captives. Student participation, the "work-shop" idea, should be involved in each lesson where feasible. There is still a day to go! On the third day a gathering of the entire student body of two hundred might be acceptable making use of the four seventy-five minute periods to further discuss and enlarge upon four of the eight lessons. For example, if one of the lesson topics was The Use of Miniature Color Slides in Teaching Engineering Drawing, the third day in the lecture hall would be an appropriate time for the sample color slide presentation.

If future Summer Schools are to be a success, the Engineering Drawing Division must:

1. Clearly state a mission or purpose and devote all of the Summer School time to accomplishing that mission.

2. Recognize the Division's duty to the young teacher and provide a Summer School program in keeping with his needs, eliminating generalities and concentrating on the specific.

3. Endeavor to make every session a model of the finest pedagogy the Division has to offer. It is not enough to prepare an excellent paper. Equal attention must be paid to the presentation. Young instructors learn from example as well as precept.

An Evaluation of Paper Presentations At the 1956 Summer School

By R. Ford Pray

Syracuse University

The following comments are those of a young engineering teacher who has been in the profession only two years. It is hoped that they will encourage some re-evaluation or at least some additional thinking on the subject of the 1956 Engineering Drawing Summer School.

After some years of industrial experience, I joined the faculty at Syracuse University. Naturally, as is the case with most young engineering teachers today, my experience and formal training in the field of education was nil.

As with anyone interested in the welfare and improvement of his students, many problematic thoughts confronted me. Basic among these various problems were the thoughts: "What is the best way to put a certain idea across to the student?" "How can I make it easier for the student to learn?" "What teaching methods should be employed in this or that topic?" "How do I know whether the student is learning what he should?" "Do my quizzes truly show the student's knowledge?" and "How can I broaden my background within a field?". Additional questions in this train of thought can be given "ad infinitum." We all have experienced these thoughts.

Naturally, upon receipt of the announcement of the Fifth Summer School for Teachers of Engineering Drawing," my general thought was -- now I will get some answers to basic problems. Therefore, the approach to the summer school was all eagerness and hope for finding out how others met these problems, what was new in industry's desires, and what was new in the field of engineering drawing. A natural background could be obtained from looking at past records of these meetings. Information on the meeting five years ago was available in various back issues of the JOURNAL OF ENGINEERING DRAWING and ten years ago, 1946, was well represented — bound volume and all. Let's look at some of the topics of 10 years ago for example. The section titles are indicative:

Section 4 — Course content in Drawing and Descriptive Geometry
Section 5 — Teaching Methods
Section 6 — Examinations
Section 7 — Organization and Administration of the Drawing Department
Section 9 — Audio-Visual Teaching Materials
Section 10 — Courses in Advanced Graphics

There is no need to list more or to give the individual paper titles — they are all there for those who are interested. But are not these section titles indicative of what should be undertaken during a summer school — not only for the "younger" members, but for the more experienced members too?

These topics would certainly meet the needs of the younger teacher who is truly interested in his work and students and who wishes to improve himself. Also, I contend, these topics (at least most of them) should certainly meet the needs of the experienced teacher as well. It is a well known fact that there is always room for revision and improvement. However, this necessitates the assumption of an open mind, a requirement of the modern world in every field including education. If a particular member feels his methods, ideas, or what have you, are perfect and need no revision, then he should be the first to be on his feet presenting them so that his colleagues and their students can benefit.

Now, with a few of these thoughts in mind, lets look briefly at the Summer School just completed. What objectives did it meet? How many times did you, if you were present, stop and say to yourself: "That's something I should employ to improve my course" or "There's a problem I had better watch out for" or "Can that help my students to learn?"

There are many points of great value about the School which should be mentioned. First of all, the Summer School provided us with an extra long period of time to meet and to really get to know each other, to learn from the others' experience, and to generally make new and renew old friends from all over the country. This is extremely important for all of us, academically, culturally, and socially. It certainly is agreed that the Drawing Division officers and the staff at Iowa State College did a bang-up job on the preparations for and the operation of the Summer School this year. The chosen theme was far-reaching in intent, and a number of the presented papers were well thought out, planned, and delivered. At least numerous attempts were made to adhere to rigid time schedules and discussion periods. (I might mention that in many organizations, if a speaker goes overtime he is promptly cut off by the presiding officer, a practice which will usually force the speaker into a better presentation.)

But to go back to what I had hoped for, as brought out previously, I still find unanswered questions as far as I am concerned. Basically, in my opinion, the Summer School failed in many respects to live up to expectations. Others have expressed this same complaint. The general theme and most of the paper titles were well chosen with the intent and interest of all apparently in mind. But what happened between the title selection and the mind of listener or reader?

Most disturbing to me was the fact that so many man who lecture and teach practically every day could not get on their feet and deliver a paper without reading it in a most boring and sleep provoking manner. Presentations are supposed to hit the "high points" and stir interest in a subject. By so doing they will put across emphatically the important ideas and encourage the listener to read the paper for the details. Note how well received and remembered are those papers which were not read, but were "delivered."

The idea of panel discussions is good if properly organized and run. However, it doesn't prove much if panel members get up and praise the individual paper for five minutes. As with the speakers, panel members must be prepared to criticize, take issue with, and add to the paper presented. This way, several channels will be opened for audience participation with the resulting obvious benefits to all.

What can be done to improve this situation? Plenty! The following suggested procedure could be used:

1. Papers should be submitted 6 months prior to proposed presentation.
2. A board of editors should carefully go over the paper looking for adherence to topic, theme, timeliness, and appropriatness.
3. Upon acceptance of the original (or revised) paper by the board, it should be duplicated in some fashion for distribution. Publication in the JOURNAL priot to, concurrently with, or immediately following the meeting would be best.
4. Author should submit a listing of visual and projection equipment which he shall need at least one month in advance to a visual aid committee responsible for having said equipment available on time.
5. Author should "outline" his presentation one month in advance. A system outline of one or two pages maximum or index card notes should be sufficient. No copies of actual papers should be permitted on podium. Also every effort should be made to use as many pertinent illustrations as possible as these greatly add to the presentation. In making up the outline the author should be very careful to avoid tedious facts and boring "wordology" in his presentation. His goal is to stir interest and thought.
6. It would be good to have one or two associates criticize the outline and the proposed presentation including the illustrations.
7. All those who will be presiding at various sessions should have a "get together" prior to the beginning This would provide an opportunity to set up time schedules, procedures, and the like. Each session "leader" should receive, one month previous, a copy of the papers to be presented and should have become familiar with them. Also he should have obtained all available information in the individual speakers and discussers for introductions, and the like.
8. Each day there should be an authors' breakfast for all authors, discussers, session leaders, visual aid men, room custodians, who will be involved on that particular day, as well as for the meeting coordinator and possibly the board of editors. The purpose is to inform the authors of final time schedules, the use of available equipment, the acoustic problem and other items of interest. It should be impressed upon the authors that the time schedule will be adhered to, and that they will be "cut off" if they run over time.
9. The session leader shall be completely responsible for the introduction of speakers, and discussers (if same are involved), strict adherence to the time schedule, and other details necessary to assure a good, invigorating session. It might be mentioned that quite often a discussion can be well lead by a co-author.

Perhaps portions of the foregoing are used in the present organization. If so, are they rigid enough? If a system such as I have outlined were incorporated, I feel it would go a long way toward producing the type of summer school meetings which will be of benefit to all in all respects. Similar systems have worked for comparable organizations. To produce a desired effect, considerable planning, organization, scheduling, and strict regulation must be incorporated. Certainly this should be true of the preparations for and presentations at the Engineering Drawing Division's Summer School; one of the best of meetings which could be even better.

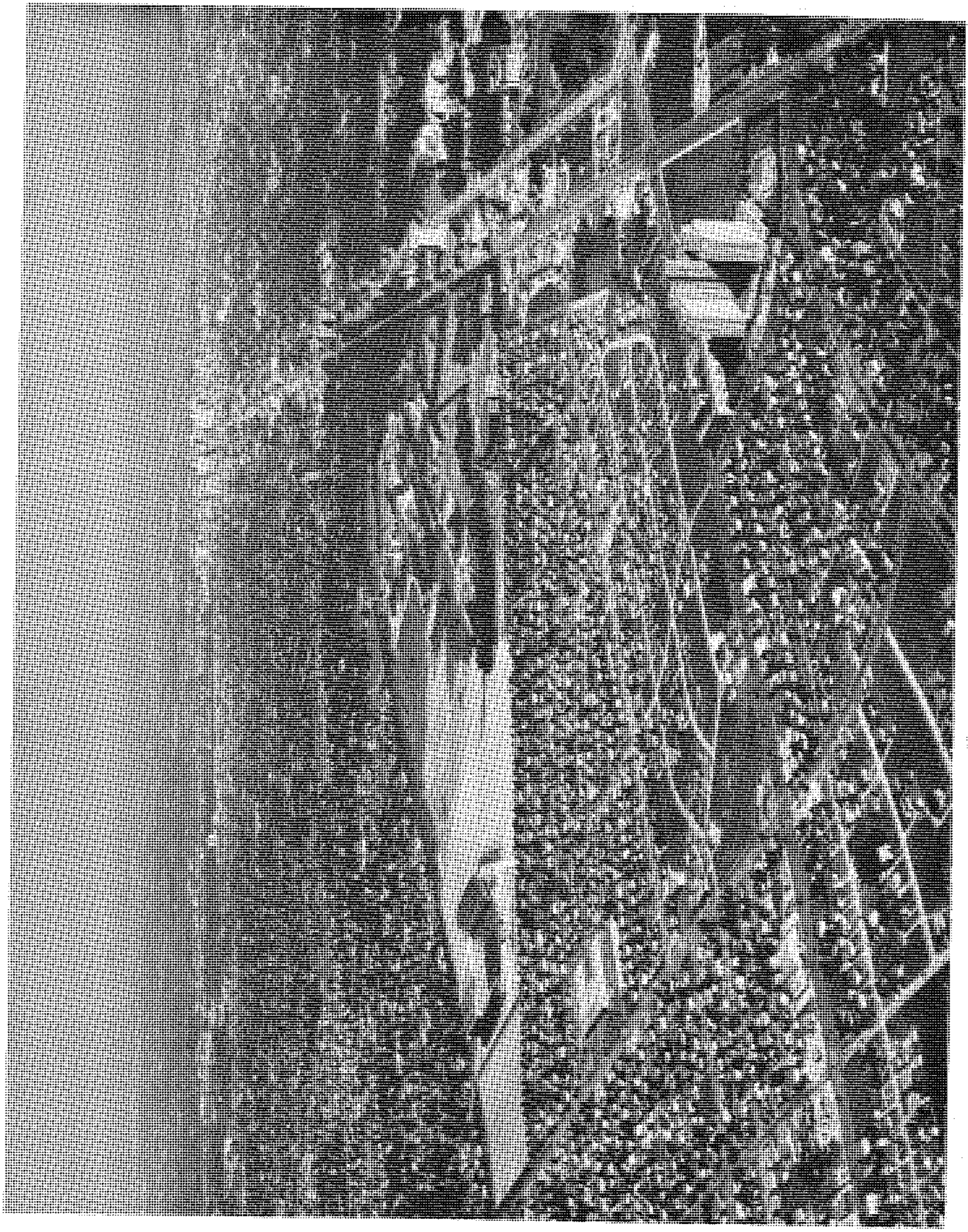
THE ROMANCE OF ACHIEVEMENT*

EVERETT S. LEE
Editor, General Electric Review

And then I thought of the superlative sum total of achievement in the great engineering profession — in the lives of men dedicated to advancing new and better products, keen in the anticipation of rendering a still greater service. Theirs is the romance of achievement.

Over the years the world has seen engineering and scientific achievements come into being the like of which have never been seen before. The day-by-day contributions of the engineers and the scientists to bring new products into use and to improve existing products never cease. The year 1955 has added its brilliance to the past as the record shows. . . . The romance of achievement continues to go on.

*Reprinted by special permission, an excerpt from an editorial in GENERAL ELECTRIC REVIEW, January 1956.



The Rice Institute, Houston, Texas

The Rice Institute*

By A. P. McDonald

The Rice Institute

Rice is a privately supported, co-educational, tuition free university, that offers courses in the traditionally basic fields of Liberal Arts, Sciences, Engineering, and Architecture. The student body comprises approximately 1700 men and women students, with some 225 of these doing work toward advanced degrees. Because the Institute is able to offer all of the advantages of a privately supported institution without charging its students tuition, admission is on an academic competitive basis. Thus since all students are expected to show a fine record of achievement, the graduates are trained for leadership in the true American sense, a leadership won by personal effort in a field of equal opportunity.

The institute was founded by William Marsh Rice, who provided the original endowment. With its beautiful campus of three hundred acres, Rice opened its doors to students in 1912.

The President of Rice is Dr. William V. Houston, who came to the Institute in 1947 from the California Institute of Technology, where he was chairman of the Department of Physics and Mathematics. At Rice he heads a faculty that is noted for its scholarly attainment and academic research. Dr. Edgar Odell Lovett, now President Emeritus, served Rice as President from its opening in 1912 until the appointment of Dr. Houston.

In addition to providing excellent instruction to undergraduates, the various departments at Rice direct much effort toward basic and fundamental research. Rice scholars are constantly exploring areas of future importance, in engineering, in the sciences, in the humanities, and in architecture. In addition to Rice's numerous laboratories, the Fondren library with its 262,000 volumes constitutes a tremendous storehouse of technical and liberal knowledge of yesterday and today and the intellectual tools for constructing the world of tomorrow.

From the beginning, the Institute has been noted for its outstanding faculty and for the scholarly relationship that exists between the faculty member and the individual student. A fine sense of academic freedom and thought along with responsibility has attracted these scholars to Rice. During the past two years a faculty numbering some 130 full time members has published 276 learned articles and 14 books.

Rice graduates have established an excellent record in the major industrial complex that is the Southwest. Its engineering, science, architecture, and liberal arts graduates are making a significant contribution to industry, commerce, and the life of their respective communities.

LABORATORIES

Architecture

The department of architecture is located on the second floor of Anderson Hall. It consists of two large general drafting rooms for undergraduate students and a large studio well equipped for advanced work in freehand drawing and painting. The drafting rooms for fifth-year graduate students and for construction work are located in a large, air-conditioned area in the basement of the main library building. The construction area consists of a drafting room, a model room, a materials museum with files, and adjacent offices for members of the faculty.

In each drafting room throughout the department, every student has a large individual drafting table. At the fifth- and sixth-year levels the student is provided with two drafting tables.

Chemical Engineering

Laboratory facilities for undergraduate instruction in chemical engineering are housed in the Chemistry Laboratory. They include not only the usual equipment associated with fuels and combustion and with unit-operations courses, but also such special items of undergraduate instructional equipment as an engine-driven vapor-compression evaporator (Kleinschmidt) and a full-size water cooling tower.

Facilities for graduate instruction and research in chemical engineering are housed in the Abercrombie Laboratory. There are well-equipped shops, an open two-story laboratory, bench-scale research laboratories, and a P-V-T-X laboratory. There is also specialized research equipment such as fluid and fixed-bed catalytic converters, vapor-liquid equilibrium apparatus, apparatus for condensation heat transfer, equipment for gas chromatography, and equipment for interphase mass transfer.

A feature of the central wing of the Abercrombie Laboratory is an expanse of unallocated laboratory space to be assigned to engineering research problems as the need arises in various fields.

Civil Engineering

The civil engineering laboratory is equipped with the usual surveying instruments: transmits, levels, compasses, and plane tables of a wide variety of standard American makes. The drafting room is fully equipped with instruments not required by each individual student, such as planimeters, protractors, special slide rules, railroad curves and irregular curves consisting of splines and weights, and calculating machines. The

*The Rice Institute, Houston, Texas is to be the Host for the Mid-winter Meeting, January, 1957.

materials-testing laboratory of the department is equipped with one 50,000-pound Riehle universal machine, one 60,000-pound Riehle hydraulic testing machine, one Olsen 15,000-pound universal machine, one 100,000-pound Olsen universal machine, and others. Two R. R. Moore endurance-testing and a Riehle universal impact machine have been added recently. Further recent additions include a soil-mechanics laboratory equipped for instruction and research, a departmental machine shop for maintenance and construction of research equipment and equipment for making and testing pre-stressed reinforced concrete. The hydraulics laboratory is equipped with a 200-gallon-per minute, 100-foot head volute centrifugal pump with a directly connected slip-ring motor; a simplex Venturi meter; trapezoidal, triangular, and rectangular weirs; a Pelton-Doble impulse wheel; and necessary gages and other usual equipment.

Complete electric strain-measuring facilities are available in the form of Baldwin-Southwork and Young strain indicators, a Du Mont Oscilloscope, Schaevitz linear variable differential transformers, and attendant switching equipment.

Electrical Engineering

The equipment of the electrical engineering laboratories is ample for a thorough study of direct and alternating current circuits, machines, and controls, as well as for investigations in the electronics and communications fields. In the power laboratories, examples of a wide variety of rotating machinery, transformers, control devices, industrial electronic devices (including mercury-arc power rectifiers and X-ray equipment), servomechanisms, and instruments are available. The electronics laboratory is equipped for investigations in voice recording, wire communication, radio, and microwave fields, and for basic studies of electronic tubes and their circuits. Instruments, other measuring apparatus, and standards are sufficient to make any measurements likely to be needed, and are maintained on the level of current practices and advancements in the fields to which they apply.

In addition to being a part of the communications laboratory equipment, a 1-kilowatt short-wave transmitter, with several of the latest communications and broadcast receivers, affords opportunity for electrical engineering students to become proficient in the operation of these facilities as an extracurricular activity.

Mechanical Engineering

The mechanical engineering laboratories are well-equipped with standard apparatus for undergraduate instruction in thermodynamics and heat power, internal combustion engines, manufacturing processes, physical metallurgy, and engineering mechanics. A drafting room is also available for laboratory instruction in machine design.

In addition to the above, there are laboratory facilities for graduate study and research in thermodynamics, fluid dynamics, engineering mechanics, and physical metallurgy. Of particular interest are: a 5 x 10-foot "water table" for analogue studies of supersonic gas flow, a stress-analysis laboratory equipped for three-dimensional photoelastic studies, and a vacuum melting furnace for production of high purity alloys for metallurgical research.

An integral part of the laboratories is the machinists' shop, which is equipped for the construction of apparatus for undergraduate instruction and graduate research.

Engineering Drawing

The drafting room for instruction in engineering drawing is located in the west wing of the Engineering Annex. This room is equipped with drawing tables, lockers, and racks in such number that all students may work independently. Special equipment includes a suspension pantograph, universal drafting machines, ellipsographs, beam compasses, sufficient number of sets of Doric lettering instruments for each student's use, and an elaborate set of Olivier models including the war mast, hyperbolic paraboloid, elliptical and conchoidal hyperboloid, conoid, groined, and cloistered arch, intersecting cylinders, raccording warped surface and corne de vache.

Tentative Slate of Candidates For Offices of the Division, 1957-58

In accordance with the Rules of the Division, the Nominating Committee, Dean J. Gerardi, Chairman, presents a list of candidates for offices for the 1957-58 term. Additional candidates may be nominated by petition. A petition should be signed by ten members of the Division, the candidate named having expressed his willingness to accept the office specified, if elected. Such petitions should reach Dean Gerardi, University of Detroit, before the conclusion of the Mid-winter Meeting, January, 1957.

The slate is as follows:

VICE-CHAIRMAN:
Harold P. Skamser, Michigan State University
James S. Rising, Iowa State College

SECRETARY-TREASURER:
Carson P. Buck, Syracuse University
James S. Blackman, University of Nebraska

ADVERTISING MANAGER:
A. P. McDonald, Rice Institute
Wayne L. Shick, University of Illinois (Urbana)

EDITOR OF GRAPHIC SCIENCE (T-SQUARE) PAGE
Eugene G. Paré, Washington State College
Leon M. Sahag, Alabama Polytechnic Institute

EXECUTIVE COMMITTEE
B. Leighton Wellman, Worcester Polytechnic Institute
Harold B. Howe, Rensselaer Polytechnic Institute.

Nominating Committee
J. Gerardi, Chairman.

A Study of Graphical Standards For Electrical Diagrams and Components

By Charles J. Baer

University of Kansas

With the tremendous recent advancements in such fields as automation, guided missile design, and radar and television refinement, many engineers today are coming into occasional, if not daily, contact with the subject of electronics. Many of these persons are graduates in fields other than electrical engineering and have to learn, on the job, how to read and prepare electrical schematic drawings.

The basic concepts of electrical schematics can be effectively presented in a few hours in engineering graphics courses at the freshman or sophomore level. Although little, if any of this material is available in current textbooks, the subject material is well presented in two sets of standards, both quite up-to-date. These are "GRAPHICAL SYMBOLS FOR ELECTRICAL DIAGRAMS," Y32.2-1954, published by the American Standards Association, and Military Standard 15A, "ELECTRICAL AND ELECTRONIC SYMBOLS," published and approved by the Department of Defense in 1954. The two sets of standards are nearly identical, so much so, in fact. that some companies having contracts with the armed forces are able to follow the ASA Standard without seriously violating any of the military standard specifications.

It is the objective of this study to present many of the more common symbols and practices listed in the American Standard code, and to show wherein these differ from the military standards where differences do exist.

Because revision of the ASA Standards is underway in some areas, it would seem appropriate to clarify the status of Y32.2-1954. According to Mr. Allen F. Pomeroy, chairman of ASA Technical Committee Y32., "GRAPHICAL SYMBOLS FOR ELECTRICAL DIAGRAMS," Y32.2-1954, is in good standing at this time. The only major change impending is that this group will probably adopt the Institute of Radio Engineers' proposed transistor symbols within a year. Because of the recent revision of Military Standard 15A and its close agreement with ASA Y32.2, it does not appear probable that the military standard will change appreciably in the next few years. (Persons familiar with the military establishment know, however, that the military can, if it so wishes to do, change its specifications on short advance notice.)

It might also be well to note that there are many alternate symbols for a particular component in both sets of standards. The following statement can be found in the foreword to ASA Y32.2. "It is hoped that in time the number of alternate symbols will be reduced."

The single (one-line) diagram is a popular way to show essential components and functions, although complete diagrams are often used embodying a complete system, and using two lines. The one-line diagram system will be used herein.

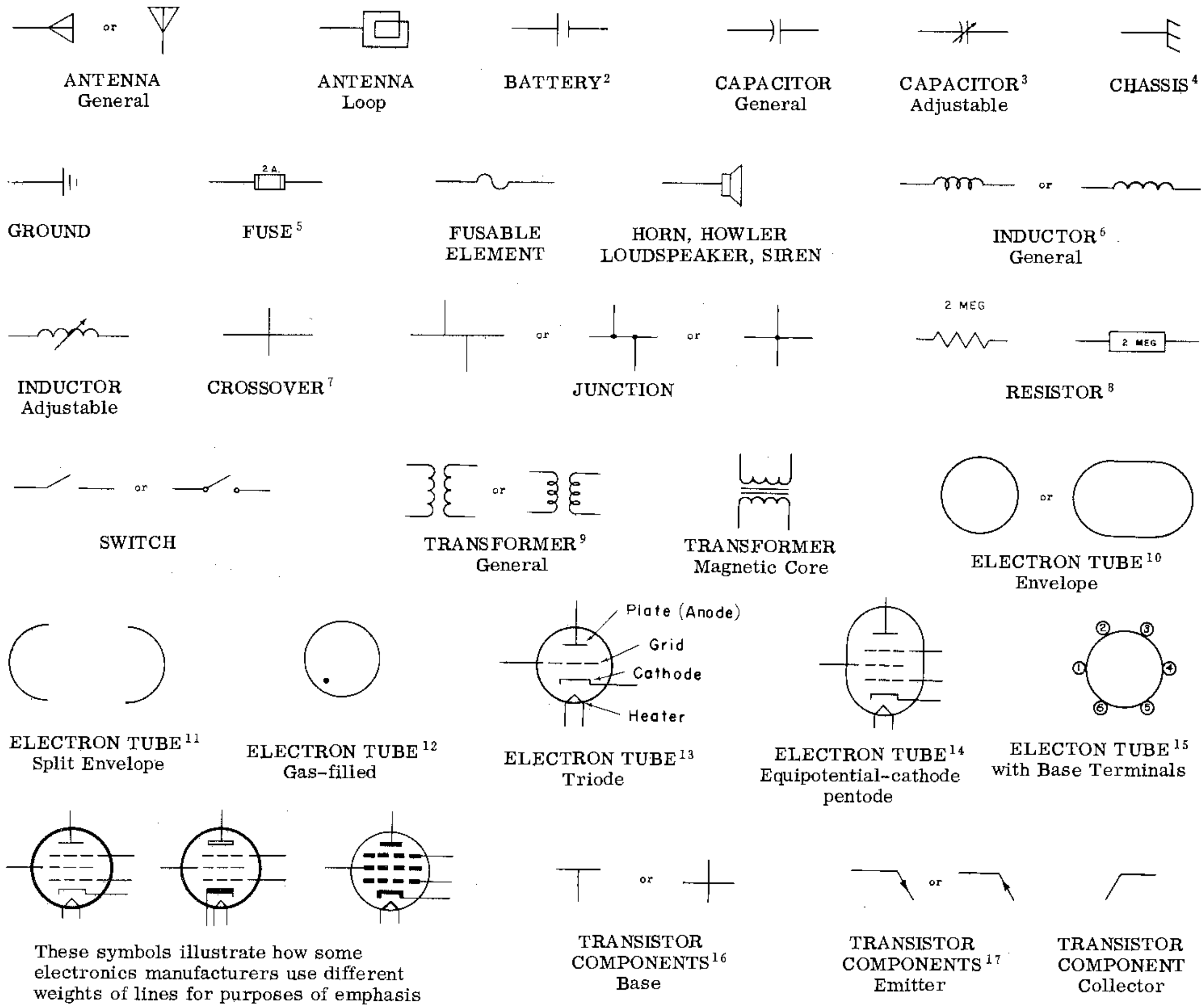
The following statements of drafting practice are applicable.

1. The weight of a line does not alter the meaning of a symbol. In specific cases a heavier line may be used for emphasis.
2. A symbol may be drawn to any proportional size that suits a particular drawing, depending on reduction or enlargement anticipated. It is recommended that only two sizes be used on any one diagram.
3. Details of type, impedance, rating, etc., may be added, when required, adjacent to any symbol.
4. The arrowhead of a symbol may be ——→ or ——→ unless otherwise noted in the ASA Standard. Military Standard 15A shows the arrowhead thusly ——➤
5. For simplification, parts of a device, such as a relay or tube, may be separated, provided there is suitable designation to show proper correlation of the parts.
6. The angle at which a connecting lead is brought to a graphical symbol has no particular significance unless otherwise noted.

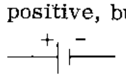
In general, the following procedure is followed in the preparation of simple schematic diagrams.

1. The signal path is from left to right. In other words, the energy source, such as the input channel, or antenna, is at the left; and the output, a speaker for example, is at the right. In large drawings input is at the upper left and output is at the lower right.
2. Lines are usually drawn vertically or horizontally, but may be drawn in other directions when circumstances so dictate.
3. All tubes are generally made of the same size, about an inch or more in diameter, on original drawings. Transistor envelopes are usually drawn somewhat smaller, sometimes as small as 3/8 inch.
4. Uniform density is desired so that there are no congested areas and a minimum number of white areas.
5. Attention must be given to the spacing of lines, size of symbols, and size of lettering if the diagram is to be reduced photographically. A final reduced lettering size of .050 to .070 inch will pass most specifications.
6. In the case of diagrams that are to be reduced for manufacturing purposes or handbook publication (with a maximum reduction of 2 1/2 to 1 recommended) the symbols are usually drawn 1 1/1 times the size in which they appear in the American Standard.

On the following pages are some symbols as they appear in the ASA Standard. These will also be the same as those used by the Military Standard, except where so indicated.



1. Types or functions may be indicated by words or abbreviations adjacent to the symbol. It should be noted that the orientation of a symbol does not alter its meaning.

2. The long line is always positive, but polarity may be indicated in addition, thus: 

3. The shaft of the arrow is drawn at about 45 degrees across the body of the symbol.

4. The chassis or frame is not necessarily at ground potential. Also, a system ground may or may not be connected to a chassis.

5. Current rating is usually indicated.

6. Only the symbol at right is authorized in the Military Standard.

7. The crossing does not necessarily have to be at 90 degrees.

8. Identification may be made adjacent to symbol (usually above) or in the case of the rectangle, it may be placed within the rectangle.

9. Additional findings may be shown or indicated by note. The Military Standard shows only the symbol at left.

10. The general envelope symbol inicates a vacuum enclosure unless otherwise specified.

11. The envelope may be split, if necessary.

12. The dot may be located where convenient.

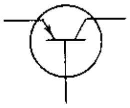
13. Connection to plate is drawn to the center. On most other electrodes connection may be drawn to either end or both ends. The heater may be shown elsewhere in a schematic as part of a heater circuit.

14. This may also be drawn with a circular envelope. The pentode derives its name from the fact that there are five electrodes. (Heater is not considered as an electrode.)

15. Terminal symbols may be added to the symbol without changing the meaning, and are not a part of the symbol.

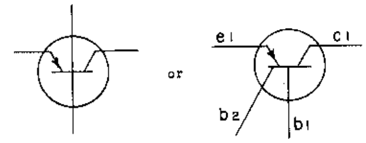
16. As was stated previously, no symbols have yet been adopted by the American Standards Association. These symbols represent those which are proposed by the Institute of Radio Engineers, and which may soon be adopted by the ASA.

17. Arrowhead shall be filled and shall not touch adjacent line(s). Arrowhead shows direction of current flow.



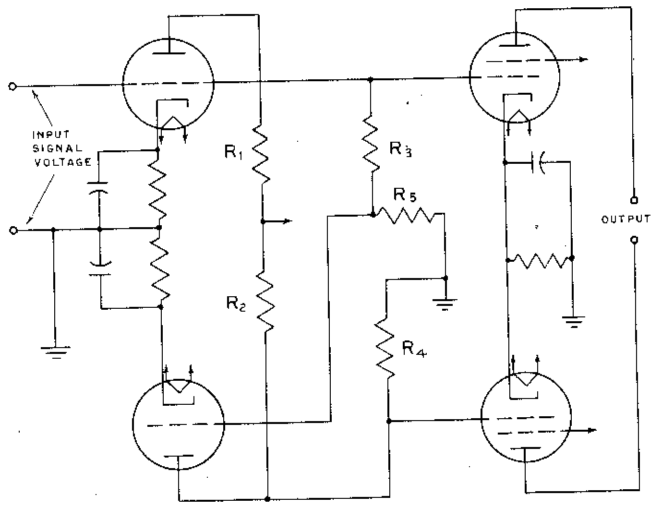
TRANSISTOR TRIODE
N Type Point Contact or
PNP Junction Transistor

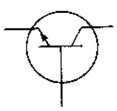
The circles representing envelopes may be omitted. When drawn they are usually made smaller than circles used for electron tube envelopes.



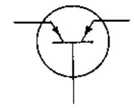
TRANSISTOR TETRODE

The letters are not part of the symbol, but may be used for clarity. The right-hand symbol appears in the Military Standard.





TRANSISTOR TRIODE
P Type Point Contact or
NPN Junction Transistor



TRANSISTOR TRIODE
Symmetrical

TYPICAL SCHEMATIC LAYOUT OF
PUSH-PULL AMPLIFIER

No values have been shown adjacent to symbols in the above drawing, as is often done in industry. Components are sometimes labeled, as shown in the case of resistors R1 through R5, in which case, values and other information may be shown in a key or schedule elsewhere in the drawing.

Electrical components, when placed in different combinations with other parts, can be made to perform different functions. Diode tubes, for example, can be used as rectifiers or for detection, that is, demodulation. Triodes can be used for current amplification, voltage amplification, automatic frequency control or oscillation. Anyone wishing to learn more about electron tubes and simple circuits involving them will find the RCA Receiving Tube Manual very helpful and easy to read. It is published by the Harrison Tube Division of RCA, Harrison, New Jersey, and sells for 60 cents. Transistors, which have been developed since 1950, can be used for some of the same purposes. They have several advantages over vacuum tubes, where usable. Some of these advantages are much smaller size, more durability, much longer life, and smaller current requirements because no heating is required. Some observers originally thought that development of transistors would do away with many electron tubes. This has been the case. However, present evidence indicates that the use of transistors has made necessary the manufacture of more tubes than ever before.

Another ASA committee, Y-14, under the leadership of Mr. D. C. Bowen, has studied the aspects of preparing schematic diagrams, using the symbology of Committee Y32.2, described herein, as sole authority. Committee Y-14 is currently preparing the final draft of its report. When adopted, this standard would be an appropriate source for another study in this journal.

Every department of Engineering Drawing should have either American Standard Graphical Symbols Y32.2, or Military Standard 15A, or both in its departmental library. The former can be obtained from the American Standards Association for $1.25 and the latter from the United States Government Printing Office for 40 cents.

References

1. ASA "Graphical Symbols for Electrical Diagrams," Y32.2-1954
2. MIL STD "Electrical and Electronic Symbols", 15A-1954
3. RCA "Receiving Tube Manual", Tube Division, RCA, 1954
4. IBM "Electrical Symbols", January 1955

(Continued on Page 62)

A Balanced Course in Engineering Graphics

By Lyle E. Young

University of Nebraska

It is always timely for teachers to take a close look at their courses, but in these times of accelerated scientific development and change it is a sin of omission not to do so.

Those of us who teach graphics have been very much aware of a growing trend to de-emphasize our courses and the time devoted to them. It has been said: Drawing is a trade and deserves little time in an engineering curriculum". This criticism as applied to most graphics courses is greatly exaggerated. The prestige of our courses and time alloted to them will tend to be directly proportional to their value to the engineer. This value to the engineer can only be evaluated after careful consideration of what the engineering student needs as fundamental knowledge and as background for other courses and post-graduation professional learning.

PRESENT DRAWING COURSES

If general observations of the character of our present drawing courses can be made, it could be said that they devote about seventy percent of the time to mechanical drafting, twenty-five percent to the descriptive geometry, and about five percent to the other phases of graphics such as structural drafting, technical sketching, nomography, curve fitting, charts, and diagrams, et cetera. Is this time allotment in proportion to present and future needs of the engineer?

The day when the majority of engineers began their professional career on a drafting job is past. With the extended prospect of too few engineers, few industries will waste engineering talent on drafting jobs which can be handled by men with shorter and less intensive training. The engineer will still be the supervisor of drafting work and a basic understanding of the graphic language is essential, but the intensive concentration upon the developing of mechanical drafting technique for engineers is no longer essential even though desirable.

THE ENGINEER'S GRAPHIC NEEDS

A criterion of the graphic knowledge that the engineer needs can be found in the apparent difficulties of many students. How often has the engineering instructor encountered these difficulties of his students:

1. Inability to work a problem in mechanics, physics, or structures, because of an inadequate sketch to help him in his analysis. This is especially true in three-dimensional problems where the student is often weak in spatial visualization and representation. See Fig. 1.

PROBLEM: THE BEVEL GEAR, A, DRIVES THE PULLEY AND V BELT. THE GEAR HAS A PITCH ANGLE OF 34°-15' AND A PRESSURE ANGLE OF 20°. BEARING B IS CAPABLE OF SUPPORTING THRUST WHILE C CAN SUPPORT ONLY RADIAL LOAD. FOR BELT TENSIONS SHOWN, DETERMINE THE GEAR TOOTH LOAD P AND LOADS ON EACH BEARING.

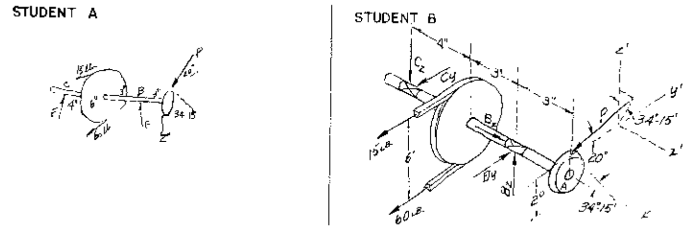


Figure 1. Student A was unable to solve this problem due to his inadequate sketch, which led to a number of errors. Student B solved the problem without difficulty.

2. Hesitancy and indecision on delving into a problem in design because of the lack of the habit of sketching as an aid to creative thinking. See Fig 2.

PROBLEM: DESIGN A "DO IT YOURSELF" REPAIR KIT FOR PATCHING A LEAK IN A PLASTIC GARDEN HOSE.

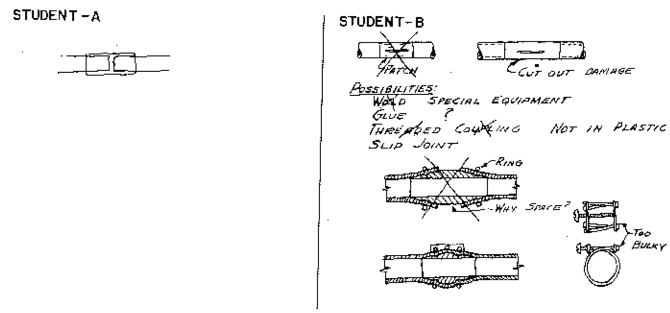
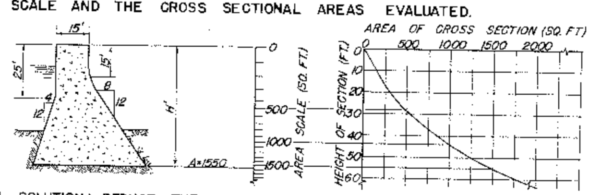


Figure 2. The comparative results of one half hour's thinking show that Student A was unable to clarify his thinking because of the lack of ability or unwillingness to use sketching as an aid to thinking. Student B has a good start towards a solution.

PROBLEM: TO MAKE PRELIMINARY ESTIMATES OF THE VOLUME OF CONCRETE IN A PROPOSED DAM FOR VARIOUS PROPOSED LOCATIONS AND HEIGHTS. THE DAM IS TO HAVE A TYPICAL SECTION AS SHOWN BELOW. TO ARRIVE AT VALUES FOR VOLUME, THE CROSS SECTION OF THE DAM AT INTERVALS ALONG ITS LENGTH WOULD BE DRAWN TO SCALE AND THE CROSS SECTIONAL AREAS EVALUATED.



ANALYTICAL SOLUTION: REDUCE THE CROSS SECTIONAL AREA TO A FUNCTION OF H & SOLVE FOR EACH SECTION.

GRAPHICAL SOLUTION: THE HUNDREDS OF CROSS SECTIONAL AREAS CAN BE EVALUATED BY A GRAPHICAL SCALE WHICH WHEN SUPERIMPOSED ON THE CROSS SECTION DRAWINGS WOULD GIVE THE AREA CORRESPONDING TO ANY H.

Figure 3. The graphical solution reduces a repetitive operation to the simplest form.

3. The use of long and less practical analytical solutions for problems in surveying, strength of materials, and mechanics which are readily adapted to graphical solution. See Fig. 3.
4. The misapplication of mathematical expressions because of the lack of the corresponding graphical concept. See Fig. 4.

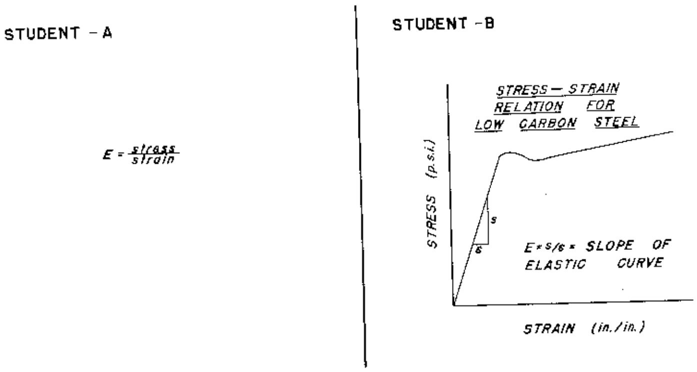


Figure 4. Students often use the expression E = s/ε indiscriminately for material in any state of stress. If their concept was based on the graphical stress-strain relation, they would have no difficulty in seeing the limitation of the expression to the elastic range of the material.

5. Inappropriate use or failure to use graphs, diagrams, nomographs, or curves to represent data or relationships obtained in the laboratory. See Fig. 5.

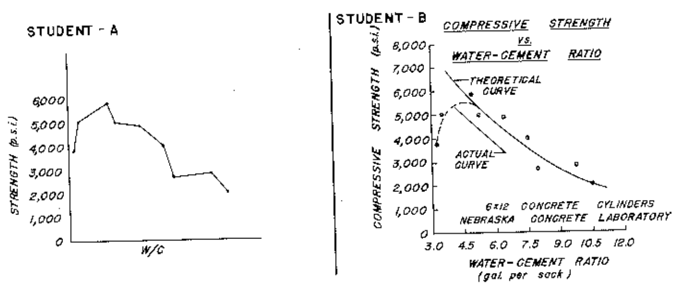


Figure 5. Student A in plotting the results of laboratory experimentation has used a broken line curve to describe a physical law. He has failed to use adequate units, title, and source of data to make the graph meaningful. Student B has presented a true and meaningful picture of this important relationship.

These graphical deficiencies are a reflection on the drawing or graphics department. The following is an attempt to put the engineer's graphical needs in positive form. Keeping in mind present and anticipated needs, they are:

1. The ability to read and make drawings of engineering mechanisms and structures. This includes an understanding of standard practices, conventions and symbols, training in drafting technique, and ability in visualization.
2. The ability of and habit of making neat, clear and complete sketches as an aid in the analysis of problems, as a means of expressing his ideas, and as a stimulus to creative thinking.
3. The ability to use graphical solutions when well adapted to engineering problems.
4. The formation of good habits of analysis as developed in the solution of descriptive geometry problems.
5. A better understanding of mathematics through the use of analagous graphical representations. Nomography, curve fitting, logarithmic scales, have countless application to engineering problems.
6. The ability to present data in appropriate graphs, charts, and diagrams.

All of these abilities are important to the engineer. A well balanced, carefully studied, well-taught graphics course would develop these abilities. This would require the inclusion of new material in most graphics courses.

PROCEDURE FOR REVISING COURSES

With every department of an engineering college competing for more time to include more material, the possibility of more time for graphics is questionable. Even with the limitation of time as alloted in present curriculums, it is generally possible to build a well-rounded course that essentially fulfills the objectives listed previously. This will require intensive study, broad visionary thinking, and the sincere cooperation of the entire drawing or graphics department.

There are many ways in which to approach the job of establishing a new graphics curriculum. The following steps are a suggested procedure:

1. If your department does not have a written set of objectives, you will find it enlightening and helpful to write some. It might be well to examine the objectives of the university, the college of engineering and then write objectives for the graphics department, and finally for each course. If these objectives are to be of real value in course revision, they must result from original and careful thinking rather than from the tendency to write objectives to fit existing courses.
2. Make a list of all the units of graphics and classify each as essential, desirable, or not necessary in the light of the objectives.
3. Determine which units can be taught by assigning text material to the student for learning and practice outside of class. Such elementary units as lettering, geometric construction, piping symbols, electrical symbols, and welding symbols can possibly be learned without formal class treatment.
4. Examine the list of units to see where units can be combined:

   a. Units with similar basic principles can be taught as parts of larger single unit. For example, sectioning and auxiliary views are special applications of the principles of orthographic projection. Slide rule, logarithmic scales and graphs have the same basis, and auxiliary view solutions such as true length of lines, true shape of planes, true angle between lines, planes, or a line and a plane, or shortest distance between skewed lines or between a point and a plane have solutions which are similar in analysis and procedure and can be grouped for treatment.

b. The teaching of fastenings, dimensioning, shop processes, etcetera, can be included under working drawings. Each sub-unit requires some individual treatment but the essential application can be more efficiently handled under the broader heading of working drawings.

The grouping of units under broader headings will give greater continuity and meaning to the courses in graphics. It would largely eliminate the student difficulty of applying what has already been covered to a new phase of the course. Considerable time can be gained by group treatment rather than by individual treatment of these sub-units.

5. Study the methods of teaching to find those most effective in presenting and practicing each of the units.

   a. The student can develop confidence and technique in sketching by its use in teaching orthographic projection (including sectioning and auxiliary views), planning working drawings and in the analysis of problems in descriptive geometry. The use of sketching allows the student to have many experiences in the minimum of time. The sketch is one of the most useful tools of the engineer and its use should become habitual.

   b. The use of exercises and completion drawings increases the number of drawings that can be completed in a given time. There is a danger here, however, that the student becomes so accustomed to having partially set up drawings with scale, spacing, and selection of views already determined that he is lost on a drawing on which he has to exercise his own judgment.

   c. The use of lecture, demonstration, visual aids, text assignment, and quizzes are most effective when their use is left up to the judgment of the individual instructor. This assumes that each instructor is interested in experimentation to develop the teaching techniques which work best for him.

6. A studied consideration of the preceding steps should indicate efficient methods for teaching the units of graphics in minimum time. Allotment of time and arrangement in sequence of the revised units should now allow the inclusion of all the essential and most of the desirable units as originally classified in step two. Among those units there will probably be several that were not taught before, but which are of real value to the engineer. The valuable opinions of men in other engineering departments should be sought and considered.
7. The selection of texts to fit your course may be difficult. The use of supplementary mimeographed material should not be overlooked. Let the text serve the course, not the course be subservient to the text.
8. Try the course. After honest and concentrated effort to make it work, make appropriate adjustments. No course, no matter how meticulously conceived, is above improvement.

SUMMARY

The trend to de-emphasize drawing in many engineering colleges may be attributed in part to the failure of the graphics departments to offer courses that best meet the needs of today's and tomorrow's engineer. Graphics courses should be weighed to determine the proper balance among all of the units of graphics. The time and emphasis placed upon instrument drawing of machine parts, the development of drafting technique, and possibly descriptive geometry seems to overshadow other useful aspects of graphics such as technical sketching, nomography, structural drawing, charts and graphs.

Indications of the shortcomings of present graphics courses appear in the form of student deficiencies or difficulties in many other courses. Consultation with other departments, men of industry, and careful consideration of other evidence will probably result in new concepts of what graphics courses should contain.

If present graphics courses appear to need revision and there is the driving desire to do something about it, the steps suggested in this paper offer a possible procedure to follow. A great deal of study, thinking, discussion, and initiative can result in a graphics course in which by efficient use of time and teaching the needs of the engineer can be more completely satisfied. Except for the "tryout" time necessary to test out new inclusions and teaching techniques, our courses should never be considered so perfect that they become static or outdated. Don't print up a five-year supply of course outlines. Rewrite last year's lecture notes. Keep the suggestion box full.

ELECTRICAL SYMBOLS AND STANDARDS

(Continued From Page 59)

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8. The following written communications:
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   b. Homer P. Smith, Bell Laboratories, Nov. 5, 1955
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   f. R. H. Armstrong, Magnavox Co., Sept. 1, 1955
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Don't Specify the Impossible

By L. R. Smith

Chief Draftsman, Turbo-Jet Section
Allison Division, General Motors Corporation

What is the impossible? The impossible is something which is highly impractical today because of time or cost but which may very well be commonplace tomorrow.

Modern aircraft engineering is constantly attempting to take full advantage of the very latest processing and metallurgical experience available and in many cases is committed to use techniques not yet fully developed. This discussion will consider the impossible to be the highly impractical of today.

The impractical is a condition of cost versus demand or time. For example, a comparison between the automotive as against the aircraft industry: The automotive field is a highly competitive business where large quantities are involved and the cost of producing the bits and pieces is probably of first importance consistant with reliability. Since weight is of secondary importance and strength of material may have a fairly high safety factor, tolerances may be relaxed and standard machining procedure can generally be used.

The aircraft industry is also in keen competition but primarily on a performance and weight basis. Each and every part on an aircraft is designed, evaluated, and tested under its own environmental and stress conditions to perform exactly as required and with a safety factor approaching one. The processes and tolerances must be more closely controlled to insure that all parts will duplicate the performance of the parts which have been tested.

While the following may apply primarily to aircraft it may be worthy of consideration in any design work. There are many conditions where it appears to be expedient to control the weight-to-strength ratio on aircraft parts which may seem to be totally unwarranted by those not associated with that field. For example, the allowable stock thickness tolerance may be reduced below the standard commercial tolerance even at the expense of special selection. Non-functional holes may be drilled in unstressed areas, or flanges may be scolloped between mounting holes, etc., to eliminate excessive weight at the expense of additional machining. Highly stressed parts may require a very fine surface finish to prevent fatigue failures even though the surface is non-contacting.

With the above mentioned conditions in mind, however, it is easy to go overboard and specify close controls where they are not required, with the resulting loss of time and money.

Don't specify a surface control which will require a grind when a smooth turned surface will serve the purpose.

Don't specify a close tolerance, just to keep the manufacturer on his toes, if it isn't essential to the function of the part.

Don't specify a grind on two adjacent surfaces at right angles to each other without providing a relief in the corner. (See Figure 1). Each surface should be ground independently and have a runout area. Also, the larger radius provided by the relief reduces stress concentration at an otherwise sharp corner. A similar case is shown in Figure 2 where a close tolerance shank diameter for a body bound bolt or shaft made from a hard material is desired. To meet the tolerance of the shank, grinding is necessary: however, a corner radius of the sharpness required under the head cannot be held on the grinding wheel; therefore, a relief should be provided.

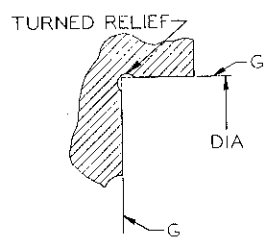


Figure 1

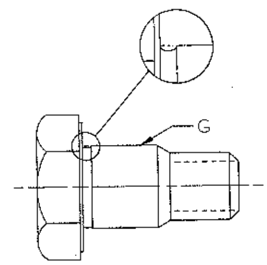


Figure 2

Don't specify a tapped hole through a wall flange that does not break through clean, for the following reasons: First, a partial break through as shown in Figure 3C will tend to break taps, and secondly, a great deal of burring will be required to eliminate snags and slivers. Figures 3A and 3B show acceptable methods of applying tapped holes for either through or blind applications.

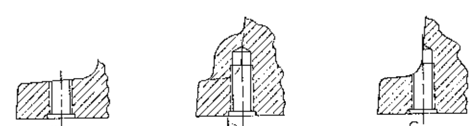


Figure 3

Don't specify an angle drill (or any drill) without checking to see that there is a straight approach on line with the drill to the outside of the part to enable a drive spindle to be used. (See Figure 4).

Similarly, when a spline or keyway is to be machined by a rotation tool, don't forget, it is necessary to provide clearance for the drive spindle. (See Figure 5).

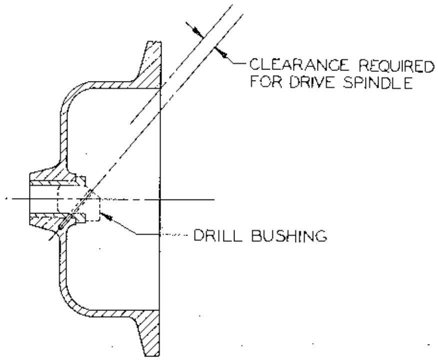


Figure 4

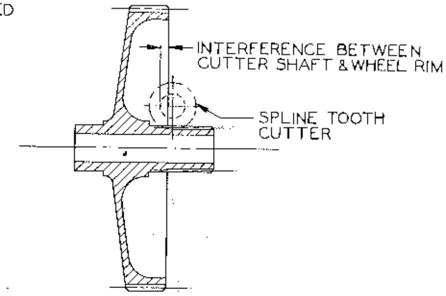


Figure 5

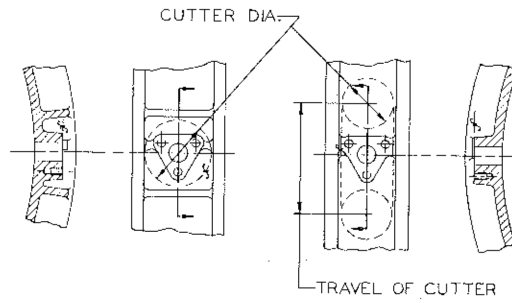


Figure 6

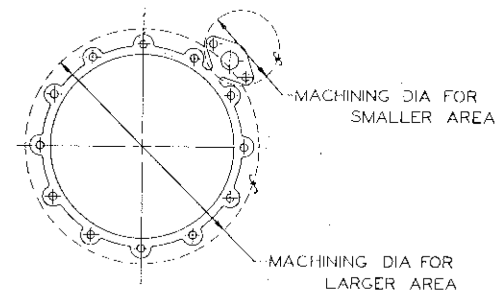


Figure 7

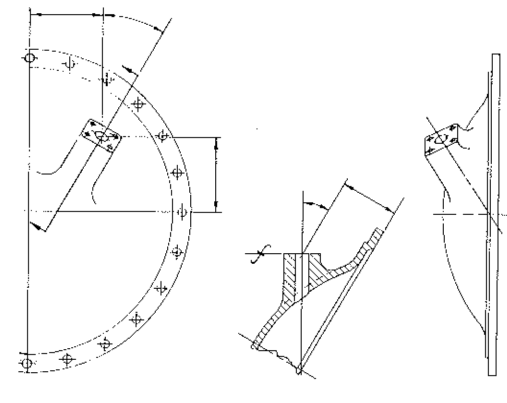


Figure 8

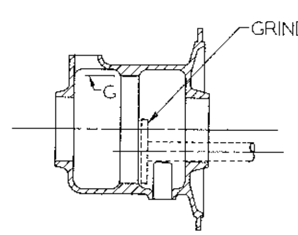


Figure 9

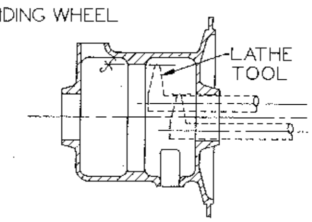


Figure 10

Don't design a mounting pad in such a way that machining cannot be accomplished in one continuous operation; i.e., either by permitting a rotating tool to be brought straight down on the pad and machine the entire surface, or by bringing a rotating tool down to the necessary height entirely clear of pad and then sweeping the pad. If the above cannot be accomplished, and the rotating tool is brought down on a portion of the pad and then the sweep started from this position, the surface below the point of hesitation will be somewhat below the balance of the surface due to the momentary relaxing of pressure while the tool is rotating in one place. (See Figure 6.) Similarly, interrupted machining of flange faces, etc., should be avoided because as the tool passes over the gap in material the tool and holder will relax; then when the material is again encountered the impact will start the tool to vibrating, which in turn will impart irregularities to the surface just beyond the interruption for a short distance. This is especially true for harder materials.

Don't specify a single surface to be accomplished by two different machining operations and expect the surface to be in plane. For example (see Figure 7), where the large diameter must be machined as shown to give a flange face sealing surface but partially within this area is another smaller area which is to be machined to seal with another item. The smaller area must be machined to slightly below the larger area to insure proper sealing characteristics.

Don't specify both angles of compound angular features from the common datum of the part, because all types of machining setups employ an arrangement whereby the second angle is fixed in relation to the plane of the first angle. (See Figure 8). If the drawings specify one angle with a section taken through the feature on the specified angle and the second angle shown on the section, the angles may be used directly by manufacturing without shop calculation or the confusion which sometimes exists when the angles are small.

Don't specify an internal inside diameter too large for the required tooling to be entered through adjacent inside diameters. For example the largest I.D. that could be machined would be three times the smallest adjacent I.D. minus twice the diameter of the tool support bar. If the I.D. requires grinding the largest possible diameter would be twice the smallest adjacent diameter minus the diameter of the drive spindle. (See Figures 9 and 10). Both of the above conditions neglect working clearances and limit stack.

Don't specify a back spotfacing operation without providing space for loading the cutter on the spindle. (See Figure 11.) Back spotfacing should be avoided if at all possible, as it is an expensive and time-consuming operationg. Spotfacing should also be eliminated in favor of turning the whole piece if practical because it is a faster operation especially if the part has a common center which must be established for other machining. It also reduces weight in cases where built up bosses have not been provided. (See Figure 12).

Don't specify a part which can be reversed or rotated physically but cannot be so relocated functionally. This can be avoided by one of two methods. Make the part so it can be used functionally in any position in which it can be assembled or make the part so that it cannot be assembled wrong by the use of an out of step hole, pin and clearance hole or other means. This is very important because if it is possible to assemble a part wrong and cause a serious malfunction, rest assured it will be assembled wrong some place along the line. Verbal instructions and installation warning notes cannot be relied upon.

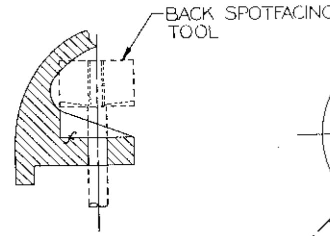


Figure 11

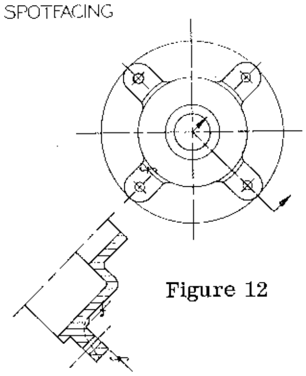


Figure 12

The foregoing discussion cites a few of the many little considerations that are frequently overlooked in design and drafting. As was mentioned at the beginning of this article, I would not say any of these items are impossible; nothing is impossible. But rather they represent items which should be avoided in good design practices because they can prove troublesome in manufacturing.

Why Simplified Drafting?

By William Streib

The State University of Iowa

It is difficult to alter existing practices. This is particularly true in the various occupations that are considered to be trades. Though many engineers work at the drawing board, drafting is essentially a trade, and it suffers from the inertia common to its sister fields of endeavor.

Why then has simplified drafting "caught on?" The situation that has precipitated simplified drafting is the extreme inefficiency of many drafting rooms. The proposed solution to this problem appears to attack the present drafting standards, but upon investigation many of proposed reforms are found to be part of the existing rules for simplification and drafting economy. Rather than being revolutionary in nature, much of simplified drafting merely emphasizes, by bringing together in one system, the efficient drafting practices found in progressive drafting offices.

Some portions of the simplified drafting proposals are truly new; other portions extend the existing practices with the aim of obtaining even greater economy. The new proposals should be studied with care, and each should be judged on its individual merit. Adoption of a practice by reference is ill advised, for the untested and untried then carry the authority of the proven portions of the proposal.

And again the question, why has simplified drafting made as much headway as it has? Many of its proponents may, in reality, advocate simplified drafting for an indirect reason. It is extremely difficult to tell a man who is assumed to be well trained in his field that he is unfamiliar with or is not applying the rules of good practice. Psychologically it is better to adopt supposedly new standards. By having the new standard emphasize the progressive portions of the existing standards, more efficient methods can be introduced without the accompanying dissatisfaction that could arise from the more direct approach.

Simplified drafting may be the drastic pound of cure necessary to correct the situation that exists in some drafting offices, but what about the ounce of prevention that can be supplied in our schools? By emphasizing the rules of simplification and drafting efficiency that are part of our present standards, by considering an extra line or view as wrong as the omission of a necessary line or view, and by demanding drawing speed (without a decrease in drawing quality) we may better prepare our future engineers in the graphic sciences. True projection must be taught to the beginning student, but before he leaves the drawing department, he must appreciate the functions of a drawing as part of a communication process where simplicity, within reasonable limits, leads to efficient communication.

ENGINEERING DRAWING IN REVIEW

(Continued from Page 27)

have gotten some attention, but mostly from industry. Graphics, and all that goes with the term, has taken over an important place in this review; nomography in particular has really moved up in the procession, with Doug Adams waving the banner while working out three-dimensional nomograms. And right behind him could be seen Al Levens, with his western brand of nomography. To keep this parade analogy marching along, there have been the bands of the deans and the bands of the drawing teachers; for two decades they have blared back and forth at each other,

"Cut your hours, trim your course!"

"We need the time, what could be worse?"

In a wild flight of fancy I can imagine the continuing debate that is raging between Professor McCully and the late Dr. Dougherty on the question of reduced hours for engineering drawing. In the old days at Carnegie, before his death, Mac would name engineers by the dozen in high positions who had moved up from drafting rooms. He would turn cherry-red and virtually explode when any slighting remark was directed at drafting or draftsmen. Then he would retire to his anteroom and stretch out on an inclined 2 x 12 bare plank to relax. (This was true, literally; it was a carryover from his early days in the steel mills, where the plank technique was standard procedure for cooling off.) At the other extreme in disposition, but no less militant in his defense of good drawing training, was the late Dr. F. E. Giesecke. Had he needed a shibboleth, it would have been "Teach drawing as the language of engineering, with manual skill as a by-product." This same philosophy was always evident in the teaching and writing of Dr. Thomas E. French.

Another illustrious teacher was Professor George J. Hood of the University of Kansas, now emeritus but continuing with his important work in the field of invention and design of surgical instruments and other technical devices. In the invention and perfection of the "large-area Dermatome" he has provided medical men with a most ingenious and needed surgical instrument; it must be a source of great satisfaction to Professor Hood to realize the extent of the benefits that will come from the use of this instrument. Drawing teachers are also indebted to him for his pioneering work in the "direct method" of descriptive geometry.

To one outside of teaching, it appears that change in engineering drawing course content and teaching method has kept rather well abreast of engineering practice. Changing emphasis in introductory drawing work has undoubtedly resulted in a better utilization of time for the young engineer in training. Countless hours that were prveiously spent on inking of drawings, for instance, are probably used to better engineering advantage now. And though lettering still spells out the language of engineering, it does so in much less time than in past years. Much has been done also in the use of visual aids by drawing teachers. Certainly the pioneering work of Judd Rising in the use of moving pictures has eased the presentation of many troublesome points for students. At M.I.T., Jack Rule and the late Professor Watt have done a great deal to inject a valid challenge into their drafting work by some clever innovations in "graphics of space representation" — and they have done it without depriving their students of too many drafting fundamentals. All these devices for time saving and for better utilization of time seem to indicate plenty of concern on the part of drafting teachers for the real needs of today's engineering students.

If all goes well with the present generation of engineering students, we can expect them to be drawing and designing reactors and cyclotrons before long and turning out electronic computers, jets, and guided missiles. Some will build bridges and buildings. Let us hope that these "civils," at least, will know their fundamentals of drafting and design; it would be bad indeed to see the New York end of the next Hudson River tunnel emerge under the altar in St. Patrick's Cathedral.

A PITCH

This issue commemorates twenty years of the JOURNAL. It is the largest issue in our history and it brings together between its covers some of the towering personalities of engineering drawing and descriptive geometry.

Naturally we would like to believe that it is more than just the biggest. We would like to believe it is our best. If you think it is, suggest to your new staff members that they can start their subscriptions with this issue -- while we have a few left. Send the checks to Prof. E. M. Griswold, The Cooper Union, Cooper Square, New York 3, N. Y. Subscriptions are $1.25 a year. A $5.00 check will bring four years!

NEWS ITEM

Prof. Ralph S. Paffenbarger has been named chairman of the ASEE George Westinghouse Award Committee by Dean W. L. Everitt, President of the Society. This is the second year that Ralph has served this Committee as Chairman.

EDWARDS BROTHERS

The first issue of the JOURNAL, twenty years ago, was printed by Edwards Brothers, Inc., Ann Arbor, Michigan. With the present issue, No. 60 in the series, we return to Edwards.

The compositor is Vance Weaver, 2672 Broadway, New York 25, N. Y. If you like the way the job looks, you may want to remember who had a hand in it.

A Drawing Course for Science Majors

By Eugene G. Paré

Washington State College

A few years ago the department of an institution with which I was then affiliated was asked to develop a basic drawing course for students majoring in chemistry, mathematics, and physics. In consultation with the other interested departments, we learned that a course was desired that varied from our usual program in several ways. A broader course was requested that contained less specialization in the instrumental drafting of machine parts. A course was requested that would promote better freehand graphical presentations in scientific reports.

These specifications and others called for a rather extensive revision of our regular program, which had been designed primarily for the mechanical engineering student. Still, it was essential that we retain most of our training in orthographic visualization, since these science students were expected to have the necessary prerequisites for descriptive geometry.

Certain aspects of this new course entailed primarily a fresh point of view rather than a change in topics. For instance, problems in geometric constructions and basic orthographic were just as well selected from the chemistry and physics fields as from mechanical engineering. Freehand execution in many cases replaced the instrumental technique.

The new topics that were added included:

1. Use of mechanical lettering devices.
2. Title design for laboratory reports.
3. Charts and graphs.
   a. Bar graphs
   b. Line graphs
   c. Rate-of-change graphs
   d. Percentage charts
   e. Organization charts
4. Graphical Mathematics.
   a. Curve plotting
   b. Roots of equations
   c. Solutions of simultaneous equations
   d. Periodic functions
   c. Graphical development of empirical equations
   f. Vectors

These innovations represented a thirty per cent addition to our program; so it was essential to make some substantial cuts in the traditional material. The time previously devoted to the following was drastically reduced.

1. Dimensioning.
2. Screw threads and fasteners.
3. Production of working drawings.

The student was introduced to those curtailed topics through the medium of blueprint reading problems.

The order of topics for the entire course is as follows:

1. Evolution of graphical representation.

In our introductory lecture we trace the historical development of drawing as a means of communication. We discuss the accumulated wealth of man's experience and knowledge that led to the development of Monge's system of orthographic projection. Reference is made to the creation of ever-changing drafting standards and practices to keep in step with other industrial advances.

2. Mechanics of freehand and instrumental drawing.

Particular emphasis is focused on freehand execution. The student is not left to his own devices, but is presented instructional assistance to guide the development of this technique. At this time similarities between freehand lettering and freehand drafting are considered.

3. Freehand lettering and mechanical lettering devices.

Each student is required to purchase the relatively inexpensive Doric lettering device, and about sixty per cent of the lettering in the course is performed with this mechanical lettering aid.

4. Title design for reports.

The student is not presented with a set of rigid rules for titles, but rather is encouraged to experiment with original patterns of his own, particularly in the area of non-symmetrical design.

5. Use of measuring equipment.

Since we are concerned with science students, a good deal of attention is directed to the metric and the American decimal systems.

6. Graphic constructions.

Under this topic, problems have been obtained that involve such pertinent equipment as the Centigrade and Fahrenheit thermometers, laboratory standards, electric cell, ammeter, centrifuge, Erlenmeyer flask, thistle tube, and pulley systems. In this connection, we find that we are teaching not only graphic representation but a little physics as well.

7. Charts and graphs.

In connection with this area of work, the student is introduced to the use of colored pencils for both lines and shading. Included in these problems is one in which the student deals with the electro-chemical equivalents of a selected list of elements.

8. Orthographic drawing.

9. Selection of views.

10. Orthographic reading.

11. Sectioning.

12. Brief introduction to primary auxiliaries.

Under those topics dealing directly with orthographic projection we are more concerned with the student's ability to visualize than we are his drafting proficiency.

13. Pictorials.

Isometric and oblique are both formally presented at this time, although students have been introduced to pictorial sketching earlier in the course. Some basic concepts of line and smudge rendering are also discussed at this time.

14. Graphical mathematics.

We deal with the accurate plotting and significance of equations, graphical intercepts, simultaneous equations, use of coordinate and logarithmic paper for the procurement of empirical equations, and the graphical addition and subtraction of periodic functions.

15. Dimensioning analysis.

16. Blueprint reading.

17. Elements of design.

I believe we have used as a final project in this course a problem that could well be employed in any basic drawing course. The student is provided with a blueprint of a vise base, complete with detail specifications. The drawing includes screw threads and limit dimensions as needed. To answer many of the questions presented in this problem, the student finds it necessary to utilize a textbook for reference such as he may never had had to do before. He must for the first time discover the meaning of a thread note; he must indicate the tolerances for both fractional and limit dimensions. In all, some fifteen questions based on the drawing provide a measure of the student's ability to visualize, and at the same time the print introduces several new features of industrial drawings. After this blueprint reading portion of the job has been completed, the student is confronted with an original design project of his own. Using the given vise base as a control, he is asked to create the design for a suitable sliding jaw to function properly with the base. This work is done freehand but is presented complete with dimensions and other specifications. The student is left pretty much to his own devices and, as you can well realize, he again finds that his textbook is a valuable source for reference.

The course has been an interesting one to teach and apparently has been equally stimulating to the student.

The preceding can best be specified on paper, but several alterations were made in teaching methods that served both to conserve time and to offer a more effective teaching program.

The descriptive geometry approach was introduced early in the course and treated as a tool for visualization throughout the semester. This procedure proved fruitful both in this first course and in descriptive geometry as well. Problem solving was utilized more as an instructional aid than a device for measuring drafting skills. About forty per cent of the laboratory time was devoted to practice problems. Some were solved by the entire class as part of a blackboard presentation. In other cases separate problems were distributed according to abilities and solutions discussed as they were completed. By this recognition of individual differences the visualization skill of the slower student was more rapidly developed, and at the same time the more adept student was presented material that represented a challenge.

I feel that the development of this new course has been a valuable addition to our departmental offerings. It has, I am sure, been of even greater significance to me as a teacher, for it has served to reorient some of my basic concepts on the teaching of drawing. It has stimulated my interest in experimenting with different teaching methods. It has caused me to question the traditional course content.

In general, I believe, we as drawing teachers are hesitant about experimentation, for we have always been rather proud of a basic uniformity of course content. We have developed or purchased expensive films and used other visual aids that we hesitate to set aside even for a semester. We have accumulated a collection of good problem material that we religiously employ year after year. And yet our devotion to the traditional is bound to impede rather than to encourage progress.

Perhaps we ourselves should take the initiative in the development of simplified drafting methods, rather than just offer resistance to such experiments by industrial leaders. Perhaps we should concentrate less effort on formal problem solving and devote more time to other instructional methods. Perhaps we should not strive for such a high degree of drafting proficiency, but rather utilize the time to introduce broader concepts of graphical representation. Perhaps we should teach the economics of dimensioning rather than the technique of size description. Perhaps we can introduce some aspects of the geometry of design rather than the formal presentation of working drawings.

Might it not be wiser if we deleted from our basic courses those topics of handbook drafting such as the representation of screw threads, springs, and fasteners and apply the time saved to a more thorough treatment of the theory of projection. Yes, there are many things we do. But whatever we do, let us not be content with the status quo, let us set aside the traditional, let us experiment.

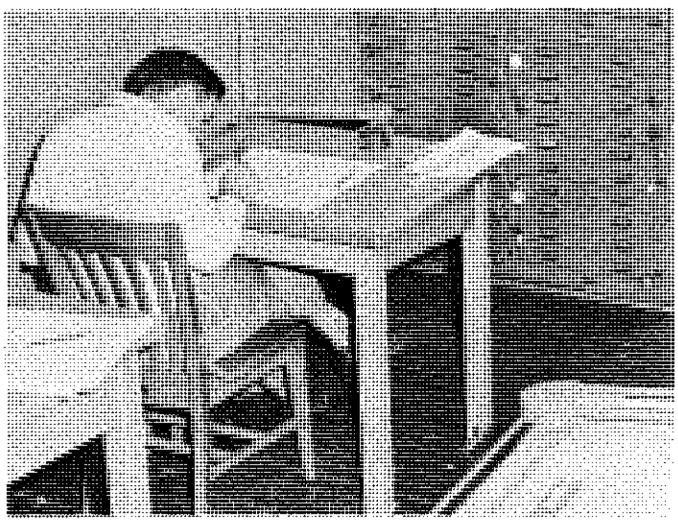
New Style Drafting Tables

By Hiram E. Grant

Washington University, St. Louis

Is it essential that drafting tables be of the present height? After using the new style shown below for a year, I would say the answer is no. Evidently the standard drafting table's height was established in the days when draftsmen stood. The same is most likely true of the old style bookkeeping desks. But unlike draftsmen, the bookkeepers discarded the "high boy" desks and stools years ago for the more comfortable office chairs and desks.

The size of the top of the new style drafting table in the illustration is 26"x 36"; its height in front is 29" and in the rear 32". The pencil rail is 1/4" above the



desk top and its edges are rounded. The size of the table may be varied because at the present time there is no standard size though a standard size would cost less. The chair is a standard straight back chair.

The total cost of the equipment including drafting machines shown in Figure 1 is the same as that of standard drafting tables and stools alone. Suppliers of drafting machines can be urged to give generous special discounts.

By using drafting machines and the desk top as the drafting board, only small light weight metal drawer cabinets would be required. The elimination of the heavy large drawing board and T-square permits the use of the considerably less expensive cabinets. Another point in favor of the drafting machines is that they speed up the classroom work sufficiently that it is the equivalent of extending the semester nearly two weeks.

An alternative to the drafting machine and still no drafting board is the recessing flush along the left edge of the table, a 1"x 1" finished structural member. This will give the desk a steel straight edge for the T-square which would be superior to any drafting board. A larger cabinet would be needed to accomodate the T-square.

Will the wood desk tops remain in good condition? We have had drafting boards mounted on 66 old style desks since 1948 and only one hole was carved out and it was promptly filled with plastic wood. It has been necessary to resurface the boards but once and it was done with a portable belt sander.

This new style desk may also be obtained with a natural wood finish, hard plastic top. The hard plastic surface is very resistant to dents, cutting and thumb tacks.

The elimination of the heavy large drawing board and T-square makes it possible to reduce the size of the table top thereby making all of the table top except the area required by the drawing itself available for the text and drafting supplies. It also permits the use of considerably less expensive cabinets. We have been asked whether the grouping of cabinets does not result in confusion by having all of the students wanting to get at their cabinets at the same time at the beginning and end of the class period. There has been no confusion for we assigned the students of an individual class to cabinets in a scattered pattern with the result that they were widely enough separated to avoid confusion. During the class few students return to their cabinets.

Our students prefer the new style drafting tables to the old style tables for they experience the same freedom of action with greater comfort. The standard chair cannot help but be more comfortable for it is designed to fit the student's anatomy which is more than you can say for the stool. He rests his feet on the floor in the normal fashion instead of hooking them on a rung of a stool. There is no advantage to being seated and working 8" higher in the air.

Our staff also prefer the new tables. Talking with a student seated at the new style table is no different than talking with anyone seated at an office desk. Some of our staff are six feet tall or more and even they prefer the new tables.

There are even advantages for this type of table from the standpoint of the administration. Since the desks and cabinets are smaller, a smaller room may be converted into a drafting room. The standard chairs make it practical to use the room for any course, whether it be drawing, mathematics or philosophy. This convertibility should not be overlooked as a selling point when seeking approval for the purchase of the equipment.

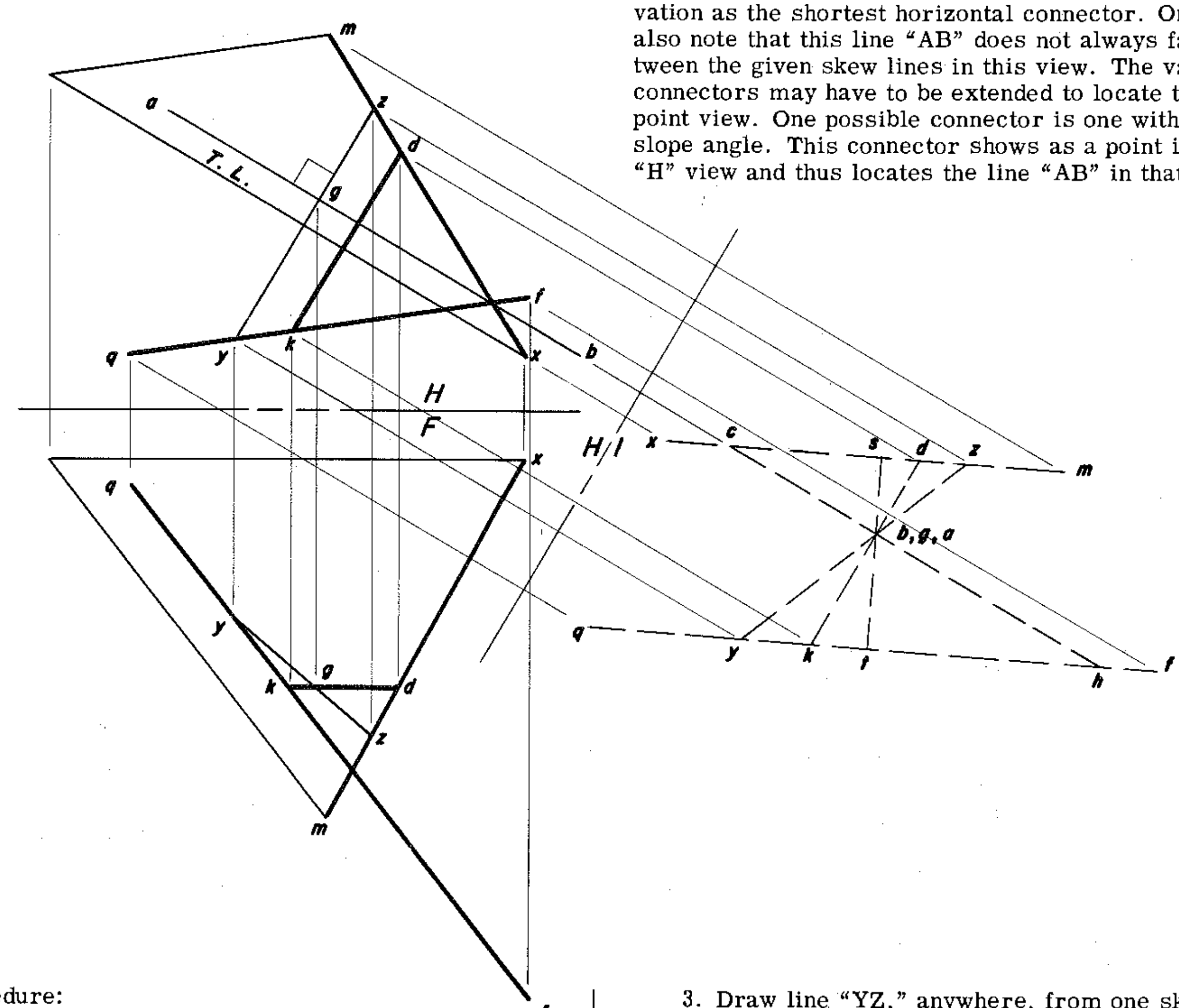
To Find the Shortest Horizontal Connector Between Two Skew Lines Using Only Two Given Views

By Kenneth E. Houghton

Iowa State College

In the February issue Brother Curran of St. Edward's University indicated a short-cut method for finding the shortest horizontal connector between two skew lines. The method mentioned brings to mind a method of solving this problem using only the given "H" and "F" views of the lines.

When using conventional methods of finding the shortest connector, the shortest horizontal connector, or the shortest connector of any given grade, one will observe that all of these connectors appear to cross at one point in the view where the given lines appear parallel. (shown as b, g, a, in view 1) Actually, b, g, a, is a point view of a level line "AB" at the same elevation as the shortest horizontal connector. One might also note that this line "AB" does not always fall between the given skew lines in this view. The various connectors may have to be extended to locate this point view. One possible connector is one with a 90° slope angle. This connector shows as a point in the "H" view and thus locates the line "AB" in that view.



Procedure:

1. Construct a plane containing one line and parallel to the other. Obtain a line in that plane that shows true length in the "H" view.
2. Draw line "AB," in the "H" view, parallel to the true length line and passing through the apparent intersection of the given skew lines. (If the skew lines appear parallel in the "H" view, draw line "AB" midway between them)
3. Draw line "YZ," anywhere, from one skew line to the other and perpendicular to line "AB." Point "G" is where "AB" and "YZ" intersect.
4. Project "YZ" to the "F" view and point "G" will be at the elevation of the shortest horizontal connector "KD" which can now be drawn.

It will be noted that this solution depends upon the very existence of line "AB." Why does line "AB" exist?

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Report of the Bibliography Committee

By S. E. Shapiro, Chairman

University of Illinois, Chicago

Books Published 1951 to 1956

AUTHORS	TITLE	ED.	PUBLISHER	YEAR	PAGES	PRICE
M. W. Almfeldt & K. E. Haughton	Engineering Graphics Problem Book I		Wm. C. Brown Co.	1955	75	
	Engineering Graphics Problem Book II		Wm. C. Brown Co.	1955	86	
C. C. Bishop	Electrical & Electronics Drafting		McGraw-Hill	1952	272	4.50
S. L. Coover	Blue Print Reading		McGraw-Hill	1954	377	3.96
H. T. Davey & R. J. Wilkins	Engineering Drawing	1st	MacDonald & Co.	1952		8.50
J. H. Farmer	Illustrating for Tomorrow's Production	1st	Macmillan	1951		4.35
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H. E. Grant	Practical Descriptive Geometry	1st	McGraw-Hill	1952	253	4.25
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R. P. Hoelscher C. H. Springer B. O. Larson & J. E. Pearson	Problems in Engineering Drawing Series A		Stipes Publishing Co.	1954	58	2.75
S. G. Hall L. D. Walker, E. D. Ebert, A. G. Frederich	Problems in Engineering Drawing Series B.		Stipes Publishing Co.	1955	62	2.75
H. D. Walraven C. I. Carlson & E. J. Mysiak	Problems in Engineering Drawing Series C	In print	Stipes Publishing Co.	1956	64	2.75

AUTHORS	TITLE	ED.	PUBLISHER	YEAR	PAGES	PRICE
R. P. Hoelscher, J. N. Arnold & S. H. Pierce	Graphic Aids in Engineering Computation	1st	McGraw-Hill	1952	197	4.50
F. C. Horstmann	Technical Freehand Drawing	1st	Pitman	1952		1.75
P. S. Houghton	Engineering Drawing & Drawing Office Practice		Lockwood			
H. B. Howe	Descriptive Geometry	1st	Ronald Press	1951	332	4.25
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L. O. Johnson & I. Wladaver	Engineering Drawing Problems	1st	Prentice-Hall	1956	66	5.00
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C. A. Kulmann	Nomograph Charts		McGraw-Hill	1951	92	7.00
A. S. Levens	Graphics in Engineering & Science		John Wiley & Sons	1954	696	7.00
A. S. Levens	Workbooks to Accompany Graphics in Engineering and Science Book 1, Series 1 Book 2, Series 1 (with A. E. Edstrom)		John Wiley & Sons	1954 1954	125 120	4.00 4.00
A. S. Levens & A. E. Edstrom	Problems in Engineering Drawing Series IV	1st	McGraw-Hill	1953	155	4.00
W. J. Luzadder	Fundamentals of Engineering Drawing	3rd	Prentice-Hall	1952	721	5.95
C. L. Martin	Architectural Graphics	1st	Macmillan Co.	1952	213	4.00
Paré, Eugene, Loving, Robert Hill, Ivan	Descriptive Geometry	1st	Macmillan Co.	1952	309	4.00
Paré, Hrachovsky & Tozer	Graphic Representation	1st	Macmillan	1954	40	3.60
Paré, Loving & Hill	Descriptive Geometry Work Sheets Series B	1st	Macmillan	1954	75	3.75
J. H. Porsch, S. B. Elrod & R. H. Hammond	Problems in Engineering Graphics & Descriptive Geometry	1st	Balt Publishers Southworth's Ext. Ser., W. Lafayette, Indiana	1952	90 problem sheets	3.00
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J. S. Rising & K. E. Haughton	Engineering Graphics Problem Book III		Wm. C. Brown Co.	1955	101	
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J. T. Rule & E. F. Watts	Engineering Graphics	1st	Pitman	1952	396	4.50
J. T. Rule & E. F. Watts	Engineering Graphics Workbook	1st	Pitman			4.00
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W. L. Shick G. Wilson D. M. Holladay & S. E. Shapiro	Problems in Geometry for Architects Part II Series A		Stipes Publishing Co.	1956	56	2.75
W. W. Turner	Integrated Problems in Engineering Drawing & Descriptive Geometry	1st	Ronald Press	1953		4.00

AUTHORS	TITLE	ED.	PUBLISHER	YEAR	PAGES	PRICE
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Vierck, Cooper & Machovina	Engineering Drawing Problems Series II		McGraw-Hill	1953	122	4.50
Vierck, Cooper, & Machovina	Engineering Drawing - Basic Problems Series A		McGraw-Hill	1953	72	3.50
E. F. Waller	Technical Sketching		Pitman	1951		
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F. Zozzora	Engineering Drawing	1st	McGraw-Hill	1953	369	5.00
F. Zozzora	Engineering Drawing Problems		McGraw-Hill	1954	72	3.75

Mid-Winter Meeting

Engineering Drawing Division, A.S.E.E.
January 30–February 2, 1957
At Rice Institute, Houston, Texas

Tentative Program

Wednesday January 30

1:00 P. M. Registration, Lobby of Shamrock Hotel.
6:30 P. M. Executive Committee Dinner, Rice Faculty Club.

Thursday January 31

8:00 A. M. Registration, Lobby of Shamrock Hotel
General Session, Fondren Library, Rice Campus.
Presiding: Professor A. P. McDonald (Rice Institute)
Welcome: Dr. Houston
Response: Professor I. L. Hill (Illinois Institute of Technology)
Papers: Narrator: Professor Paul Weaver (Texas A & M).

1. The Role of Descriptive Geometry as Applied to Oil Exploration. Dr. W. M. Rust (Humble Oil and Refining Company).
2. How Exploration Information is Used in Drilling an Oil Well and Developing a Field. Mr. J. S. Blanton (Scurlock Oil Co.).

12:00 P. M. Luncheon, Rice Commons
1:30 P. M. Board bus to Pierce Junction Oil Field and inspect drilling oil well and producing well. Guided by Mr. J. S. Blanton.
2:30 P. M. Board bus for Hughes Tool Company.
Evening Entertainment to be arranged

Friday February 1

10:00 A. M. General Session, Fondren Library
Presiding: Professor W. J. Luzadder (Purdue University)
Papers:

1. Implied Shop Run Geometric Tolerances. Professor S. B. Elrod (Purdue University).
2. A Graphical Method of Determining the Shadows of a Moving Sun. Professor J. R. Holmes (University of Texas).
3. Some Interesting Facets of the Design and Construction of The Rice Institute Stadium. Professor J. R. Sims (Rice Institute).

Panel:
Professor M. F. Blade (The Cooper Union),
Professor André Halasz (The City College, New York),
Professor H. W. Vreeland (Columbia University),
Professor Irwin Wladaver (New York University).

12:00 P. M. Luncheon and Business Meeting, Rice Commons.
1:30 P. M. General Session, Fondren Library
Presiding: Professor I. L. Hill
Papers:

1. Preparation Beats Perspiration. Dr. L. D. Haskew (University of Texas).
2. How Can a Drawing Department Best Participate in Research? Professor Steven A. Coons (M. I. T.).
3. The Rendering of Drawings for Textbooks. Professor C. H. Springer (University of Illinois).

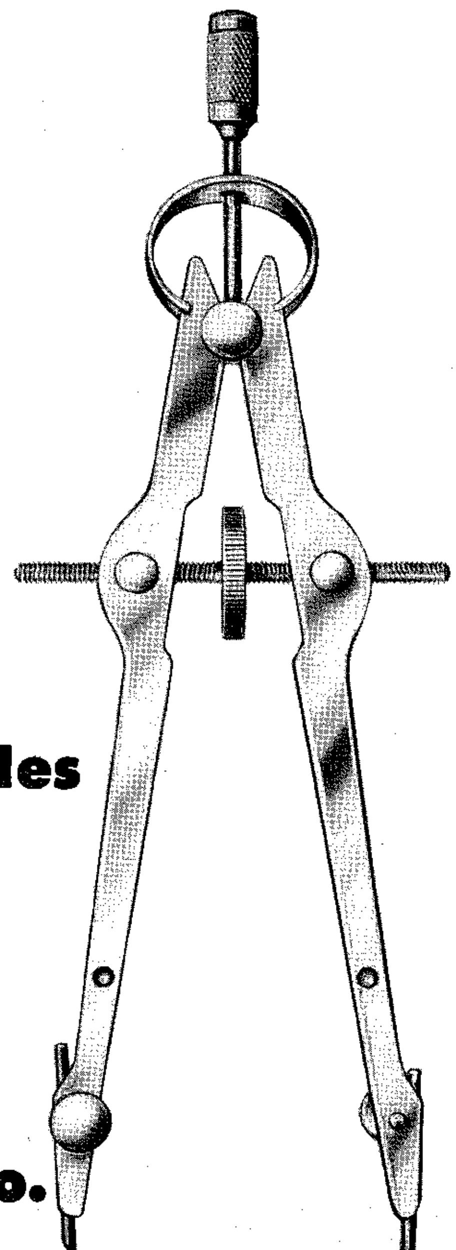
Panel:
Professor C. R. Buck (Syracuse University),
Major R. H. Hammond (U. S. Military Academy),
Professor R. G. Huzarski (University of New Mexico),
Professor E. W. Jackunski (University of Florida).

6:00 P. M. Banquet, Rice Commons
Presiding: Professor I. L. Hill.
Address: South America in Color. Professor Cary Croneis (Provost, Rice Institute).

Adjournment

Saturday February 2

Optional trip to Galveston.



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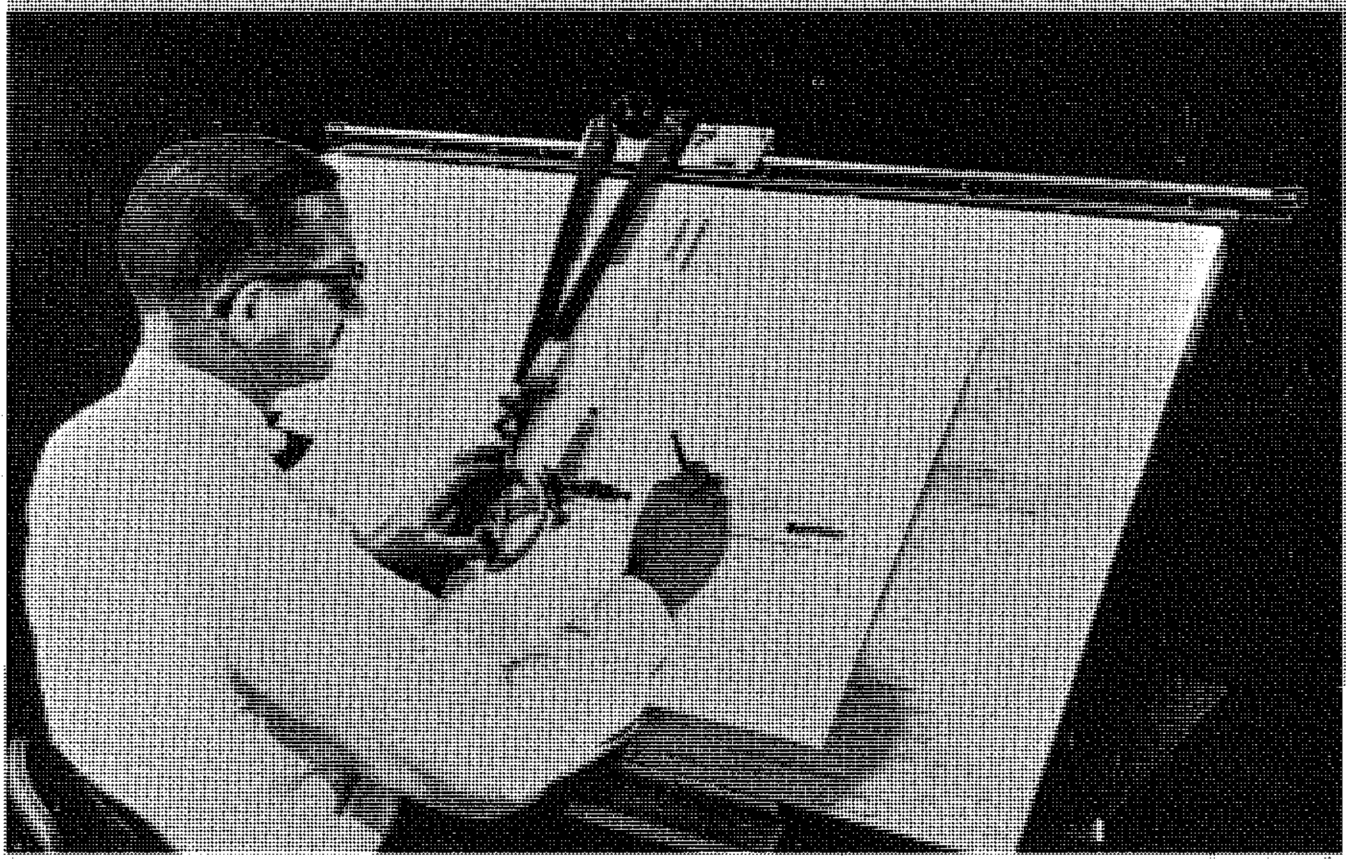

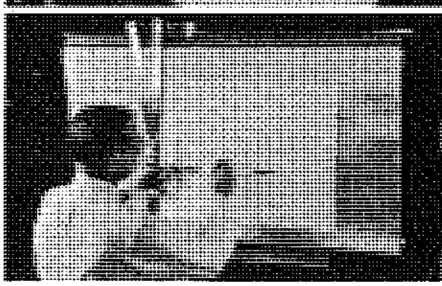

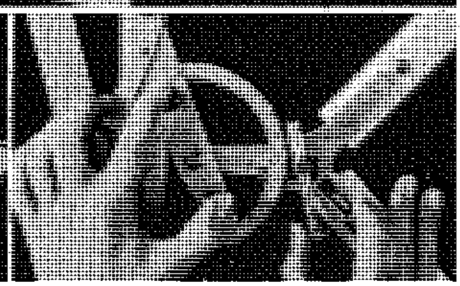

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