THE JOURNAL OF

ENGINEERING GRAPHICS

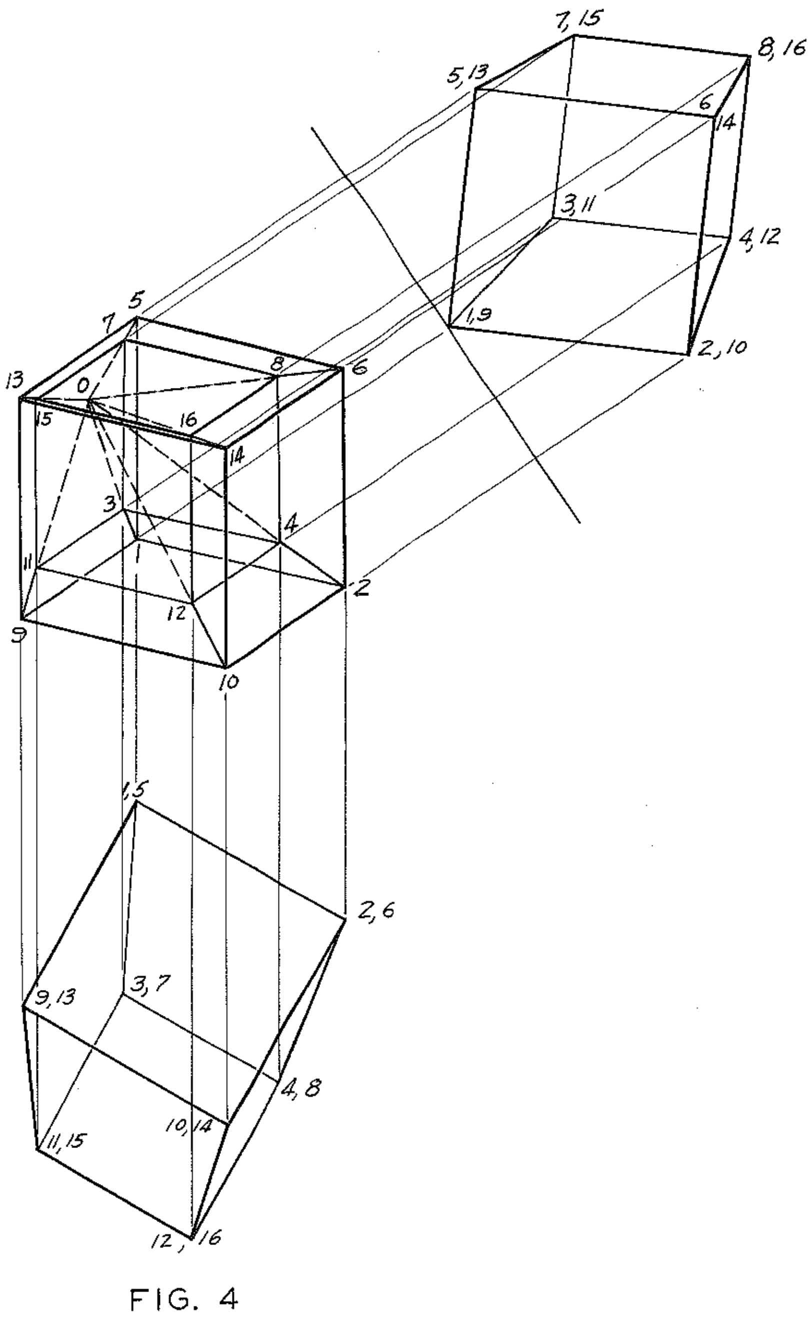

FIG. 4

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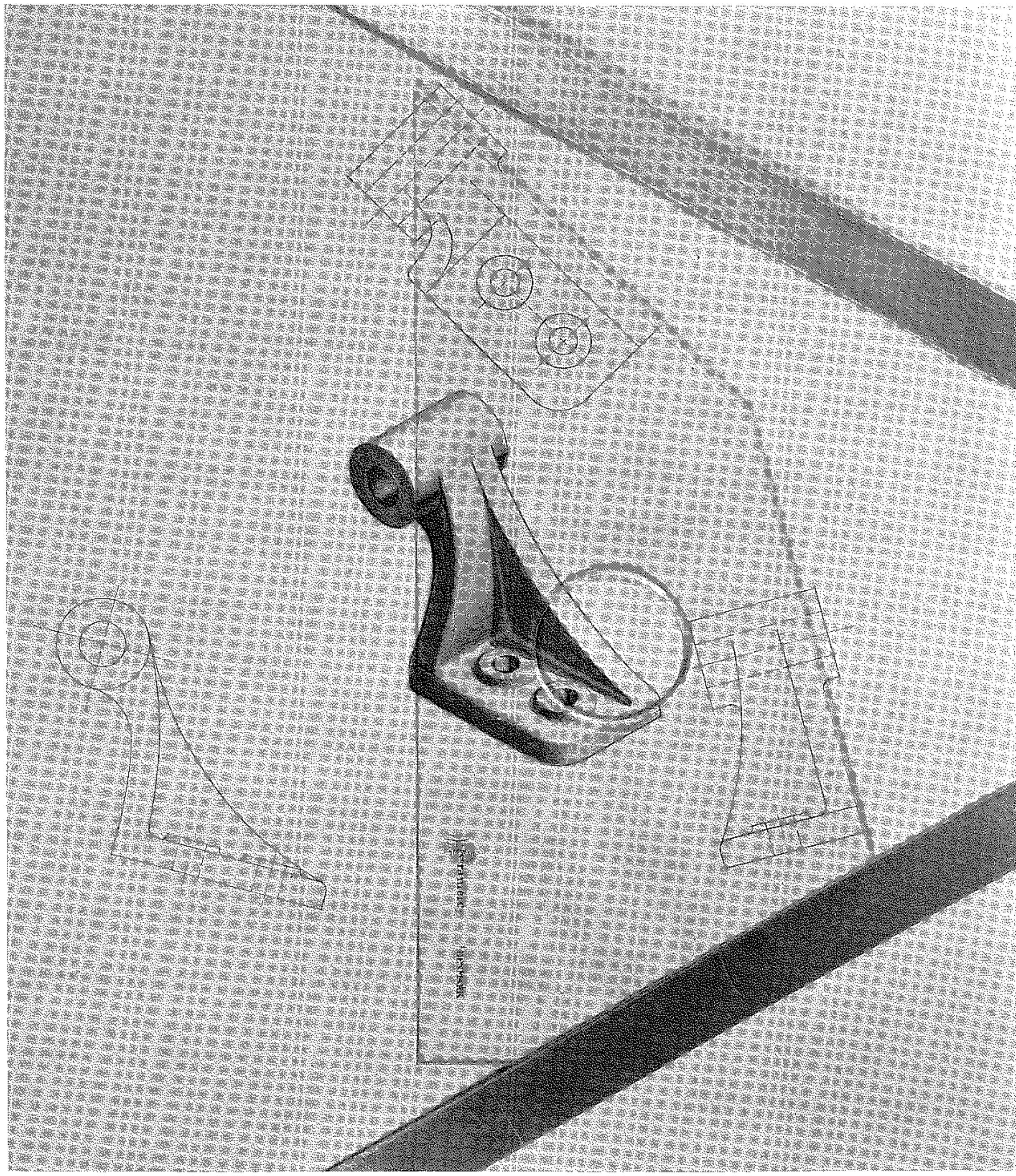

THE UNITED DRAWING SYSTEM

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PROFESSOR WAYNE L. SHICK
209 B TRANSPORTATION BUILDING
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URBANA, ILLINOIS

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MID-WINTER MEETING

The Mid-Winter Meeting of the Division of Engineering Graphics will be January 18-20, 1961, at the University of Wichita, Wichita, Kansas. Contact Arthur C. Risser for further information.

LETTER FROM THE CHAIRMAN

The Summer School that the Division had expected to conduct at the University of Kentucky Annual Meeting, June, 1961, has been postponed. The Executive Committee felt that for geographical reasons it would be more productive to run the summer school in Colorado about the time of the Annual Meeting in 1962.

Many suggestions have been received that should make our summer school interesting and useful. These are critical times for engineering graphics and surely there are many members of our division who have good ideas and hopes that they are silently cherishing. If you have any ideas which you feel deserve a trial, please write to me or to E. M. Griswold, Vice-Chairman, and tell us what you would propose. To arrange a good program, we need your help in the form of suggested speakers, topics, themes, and arrangements.

Irwin Wladaver, Chairman

M. I. T. REPORT

We commend to your study the "Interim Report of the Committee on Engineering Design" by the School of Engineering, Massachusetts Institute of Technology, November 3, 1959.

MANUAL SKILLS IN THE PROFESSIONAL CURRICULUM

Should manual skills be emphasized in the education and practice of a professional man? The 1955 Evaluation of Engineering Education declared that "skill alone does not justify the inclusion of a course in an engineering curriculum." Can this criterion be applied to the medical profession as well? The following types of education for the medical profession (hypothetical) may be analogous to the existing types of engineering education.

Doctor X attended a "first-class" medical school where science, not skill, was emphasized. He had observed several operations, gaining a general idea as to how cutting was done. In one short course he was allowed to do a little practicing of minor operations on a simplified, model body. He was somewhat prepared to give quick, sketchy instructions --"freehand" ideas--to technicians who would perform the actual operations. He was convinced that such routine, unsavory work involving manual skills was beneath his dignity, not creative, and unsuited to his superior intellect.

Doctor Y went to an old-fashioned "second-class" school where he learned to do his own operating. He developed the dexterity of his hands in all the manipulations and use of instruments required. He could make cuts and tie knots beautifully. He learned all about the "hardware" which made the body function. Admiring technicians helped him as he performed many, complex operations with his own hands. He did his own precision work, and he usually succeeded, that is, the patient recovered. He became a professional man with scientific knowledge, and with highly developed manual skills.

GRAPHIC SCIENCE - A NEW AND CHALLENGING FRONTIER

By A. S. Levens

Throughout history, engineering curricula have changed to keep pace with the growth of technology. Research, development and design have brought about the need for more science oriented curricula in engineering. Greater emphasis is placed upon mathematics, physics, chemistry, and engineering sciences and less on the "art of engineering", much less, if not the virtual elimination, on descriptive courses such as surveying, shop work, and drafting.

Let us look back for a moment before we consider the role of graphics in engineering and science.

During the first half of the 19th Century, the U. S. Military Academy established the beginnings of an engineering curriculum in 1802. Before the passage of the Morrill Act in 1862 helping to establish agricultural and mechanical colleges, very few schools offered courses in engineering.

Historically, drawing and descriptive geometry have been recognized as very important in the education of an engineer. It is hard to believe that in 1849 Rennselaer Polytechnic Institute, for example, included four courses in drawing and descriptive geometry during the three-year curriculum, and that Massachusetts Institute of Technology in 1865 gave two courses in drawing and two in descriptive geometry. As needs have increased for more science in engineering, devastating encroachments have been made on the time allocated to the teaching of drawing and descriptive geometry. Despite the evidence collected through various industrial surveys made by the Drawing Division (now Engineering Graphics Division) of A. S. E. E. in support of a minimum of 6 units of engineering drawing and descriptive geometry, the reduction of time for these courses is still being coerced.

We have presented valid argument for a reasonable share of graphics in engineering education. We have demonstrated the significant contributions that engineering graphics has made to design, production and development of industry. We have cited the work of Monge. We know that the basic principles of orthogonal projection, fully understood and employed, have contributed to replacing those empirical methods which have been confusing, incoherent, and wasteful.

Perhaps we have not adapted to changes in engineering curricula since World War II. The report of the Committee on Evaluation of Engineering Education, 1955, seemed to give little consideration to graphics. It appeared that the entire field of graphics had been jettisoned. Actually, the report states that "graphical expression is both a form of communication and a means for analysis and synthesis. The extent to which it is successful for these purposes is a measure of its professional usefulness. Its value as a skill alone does not justify its inclusion in a curriculum. The emphasis should be on spatial visualization, experience in creative thinking, and the ability to convey ideas, especially by freehand sketching, which is the normal mode of expression in the initial stages of creative work. Though the engineer may only supervise the preparation of the drawings required to execute his designs, he can hardly be expected to do this effectively unless he himself is thoroughly familiar with graphical communication."

Personally, I have had no quarrel with this statement, except for the omission of graphical methods of computation, nor with the strong emphasis placed on the basic sciences, the engineering sciences, and the need for studies in humanities and social sciences. I have felt strongly, however, about the inclusion of graphics in the category of "non-departmental engineering courses" (whatever that implies) and the failure to recognize graphics as an important science in engineering. I believe that the lack of recognition of the importance of engineering graphics was due, in part, to the recollection by members of the committee of the dull and uninteresting drawing and descriptive geometry courses they had some 25 years ago when over-emphasis was placed upon lettering, line work, inking, etc. It may well be that the antipathy toward graphics courses today reflects that same feeling on the part of some of our colleagues. Most of them are not aware of the changes that have taken place in recent years. Members of engineering and science faculties would be startled to discover that modern courses in engineering graphics have no time for such topics as pencil sharpening, lettering, line work, use of drawing instruments, geometric constructions, and inking, that less emphasis is placed upon sectioning, fasteners, detail and assembly drawings, and that much more attention is paid to the importance of the fundamental principles of orthogonal projection, analysis and synthesis, freehand sketching, and to introductory phases of graphical mathematics, including empirical equations, functional scales, graphical calculus and elements of nomography.

Basic courses in engineering graphics could definitely include these areas. However, many schools continue the traditional courses in drawing and descriptive geometry, which I consider unfortunate.

For several years, we have listened to argument that the topics mentioned above cannot be introduced because the college entrant has had no previous drawing instruction, and therefore instruction must begin at a fundamental level with lettering, line work, use of instruments, etc. For those students entering the college of engineering without high school or other credit in drawing, the engineering school can offer a non-credit course in pre-engineering drawing, or a two-weeks program in pre-engineering drawing just prior to the opening of the school year. We have found the latter program to work quite well, using ten five-hour periods, developing the fundamental processes and manual skills. However, the high school should do this pre-engineering drawing job.

Graphics develops perception, visualization, power to think through, analyze and solve three-dimensional problems in engineering and science, the spirit of engineering, punctuality, resourcefulness, initiative, orderliness, and the ability to work with others. Graphics is an essential part of professional engineering. It is not enough to point out these values of graphics to the engineering student; it is essential to demonstrate the value of engineering graphics to both our students and to our colleagues, not only in design, but also in the fields of research and development. At the very outset of our basic courses in graphics, we can stimulate the students' interest by pointing out (a) the variety of three-dimensional problems that arise in engineering which require for solution a thorough knowledge of orthogonal projection, analysis and synthesis, and (b) the need for knowledge, not only of the principles of projection, but of the principles of graphical mathematics in design and research.

We should point out that there may be several solutions to an engineering problem, once the problem and its parameters have been identified, and that the challenges of the future in engineering and science will demand not only a good background in mathematics, physics, chemistry, and graphics, but also an appreciation of the social significance of engineering work. It is our opportunity to counsel engineering students, defining engineering, science, the relationship of the engineer to the technician and to the scientist, and the dynamic areas for both engineers and scientists; and we should point out that physics is not engineering.

When a new principle of physics is found - that is science. When new principles are employed in designing and firing a rocket - that is engineering.

There is great need for effective communication between engineering and science because of the short gap that occurs between discovery by the scientist and implementation by the engineer. There must be areas of common knowledge to both engineer and scientist. Majors in physics and chemistry could greatly enhance their effectiveness through a working knowledge of modern engineering graphics. Here lies an opportunity for graphics departments to work more closely with groups in related disciplines.

Members of engineering graphics faculties must work with colleagues in engineering, physics, chemistry, mathematics, biology, agriculture, and other fields. Can we expect our colleagues in engineering education to take advantage of the knowledge and experience the student has acquired in graphics if these colleagues have not been aided in their work and research by graphics, and if they are not aware of the significant changes in graphics which have been made in recent years?

We should encourage our colleagues who teach such courses as mechanics, strength of materials, thermodynamics, design, etc. to participate in the the teaching of graphics, and those of us in graphics should teach other subjects as well.

At the University of California at Berkeley, we have had some success in this connection. We have men from the fields of industrial engineering, internal combustion engines, thermodynamics, electrical engineering, and mechanics participate in the teaching of graphics courses.

In our mechanics and design division, nearly all members of the staff teach graphics courses. As a consequence, the integration of graphics with mechanics and machine design is greatly enhanced.

In this manner, the basic graphics courses are more effectively integrated with all fields of engineering, and more importantly, both faculty members and students are better prepared for the effective use of all phases of graphics whenever appropriate.

Working with a major aircraft company, I discovered that many engineering graduates could not effectively use the fundamentals of orthogonal projection to analyze and solve three-dimensional problems arising in aircraft design. When I inquired about their difficulty, I was informed that after they had completed their college courses in graphics they had been given practically no opportunity in the junior and senior years to apply their knowledge and experience to the analysis and solution of space problems because few, if any, had been presented. I found, for example, that many of these graduates failed to recognize that the same analysis was employed in solving a problem that dealt with the determination of the distance between two skew cables and another problem, seemingly different, the determination of the angle between two plates.

Similar problems arise in structural design, in transmission systems, and in frame works of various types. The few fundamentals of orthogonal projection can be applied to the analysis of many space problems that arise in both engineering and science. It is essential that our curricula and our faculty members provide many opportunities for effective carry-over in the use of these principles and in the use of graphical mathematics if our students are to be properly prepared to make the fullest use of their knowledge and experience.

We should seize upon every opportunity to work with colleagues who are active in research. We should be available, whenever appropriate, to render service both to graduate students and to industry.

For example, one of our professors in electrical engineering was interested in the application of graphical calculus to the solution of a problem that arose in the field of micro-wave optics. This problem concerned the determination of the directional radiation characteristics of a micro-wave antenna system. This was accomplished by measuring the amplitude and phase of the electric field across a straight aperture in the near-zone of the antenna system. From these measurements the far-zone field was calculated. Graphical differentiation was employed in the solution because an algebraic solution was much too cumbersome, if at all possible.

In another case, a member of the industrial engineering staff wanted to know how to employ graphical differentiation in connection with problems in engineering economy. One problem dealt with the determination of the number of articles per unit time that could be produced to yield maximum profit. Another problem was concerned with the relationship between costs and benefits.

In two other cases, assistance was given in the design of nomograms, one that dealt with "Performance of Vertical Single Stage Ammonia Compressors," and the other with the "Determination of Fixed, Operation and Maintenance Costs of Refuse Collection."

A few years ago, a request for assistance was received from a University of Texas graduate student in the field of Zoology. He was in need of a nomogram that could be used in solving an equation in connection with a technique used in Cytology to measure the amount of light passing through a symmetrically shaped nucleus of a cell. The technique is called Cytophotometry. Cells are stained with a dye which reacts chemically with a cell constituent. The dye complex is localized in the nucleus, and by measuring the amount of light absorbed by the dye complex and the projected area of the nucleus in the microscope system, one can calculate the relative amount of absorbing substance present. Repeated calculations were greatly facilitated by the use of a nomogram.

Over a period of years, we have worked closely with a team - engineers, doctors, anthropologists, and psychologists - on research in the field of prosthetic devices, specifically in the improvement of artificial limbs. More recently, we have had a fruitful experience in applying graphical methods to the solution of problems that arose in the fields of ballistics and food technology.

Our research in nomography has led to the development of a nomographic method for testing the validity of experimental data.

The application of graphical methods to the solution of problems that arose in the above mentioned fields is more fully discussed in other literature.

There are, in addition, opportunities for service to industry and to governmental agencies.

In two cases, my experience dealt with engineering and scientific personnel associated with research, development, and design work carried on in governmental agencies. A need was felt for working knowledge of nomography and graphical calculus. To help meet this need, a two-weeks short course was given. This course was attended by some 35 selected persons who were released from regular duties to participate in this class for five hours daily. Two hours were devoted to lectures and demonstrations, and three hours to supervised computation periods. The class consisted of graduates from engineering, physics, chemistry, and mathematics. I still recall the comments of a mathematics major, "I never realized what I had missed in both my undergraduate and graduate work until I had this experience in the use of graphical methods. I now appreciate the value and usefulness of nomography and graphical methods of computation. In many instances an algebraic solution is at best cumbersome. Not knowing the power of graphical methods of computation is a severe handicap."

Through contact with research activities, we can enrich the content of our basic courses in engineering graphics and further the progress of our students. The future challenges to engineering and science imply challenge to our educational program, to the need for more effective teaching, and to improved curricula.

We must help educate men who can cope with technological problems that will arise in new fields, men who thoroughly understand basic principles, men who are capable of a high degree of "imagineering." This is so vital that our position as leaders both in a free society and in technology may well be at stake. Good education in graphics can contribute significantly to the development of the engineer of the future.

To provide for such training, it is imperative that: (1) We continue to do a good job in the basic graphics courses; we revitalize course material. Skills such as pencil-sharpening, lettering, simple geometric constructions, etc. should be <u>prerequisite</u> to a college level course. Course content should strengthen the student's grasp of basic principles without sacrificing attainment of reasonable proficiency in technique Duplicate details should not be repeated. With judicious use of freehand sketching, elimination of non-essentials and simplification of delineation, actual drawing time may be reduced. Such time-saving measures coupled with pre-engineering drawing preparation provide time for introductory phases of graphical calculus, nomography, and graphical methods of computation in our <u>basic courses</u>. (2) We should participate in research projects. Here may be found excellent opportunities to demonstrate the effective use of graphical methods. As a result, classwork can be enlivened by citing cases where graphic science proves invaluable. (3) We should make every effort to work closely with our colleagues who teach other courses, such as mathematics, mechanics, strength of materials, design, etc. We can correlate graphic science with the work in these fields. This is very important in order to provide for continuous use of graphics throughout the engineering program. (4) Some schools should offer advanced graphics courses - at the senior and graduate level. The fields of nomography and graphical computations, including the solution of differential equations, afford many opportunities for advanced work. (5) We need to work more closely with high schools, technical institutes, and junior colleges. We should strongly support the high schools in their quest for an adequate number of highly qualified counselors. We must work with high school teachers of drawing, science, mathematics, and the social sciences in re-examining subject matter content. The early identification of youngsters who are capable of undertaking college work in engineering and science is of vital importance. Guiding such students to study engineering and science can be quite effective through the joint efforts of secondary and higher-education teachers. Through such efforts, we can also discover those who can and should undertake the study of technicians programs. Our need for highly qualified technicians is tremendous.

As to preparation for more effective teaching in engineering graphics, I believe that the suggestions made previously point in the right direction. We must continue our studies and our scholarly activities. We must take advantage of the opportunities to enhance our knowledge and teaching through conferences, seminars, summer institutes, research and industrial experience.

We are on the threshold of an exciting frontier in engineering and science, rich in the opportunity to help in the building of an enduring peaceful world-wide society. We in engineering and science education can contribute much to the realization of such a society through our teaching and research activities. Our teaching is of paramount importance. It must be of the highest quality. As teachers of engineering graphics, our usefulness in engineering and science communication, in engineering computation, in engineering analysis, synthesis, and research need never be challenged if we have the will and the courage to face up to the demands of an exciting, rapidly expanding engineering and science era.

DISTINGUISHED SERVICE AWARD

To the Members of the Engineering Graphics Division:

The Special Awards Committee solicits your nomination for the Distinguished Service Award for 1961. The committee, composed of the three immediate past chairmen of the Division, determines the recipient of the award at the mid-winter meeting of the Division. Therefore, it will be necessary to mail your nomination not later than January 3, 1961.

To be eligible for the award, a candidate must have made clearly discernable contributions to teaching the art and science of graphics; contributed to the literature in his field; and rendered a distinct service to the Division. Kindly refer to page 27 of the May, 1952 issue of the Journal of Engineering Drawing for a full statement of the requirements for the Distinguished Service Award. Also refer to a copy of the Consitution and By-laws of the Division as amended June, 1959.

The Distinguished Service Award has been given to the following:

1950 - Frederick G. Higbee
1951 - Frederick E. Giesecke
1952 - George J. Hood
1953 - Carl L. Svensen
1954 - Randolph P. Hoelscher
1955 - Justus Rising
1956 - Ralph S. Paffenbarger
1957 - Frank Heacock
1958 - H. Cecil Spencer
1959 - C. Elmer Rowe
1960 - Clifford H. Springer

Please send your nominations to the chairman of the committee singly or in groups. Your prompt cooperation will be greatly appreciated.

W. J. Luzadder, Chairman
J. S. Rising
Albert Jorgensen

DISTINGUISHED SERVICE AWARD

FOR 1960

CLIFFORD HARRY SPRINGER, the recipient of the Distinguished Service Award, is a graduate of the Ohio State University and the University of Illinois. He has a bachelor's degree in civil engineering and a master's degree in theoretical and applied mechanics, and in addition has a professional degree in civil engineering. He is now a college teacher with thirty-six years of service.

A distinguished teacher, author, professional engineer, and consultant in the field of engineering graphics, Professor Springer began his engineering career in 1917 with the Pennsylvania Railroad. His career was interrupted by three years of military service as a Second Lieutenant and Captain in the U. S. Army Engineers Corps.

Upon return to civilian life, Professor Springer worked for the St. Louis County Minnesota Highway Department until he joined the faculty of the University of Illinois in 1924 as an instructor, and since advanced to his present rank as professor in the Department of General Engineering.

The wide use of the many books Professor Springer has contributed to as co-author is evidence of their professional quality. He has written extensively in the graphics field and served the Engineering Graphics Division in many capacities, including the offices of secretary and chairman. Professor Springer is a member of ASCE, SAE, and ASEE. He is now chairman of the American Standards Association committee on drafting standards. His participation and chairmanship of important committees of the ASA have had profound influence on our present day drawing standards.

As a teacher, counselor, and professional engineer, Professor Springer is held in high esteem by his students, colleagues, and friends. He is admired for his competence, sincerity, humility, graciousness, and devotion to the profession of Engineering Graphics.

DIVISION OF ENGINEERING GRAPHICS
OF THE
AMERICAN SOCIETY
FOR
ENGINEERING EDUCATION

RESOLVED:

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

CLIFFORD H. SPRINGER

THROUGH THE YEARS 1927-1960

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

PRESENTED THIS TWENTY-FIRST DAY OF JUNE IN THE YEAR OF OUR LORD NINETEEN HUNDRED SIXTY.

Albert Jorgensen
Chairman of the Division

Edward M. Griswold
Secretary of the Division

RESPONSE TO THE AWARD CITATION

By Professor Clifford H. Springer

Mr. Chairman, Members of the Division of Engineering Graphics, Ladies and Gentlemen:

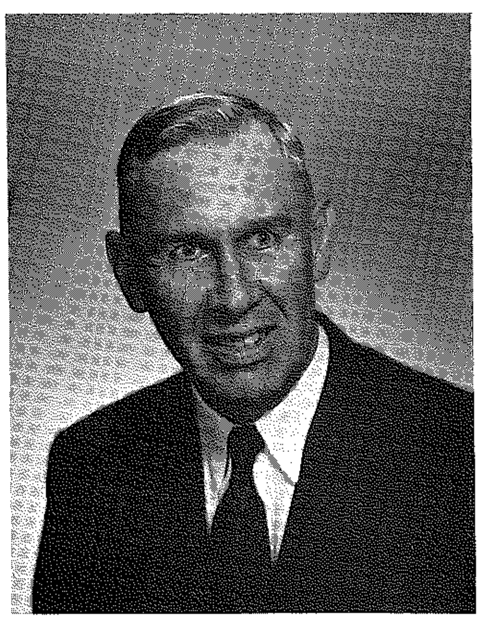
To receive an award of this kind from any organization is an honor, but to receive it from such a live organization as the Graphics Division is especially gratifying.

The baseball coach says of his best pitcher that he has a live ball. By that he means that the ball does things and that it does them at the right time. I claim that the Graphics Division is a live organization because it does things and does them at the right time.

No organization can succeed without the initiative to originate and develop new ideas. In a large organization such as this the initiative must come from the officers and leaders. In this field, our division has been particularly fortunate from the very beginning. It was organized and started on its way by such men as French, Higbee, Jordan and Hoelscher, and all down through the years there has been a succession of able and gifted men who were willing to work and contribute their time and energy for the good of the division. To list these men would require too much time, but if you look around, you will see and recognize many of them who are still active.

As you look around, you will also see many younger men of ability who are ready, willing, and able to carry on and produce new ideas and new developments that will become the theme of the future. Our only charge to them as they take over is to follow the example set by their predecessors and to be sure they are right, then go ahead.

As I said before, to receive an award from such a group is an experience of which I am very proud, and for which I thank you all very much.



Annual Meeting of
The American Society for Engineering Education
Division of Engineering Graphics
Purdue University
June 22, 1960

TENTATIVE SLATE OF CANDIDATES FOR OFFICES OF THE DIVISION, 1961-62

RULES

(a) The Nominating Committee to be appointed in June at the annual meeting shall be composed of five persons, three of whom shall be the last three past Chairmen of the Division who are present at the annual meeting (not including the retiring chairman) and two others, who are present, to be appointed by the Vice-Chairman in office with the approval of the Executive Committee. The latter two appointees shall not hold any office at the time of their appointment. The senior past Chairman of the Division shall act as Chairman.

(b) The Nominating Committee shall prepare a slate containing, for each office to be filled, two names of eligible candidates who have expressed a willingness to accept nomination and to serve if elected. The slate as prepared by the Nominating Committee shall be published in the November issue of the Journal.

(c) A properly prepared petition nominating a member for any office that bears ten (10) signatures of members of the Division and Society shall require the Nominating Committee to place the name on the ballot.

(d) The nomination period must be considered as being closed at the end of the last conference session of the mid-winter meeting. A petition for nomination received after the close of the mid-winter meeting cannot be accepted. A conference session is herein defined as a regularly scheduled meeting at which papers are presented for discussion.

(e) On March 1, and returnable before April 1, the Secretary shall mail to each member of the Division an election ballot bearing the slate prepared by the Nominating Committee.

(f) Any holder of an elective office whose term extends beyond the current year shall not be eligible for nomination to another office.

NOMINATIONS

The Nominating Committee of the Division of Engineering Graphics met at Purdue University, Lafayette, Indiana and selected the following candidates for the office indicated.

Vice Chairman:
- A. P. McDonald, The Rice Institute
- Matthew McNeary, University of Maine

Secretary:
- Edwin W. Jacunski, University of Florida
- Robert O. Loving, Illinois Institute of Technology

Director on Executive Committee (5 years):
- Ernest R. Weidhaas, Pennsylvania State University
- Steven A. Coons, Massachusetts Institute of Technology

Editor - Journal of Engineering Graphics (3 years):
- Mrs. Mary F. Blade, The Cooper Union
- Paul M. Reinhard, University of Detroit

Division Editor for ASEE:
- Jerry S. Dobrovolny, University of Illinois
- Hugh P. Ackert, University of Notre Dame

Additional candidates may be nominated by petition as outlined under paragraphs (c) and (d) of the rules given at the left. The candidate must have expressed his willingness to serve if elected. Such petitions for nominations should be presented to the chairman of the Nominating Committee by the end of the last conference of the 1961 mid-winter meeting. See rule (d).

Respectfully submitted,
The Nominating Committee
S. J. Luzadder
J. S. Rising
G. Rook
R. W. Waymack
I. L. Hill, Chairman

OFFICERS AND COMMITTEES - 1960-61

DIVISION OF ENGINEERING GRAPHICS - ASEE

OFFICERS:
Chairman: Irwin Wladaver, New York University
Vice-Chairman: E. M. Griswold, The Cooper Union
Secretary: Carson P. Buck, Syracuse University
General Council Representative: J. S. Rising, Iowa State University

COMMITTEES:

Executive:
Irwin Wladaver, New York University
E. M. Griswold, The Cooper Union
C. P. Buck, Syracuse University
Albert Jorgensen, University of Pennsylvania (Past Chairman)
J. S. Rising, Iowa State University, Council Member (2 years)
Matthew McNeary, University of Maine (1 year)
B. L. Wellman, Worcester Poly. Institute (2 years)
E. D. Black, General Motors Institute (3 years)
L. C. Christianson, University of Missouri (Rolla School of Mines and Metallurgy)(4 years)
E. G. Pare', Washington State University, Treasurer (5 years)
E. W. Jacunski, University of Florida (1 year)
W. L. Shick, University of Illinois (1 year)
R. H. Hammond, United States Military Academy (3 years)
R. D. LaRue, Colorado State University (2 years)

Publications:
Journal of Engineering Graphics:
Editor: W. L. Shick, University of Illinois
Advertising Manager: R. H. Hammond, U. S. Military Academy
Treasurer and Circulation Manager: R. D. LaRue, Colorado State University
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J. J. Gerardi, University of Detroit
F. A. Heacock, Princeton University
R. P. Hoelscher, University of Illinois
W. E. Street, A. & M. College of Texas

Nominations:
I. L. Hill, Chairman, Illinois Institute of Technology
W. J. Luzadder, Purdue University
J. S. Rising, Iowa State University
Gustav Rook, Northeastern University
Rex W. Waymack, Modesto Junior College

Special Awards:
W. J. Luzadder, Purdue University, Chairman
J. S. Rising, Iowa State University
Albert Jorgensen, University of Pennsylvania

Aims, Scope, and Status of Engineering Graphics:
Matthew McNeary, University of Main, Chairman
J. S. Blackman, University of Nebraska
C. P. Buck, Syracuse University
Amogene F. DeVaney, Amarillo College
J. S. Dobrovolny, University of Illinois
J. J. Gerardi, University of Detroit
K. E. Kroner, University of Massachusetts
A. P. McDonald, Rice Institute
E. G. Pare', Washington State University
P. M. Reinhard, University of Detroit
G. K. Stegman, State University of Iowa
B. L. Wellman, Worcester Polytechnic Institute

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E. W. Jacunski, University of Florida
R. E. Lewis, Duke University
E. A. Morrow, William Jewell College
J. M. Plant, Florida State University
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P. M. Reinhard, University of Detroit

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K. E. Botkin, Purdue University
Frank Blymer, General Motors Corporation
P. E. Machovina, The Ohio State University
C. A. Newton, University of Tennessee
J. E. Pearson, University of Illinois
R. W. Reynolds, California State Polytechnic College
L. R. Schruben, University of Southern California
W. E. Street, A. & M. College of Texas
B. L. Wellman, Worcester Polytechnic Institute
F. M. Woodworth, University of Detroit

Nomography:
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J. N. Arnold, Purdue University
M. W. Almfeldt, Iowa State University
A. S. Levens, University of California
J. H. Sarver, University of Cincinnati
Mary F. Blade, The Cooper Union

Descriptive Geometry Award:
J. S. Dobrovolny, University of Illinois, Chairman
I. L. Hill, Illinois Institute of Technology
S. M. Slaby, Princeton University

Teaching Techniques:
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ANIMATED FILMS TO AID CREATIVE SPACE PERCEPTION

By H. B. Howe

A two-year project to develop animated films to facilitate creative space perception was begun in 1959 at Rensselaer Polytechnic Institute, sponsored by the U. S. Office of Education, Department of Health, Education and Welfare. The following progress report was presented by H. B. Howe, October 4, at Pennsylvania State University at the Regional Information Conference on Research in Newer Education Media, sponsored by the U. S. Office of Education.

As the complexities of modern technology multiply, creative scientists and engineers need to understand, more and more fully, the world of three-dimensional space and to know how to express the characteristics and relationships of the objects they "see" in that world. Not only must they "see", and understand what they "see," they must create new solutions for new problems and new ideas from new data. Today, many of the problems, data, ideas and solutions require greater perception and understanding of the spatial world than ever before.

Consequently, the education of future scientists and engineers must now include more effective ways of helping students to "see" and understand three-dimensional space and to use these learned abilities to "create." It is believed that students can be thus helped (a) by the study of the science of form (i.e., the theory involved in the arrangement of geometrical forms - points, lines, planes, single-curved, warped, double-curved surfaces, etc.), (b) by practice in direct perception of form and in pictorial perception of form as it is expressed by others, (c) by development of ability to think in terms of form, and (d) by practice in expressing pictorially their own concepts of form in space.

The science of form appears to be most effectively taught by the medium of freehand pictures. Too many students formerly learned methods for solving problems related to space relationships without actually "seeing" or understanding the space relationships which exist. These methods of solution, performed without spatial "seeing," place limits on the basic graphic discipline, involving mental concepts, which should be unlimited in scope. This "seeing" in space is not confined to graphic solutions but is a necessary prelude for setting up or creating spatial problems to be solved by analytical methods. Actual problem solution in terms of measurable quantities is, of course, accomplished by the multiview projection method. The picture method serves for the analysis of the problem, and is basic to logical learning, rather than rote learning.

In this experiment in educational media we are searching for means for improving this mental and visual seeing with understanding rather than learning methods for solving the problem.

Considerable progress has been made in the use of pictorial sketches as a means for the transfer of ideas both to and from the student In our experience, it is indicated by student performance that arrangements of form are grasped more quickly and have longer retention when this pictorial method is incorporated in the teaching process. This is in contrast to the sole use of multi-view projection and word combination method.

September 22, 1960

NATIONAL SCIENCE FOUNDATION
SUMMER CONFERENCE
ON
GRAPHICS IN SCIENTIFIC ENGINEERING

Under the sponsorship of the National Science Foundation a two week Conference on "Graphics in Scientific Engineering" was held at the University of Detroit from July 11th to 22nd, 1960. Faculty members from the fields of mathematics, physics, graphics, and mechanics representing twenty six engineering and pre-engineering colleges together with industrial personnel participated.

The purpose of the Conference was to explore various applications of graphics related to the solution of experimental and practical engineering problems of the space age. With this objective in mind, the following educational and industrial conference leaders directed seminar type discussions in the designated topic areas:

1) Major Robert H. Hammond of the United States Military Academy
"Analytical Versus Graphical Solutions"

2) Professor J. Norman Arnold of Purdue University
"Empirical Data"

3) Professor Forrest M. Woodworth of the University of Detroit
"Computer Graphics"

4) Dean John T. Rule of Massachusetts Institute of Technology
"Experimental Applications of Graphical Solutions"

5) Mr. Peter G. Belitsos of the Jet Engine Division of General Electric
"Graphics of Free State Variations"

6) Mr. Robert K. Louden of International Business Machines Corporation
"Recent Trends and Developments in Graphical Computer Programing

The Conference group was the guest of the General Motors Technical Center for a full day. Papers on nomography were presented by Mr. Harvey Meeusen of the Experimental Development Group of Diesel Equipment Division and Mr. Robert Denil of Cadillac Motor Car Division. Mr Richard Justice, research mathematician from General Motors Research Laboratories, discussed the graphic output of a digital computer.

The success of the two week program was attributable to the enthusiastic participant support given all phases of the Conference. It was a most pleasant and gratifying experience for all those connected with the planning and direction of the Conference

Professor Paul M. Reinhard
Conference Director

THEORETICAL GRAPHICS

By Steve M. Slaby

The field of engineering graphics has been one which has been primarily limited to three-dimensional space analysis. This analysis has its roots in the Mongean system of projection, and over the years variations have been introduced into this system which have led to the development of the "direct method" of projection with the real or implied concept of three-mutually perpendicular projection planes.

The direct method involving three-dimensional space has been the basis of our descriptive geometry courses in most of our engineering colleges and has proven to be most useful in the teaching of courses involving descriptive geometry principles and engineering drawing, as well as in the development of a spatial relations sense in our engineering students. On the other hand the restriction of graphical analysis to three-dimensional space has limited the development of the theoretical aspects of this discipline.

If one reviews the recent history of our field one gets the impression that we have been resigned to the three-dimensional graphical space analysis and have not given much thought to the possibility of expanding the concepts of graphics into multi-dimensional space above three dimensions. This is evidenced by the lack of publications in the area of "theoretical graphics" in our journals. This vacuum in our discipline led me to apply for a National Science Foundation Science Faculty Fellowship in engineering graphics. In my application for this fellowship I indicated that I was interested in attempting to learn whether a broad concept of graphics, similar to the broad concept of mathematics, could be developed which among other things might include n-dimensional space concepts. I was granted a Faculty Science Fellowship to work with Professor Ole P. Arvesen of the Norges Tekniske Høgskole in the city of Trondheim, Norway. Professor Arvesen is a Dr. of Mathematics and the Head of the Descriptive Geometry Department at the Høgskole. In our mutual exchange of ideas I learned that he had done some work dealing with projections in a four-dimensional space which was presented by him in a paper to the Royal Norwegian Society of Science in 1955. This society consists of members from the humanities, the natural sciences, and engineering. Professor Arvesen, upon my request, agreed to have this paper published in the Journal of Engineering Graphics (following).

It is my feeling that the work of Professor Arvesen represents a pioneering effort in our quest for new knowledge in the field of engineering graphics and should open up unlimited possibilities for the scientific and theoretical development of graphics which I feel is necessary to promote the survival of engineering graphics as a unique engineering and scientific discipline. The type of thinking indicated in Professor Arvesen's work can make it possible to create courses on the graduate level in "Theoretical Graphics" and therefore increases our usefulness to our students not only on the undergraduate level - as vital as this is - but also on the upper or graduate level where original thoughts in our field may be promoted and developed. In addition our discipline will be strengthened in its scientific and professional position and thus the end result will be to increase our contribution to engineering graphics as a total and broad scientific concept.

It is hoped that Professor Arvesen's work will stimulate all of us in the field of engineering graphics towards thought and action which will lead us to fruitful research in theoretical graphics which should have a "leavening" effect on our undergraduate courses, students, and teachers.

In reading Professor Arvesen's paper certain terms and concepts are used which I shall define here. In a four-dimensional space one linear equation in x, y, z, u, defines a three-dimensional space while two equations define a plane and three equations a straight line. Four equations in a four-dimensional space define a unique point and these four equations have <u>one</u> and only one solution for a particular point.

In four-dimensional space the intersection of two planes is a point not a line. A picture <u>space</u> (as against a picture plane) when intersected by a line (ray) in four-dimensional space, results in one unique point.

A four-dimensional cube has 32 edges which are divided into 4 groups of 8 parallel lines. One group for example as shown in Fig. 4 of Arvesen's paper is 1-3, 2-4, 5-7, 6-8, 9-11, 10-12, 13-15, 14-16. In a perspective picture of a four-dimensional cube these edges converge to a "vanishing point" 'O' similar to the vanishing points of parallel lines in an ordinary perspective picture. (Also see Fig. 5 - Arvesen's paper).

R_4 refers to a four-dimensional space, and R_3 refers to a three-dimensional space.

A Simplex S_4 refers to the simplest four-dimensional space figure which is a tetrahedron with four corners. A simplex (S_3) figure in three-dimensional space is a tetrahedron having three corners while a simplex in a two-dimensional or planar space is a triangle.

ON THE QUESTION OF THE LUCIDITY OF PICTURES FROM A FOUR-DIMENSIONAL SPACE

By Ole Peder Arvesen

1. In mathematical literature representations of figures in a four-dimensional space are not infrequent. Most readers - perhaps many mathematicians too - are apt to assume that such figures must be mere schematic representations, a view which in many cases is valid. However, in this paper it shall be shown that in a "space" where the power of visualization fails, figure projections may be obtained by exactly the same method that is used to produce perspective pictures or axonometric projections of three-dimensional objects. This fact, which initially seems most surprising, is not, after all, more strange than the fact that by means of simple perspective drawing we may determine the representation of the infinitely far removed point of a straight line.

2. Planar perspectives are more or less lucid. Of the three pictures of a cube represented in Figs. 1 - 3, only Fig. 3 may be characterized as lucid; the other two, in which a special position has been chosen for the projection center, do not give the illusion of a three-dimensional figure (or at least they do so only with difficulty).

One may ask whether, in connection with the representation of pictures from an R_4, it would be profitable to make use, analogically, of our experience from the lucidity of planar perspectives. For this purpose we consider the equations for a perspective representation of the R_4 in an R_3. Here, x, y, z, u are the coordinates of a point P in a 4-dimensional space and a, b, c, d, the coordinates of the projection center O. A point P_o on a ray OP is then determined through the following equations:

$$x_o = \frac{a + \mu x}{1 + \mu}, \quad y_o = \frac{b + \mu y}{1 + \mu}, \quad z_o = \frac{c + \mu z}{1 + \mu}, \quad u_o = \frac{d + \mu}{1 + \mu}$$

In order to complete the analogy with Fig. 3 we choose for picture space $y_o = 0$, and consequently we have $b + \mu y = 0$ or $\mu = -\frac{b}{y}$. Accordingly, the coordinates of the picture point sought for are as follows:

$$(1) \quad x_o = \frac{ay - bx}{y - b}, \quad z_o = \frac{cy - bz}{y - b}, \quad u_o = \frac{dy - bu}{y - b}$$

By means of an example we shall now determine analytically the three-dimensional perspective picture of the four-dimensional cube and in (1) assume a = 3.2, b = -3, c = 2, the values applied in the representation of Fig. 3. In Fig. 4, d = 3.

The elevation of the spatial picture obtained turns out to be identical with Fig. 3, while the ground-plan likewise takes the form of a planar cube perspective. Fig. 4 shows an axonometric projection of this picture according to the Eckhart* method.

*See Jnl. of Eng. Graphics, November, 1959, pp. 13, 35-37.

3. Supposing that in Fig. 3 the perspective plane is revolved on the z axis, the picture obviously gains in lucidity. From Fig. 5, one cannot claim that this merit accrues in the same degree to the representation by analogy of the four-dimensional cube. It seems as if our experience as far as lucidity is concerned is rather insignificant in connection with the representation of pictures from the R_4. For instance, when we take for our basis the case of Fig. 2 which is not very lucid, we get the well-known Schlegelsche Darstellung (Schlegelian representation), which is no doubt the most favorable one.

4. Still a few words should be added on the representation of the four-dimensional Simplex S_4. By way of analysis one obtains the simplest possible perspective of an S_3 as indicated in Fig. 6. The base of the tetrahedron appears in full size in the xy- plane chosen as the perspective plane, and it only remains to determine picture D of the fourth corner. The projection center has been chosen on the z axis. It is clear that D must therefore always be situated on the straight line $y = \frac{1}{\sqrt{3}} x$.

On the assumption that D is located inside the triangle ABC, the picture may be characterized as lucid. This is particularly true also in the case of a parallel projection ($c \to \infty$).

The generalization of this picture in the representation of S_4 is obvious: For picture space we choose $u = 0$, and the projection center is assumed on the u axis (0, 0, 0, d). As for the picture points of the corners, four of them will coincide with those of the three-dimensional regular tetrahedron, whereas picture point E of the fifth corner must be situated on the straight line $y = \frac{1}{\sqrt{3}} x$, $z = \frac{1}{\sqrt{6}} x$. In the case of the parallel projection ($d \to \infty$), E coincides with the centroid of the remaining four corners, which may be confirmed by simple calculation.

For these very simple representations of S_3 and S_4 there is accordingly considerable agreement between the lucidity (Anschaulichkeit) of the planar S_3 picture and the clearness (Uebersichtlichkeit) of the analogical S_4 picture.

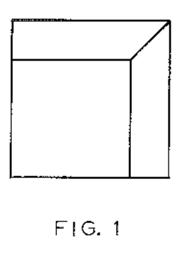


FIG. 1

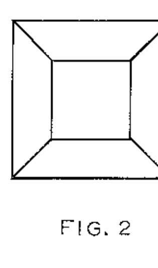


FIG. 2

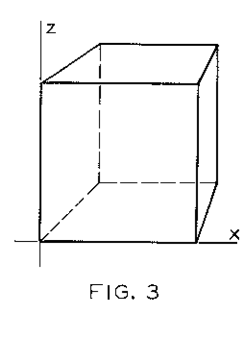


FIG. 3

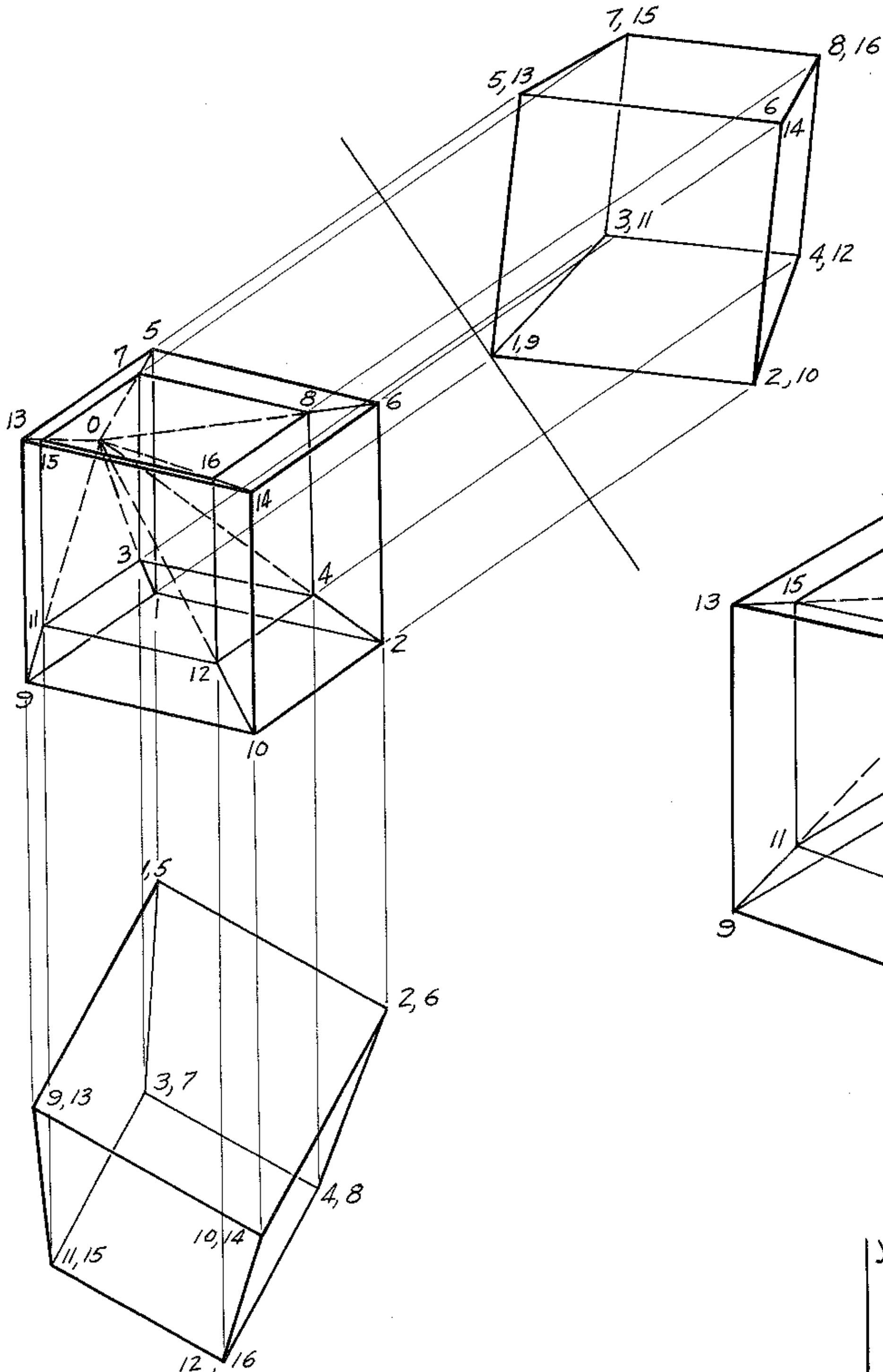


FIG. 4

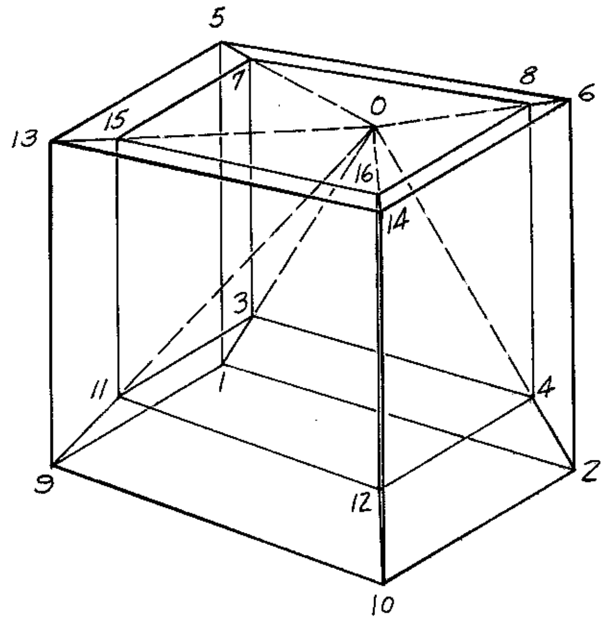


FIG. 5

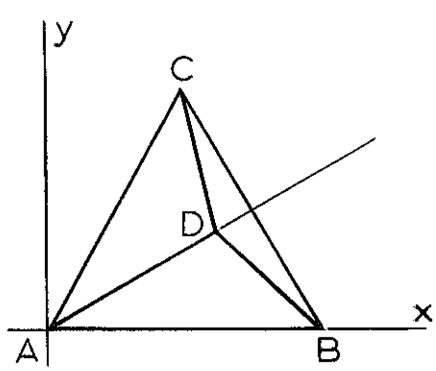


FIG. 6

Report of the Bibliography Committee

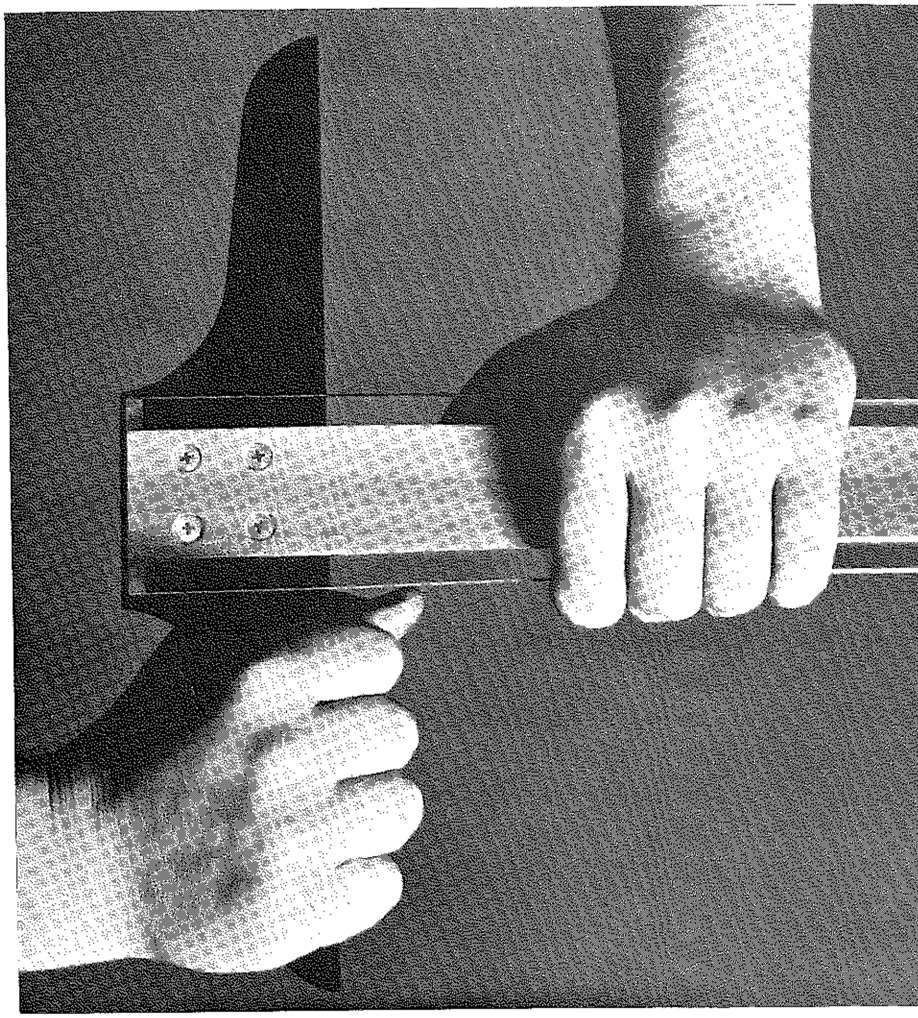
S. E. Shapiro, Chairman

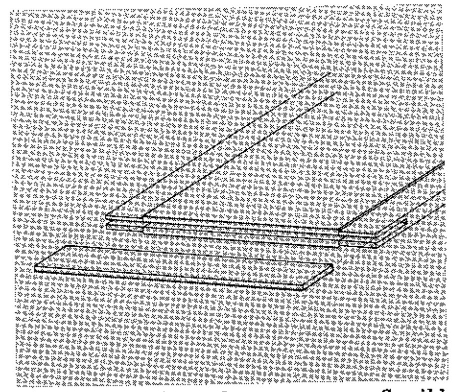
Books Published 1956 to 1960

Authors	Title	Publisher	Ed.	Year	Pages	Price
M. W. Almfeldt, C. A. Arnbal	Engineering Graphics Problem Book II	Wm.C.Brown	2	1959	85	3.00
J. N. Arnold	Introductory Graphics	McGraw-Hill	1	1958	543	7.75
J. N. Arnold, M. H. Bolds, S. B. Elrod, J. H. Porsch, R. P. Thompson	Worksheets for Introductory Graphics - Form A	Balt	1	1958	100	4.00
E.J. Caldario, C.I. Carlson, G. E. Cramer, H. R. Goppert	Problems in Engineering Geometry, Series No. 3	Stipes	2	1957	83	2.75
E. J. Caldario, E. J. Mysiak, H. A. Setton, H. D. Walraven	Problems in Engineering Drawing, Series D	Stipes	2	1958	70	3.00
T. E. French, C. J. Vierck	Graphic Science: Engineering Drawing, Descriptive Geometry, and Graphics	McGraw-Hill	1	1958	760	8.50
V. C. Fryklund, F. R. Kepler	General Drafting	Taplinger	1	1960	206	3.40
J. W. Giachino, H. J. Beukema	American Technical Society's Drafting	Amer.Tech. Soc.	2	1960	280	4.75
J. W. Giachino, H. J. Beukema	American Technical Society's Engineering Drafting	Amer. Tech.	1	1960	400	
F. E. Giesecke, A. Mitchell, H. C. Spencer	Technical Drawing	Macmillan	4	1958	844	7.50
F. E. Giesecke, A. Mitchell, H. C. Spencer	Technical Drawing Problems	Macmillan	3	1959	106	4.90
H. E. Grant	Practical Descriptive Geometry (Alternate edition with Problems)	McGraw-Hill	1	1956	403	5.75
S. G. Hall, L. D. Walker, E. D. Ebert, A. G. Frederich	Problems in Engineering Drawing, Series B	Stipes	2	1957	62	3.00
K. Hansson-Falk	Falk's Graphical Solutions	Columbia Graphs	4	1958	456	6.00
P. H. Hill	Problems in Graphical Analysis	McGraw-Hill	1	1959		5.50
R. P. Hoelscher, C. H. Springer	Engineering Drawing & Geometry	John Wiley & Sons	1	1956	520	8.50
R. P. Hoelscher, C. H. Springer, B. O. Larson, J. E. Pearson	Problems in Engineering Geometry, Series No. 1	Stipes	2	1956	84	2.75
R. P. Hoelscher, C. H. Springer, B. O. Larson, J. E. Pearson	Problems in Engineering Geometry, Series No. 2	Stipes	2	1957	84	2.75
R. P. Hoelscher, C. H. Springer, B. O. Larson, J. E. Pearson	Problems in Engineering Geometry, Series No. 4	Stipes	1	1958	65	2.75
R. P. Hoelscher, C. H. Springer, B. O. Larson, J. E. Pearson	Problems in Engineering Drawing, Series A	Stipes	2	1956	58	3.00
G. J. Hood, A. S. Palmerlee	Geometry of Engineering Drawing	McGraw-Hill	4	1958	347	5.75
G. J. Hood, A. S. Palmerlee	Problem Sheets	McGraw-Hill	4	1958		3.75
L. O. Johnson, I. Wladaver	Engineering Drawing Problems	Prentice-Hall	1	1956	132	5.00
A. S. Levens	Nomography	John Wiley & Sons	2	1959	296	8.50

Authors	Title	Publisher	Ed.Year	Pages	Price
A. S. Levens A. E. Edstrom	Problems in Mechanical Drawing, First Course	McGraw-Hill	2 1957		2.48
A. S. Levens A. E. Edstrom	Problems in Mechanical Drawing, Second Course	McGraw-Hill	2 1958		3.20
A. S. Levens A. E. Edstrom	Problem Sheets to accompany Graphics in Engineering & Science, Book I: Descriptive Geometry	Fearon	1 1958	94	3.50
A. S. Levens A. E. Edstrom	Problem Sheets to accompany Graphics in Engineering & Science, Book II: Technical Drawing Practices and Graphical Computations	Fearon	1 1959	98	3.50
J. V. Lombardo L. O. Johnson W. I. Short A. J. Lombardo	Engineering Drawing	Barnes & Noble	2 1956	432	2.50
W. J. Luzadder	Graphics for Engineers	Prentice-Hall	1 1957	608	7.25
W. J. Luzadder	Problmes in Engineering Drawing	Prentice-Hall	4 1959	80	3.95
W. J. Luzadder J. N. Arnold F. H. Thompson	Problems in Engineering Drawing Abridged	Balt	4 1956	40	1.70
E. H. Mattingly E. Scrogin W. B. Bettencourt	Applied Drawing & Design	Taplinger	2 1959	252	4.60
M. McNeary E. R. Weidhaas E. A. Kelso	Creative Problems for Basic Engineering Drawing	McGraw-Hill	1 1957	52	4.50
E. V. Mochel	Engineering Drawing Problems	Henry Holt	1 1959		4.50
M. G. Mochel	Fundamentals of Engineering Graphics	Prentice-Hall	1 1960	400	8.50
H. C. Nelson	Handbook ofDrafting Rules & Principles	Taplinger	1958	96	2.00
H. D. Orth R. R. Worsencroft H. B. Doke	Theory & Practice of Engineering Drawing	Wm. C. Brown	2 1959	498	5.00
H. D. Orth R. R. Worsencroft H. B. Doke	Workbook toaccompany "Theory and Practice of Engineering Drawing"	Wm. C Brown	2 1959	150	2.65
E. G. Paré	Engineering Drawing	Henry Holt	1 1959	500	6.50
E. G. Paré R. O. Loving I. L. Hill	Descriptive Geometry	Macmillan	2 1959	349	5.00
E. G. Paré R. O. Loving I. L. Hill	Descriptive Geometry Worksheets, Series A	Macmillan	2 1959	68	3.50
E. G. Paré R. O. Loving I. L. Hill	Descriptive Geometry Worksheets, Series C	Macmillan	1 1957	152	3.25
J. H. Porsch S. B. Elrod R. H. Hammond	Descriptive Geometry Worksheets	Balt	3 1957	57	3.00
R. W. Reynolds	Problems for Modern Engineering Drawing, Series I	Fearon	1 1956	661	5.00
R. W. Reynolds	Problems for Modern Engineering Drawing, Series II	Fearon	1 1958	66	5.00
J. S. Rising M. W. Almfeldt	Engineering Graphics	Wm. C. Brown	2 1959	438	7.25
J. S. Rising C. A. Arnbal	Engineering Graphics Problem Book I	Wm. C. Brown	2 1959	79	2.90
J. S. Rising C. A. Arnbal	Engineering Graphics Problem Book III	Wm. C. Brown	2 1960	97	3.40
A. H. Robinson	Elements of Cartography	John Wiley & Sons	2 1960	343	8.75

Authors	Title	Publisher	Ed.	Year	Pages	Price
C. E. Rowe J. D. McFarland	Engineering Descriptive Geometry Problems, Series D	D. Van Nostrand	1	1958	115	4.50
S. E. Shapiro D. M. Holladay G. Wilson W. L. Shick	Problems in Geometry for Architects, Series A, Part I	Stipes	1	1956	61	3.00
S. E. Shapiro D. M. Holladay G. Wilson W. L. Shick	Problems in Geometry for Architects, Series B, Part II	Stipes	1	1958	68	3.00
W. L. Shick G. Wilson D. M. Holladay S. E. Shapiro	Geometry for Architects	Stipes	1	1959	124	4.50
W. L. Shick G. Wilso n D. M. Holladay S. E. Shapiro	Problems in Geometry for Architects, Series A, Part II	Stipes	1	1956	56	3.00
W. L. Shick G. Wilson D. M. Holladay S. E. Shapiro	Problems in Geometry for Architects, Series B, Part I	Stipes	1	1957	75	3.00
H. W. Shupe P. E. Machovina	Engineering Geometry and Graphics	McGraw-Hill	1	1956	357	6.00
S. M. Slaby	Engineering Descriptive Geometry	Barnes & Noble	1	1956	353	2.25
H. C. Spencer	Basic Technical Drawing	Macmillan	1	1956	370	4.96
C. H. Thompson	F undamentals of Pipe Drafting	John Wiley & Sons	1	1958	66	3.50
H. D. Walraven C. I. Carlson E. J. Mysiak	Problems in Engineering Drawing, Serie s C	Stipes	2	1956	64	3.00
F. M. Warner C. E. Douglas	Applied Descriptive Geometry Problem Book	McGraw-Hill	5	1959	63	4.50
F. M. Warner M. McNeary	Applied Descriptive Geometry	McGraw-Hill	5	1959	243	5.25
B. L. Wellman	Technical Descriptive Geometry	McGraw-Hill	2	1957	640	6.25
B. L. Wellman	Problems Layouts for Technical Descriptive Geometry	McGraw-Hill	2	1957	112	3.95
W. A. Wockenfuss	Notes and Problems in Engineering Graphics	Wm. C. Brown	1	1958	114	4.65
F. Zozzora	Engineering Drawing	McGraw-Hill	2	1958	391	6.50
F. Zozzora	Engineering Drawing Problems	McGraw-Hill	2	1958	192	4.25





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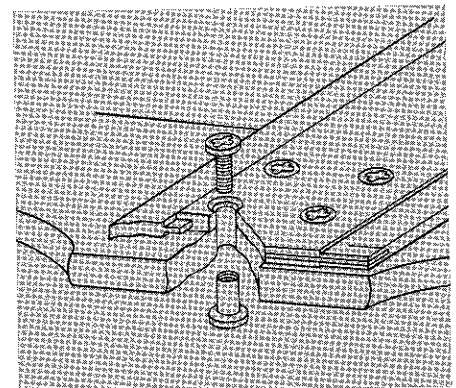

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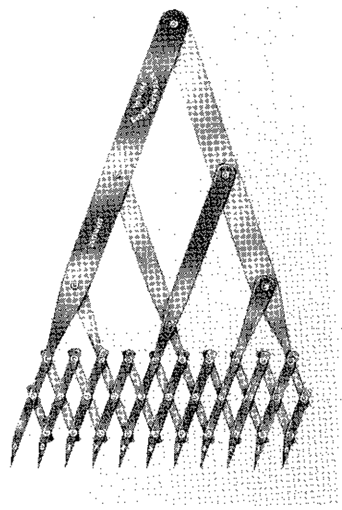

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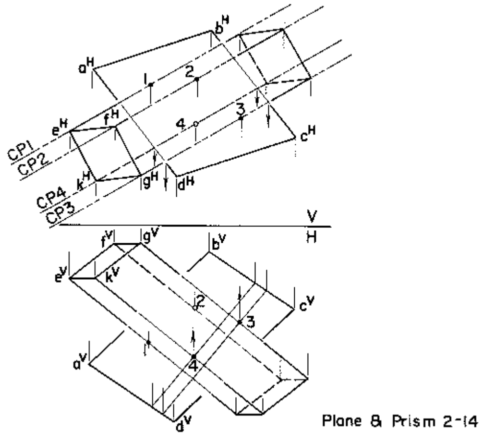

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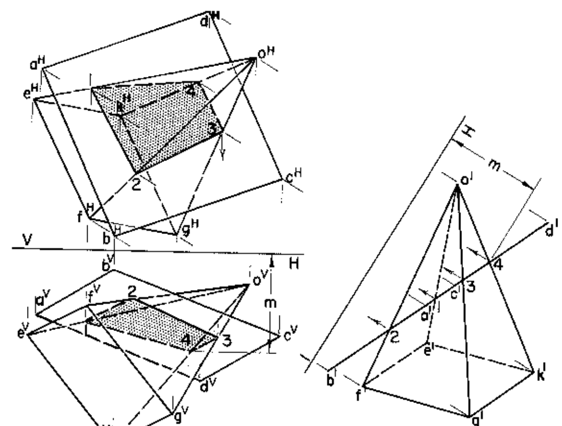

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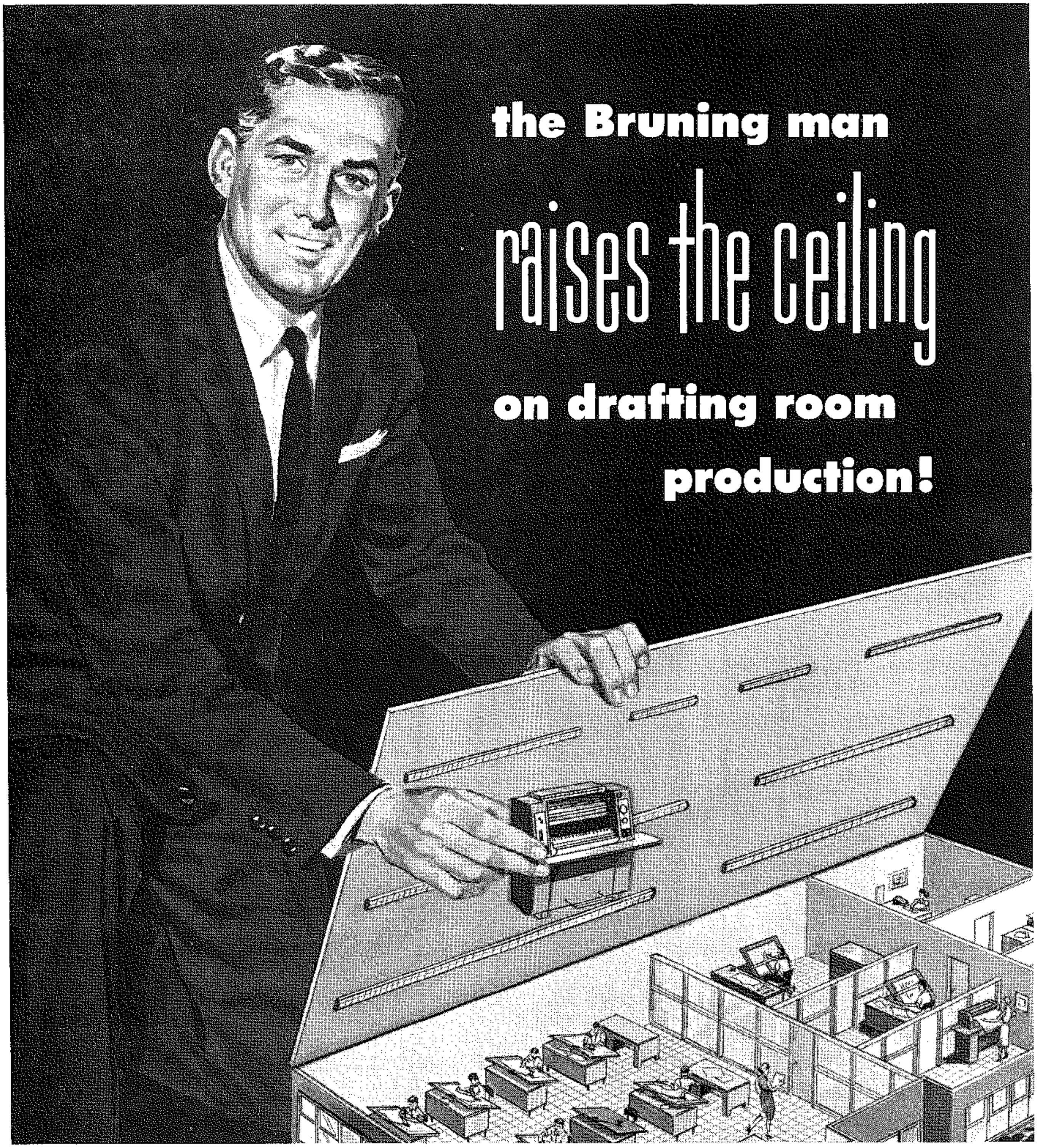

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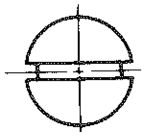

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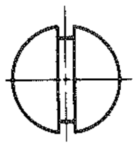

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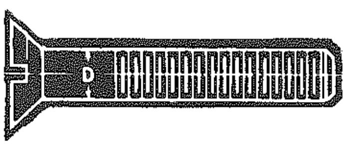

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