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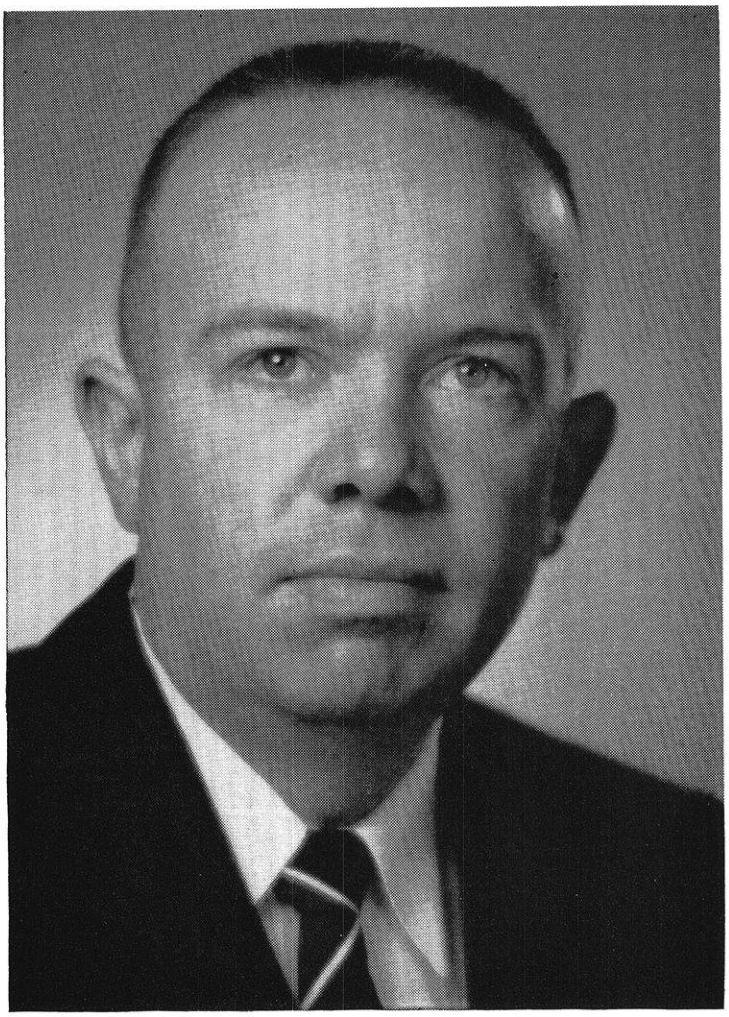
APRIL
1957

The Wisconsin engineer

25¢

Kenneth A. Brown, class of '46,
speaks from experience when he says:

"There's plenty of chance for advancement at U.S. Steel for the man who really wants to get ahead."



IF KENNETH A. BROWN were to speak to you face to face, he would tell you: "Hi fellows . . . I'm not much older than you . . . I still like a lot of the same things you do. In addition, I like my work and I sincerely believe that you will like your work at United States Steel, and like the fine bunch of fellows with whom you will come in contact."

Mr. Brown, at the comparatively young age of 29, is presently Works Engineer in charge of all engineering for the Worcester Works of the American Steel & Wire Division. He graduated from Brown University in 1946 with a B.S. degree in Engineering. He first joined U. S. Steel as a Junior Engineer at the Worcester Works, Worcester, Mass. Although his original duties included much drafting, he acquired a general administrative background and engineering experience. This qualified him for promotion to Assistant to the Works Engineer in May, 1950. Despite a tour of military service for two years, Mr. Brown's development resulted in his being transferred to the Construction Division in the Cleveland General Office. Starting January 1, 1953, he worked out of this office as Chief of Party on various construction projects.

On June 1, 1955, Mr. Brown returned to engineering and maintenance assignments at the Duluth Works. Although his work was primarily concerned with engineering problems, he also acquired a knowledge of various phases of maintenance. This experience qualified him for promotion to the position of Division Engineer on April 1, 1956. On January 1, 1957, Mr. Brown returned to the Worcester Works in his present capacity of Works Engineer.

Mr. Brown's "success story" is typical of that of many graduate engineers who have associated themselves with U. S. Steel. "The unlimited opportunities at U. S. Steel," says Mr. Brown, "plus the fine and helpful spirit that exists among the personnel, make success a matter of one's willingness to work to learn and to fit into the friendly atmosphere which exists here."

If you are interested in a challenging and rewarding career with United States Steel, and feel you can qualify, we suggest that you get in touch with your placement director for additional information. We shall be glad to send you our informative booklet, *Paths of Opportunity*, upon request. Write to United States Steel Corporation, Personnel Division, Room 1662, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

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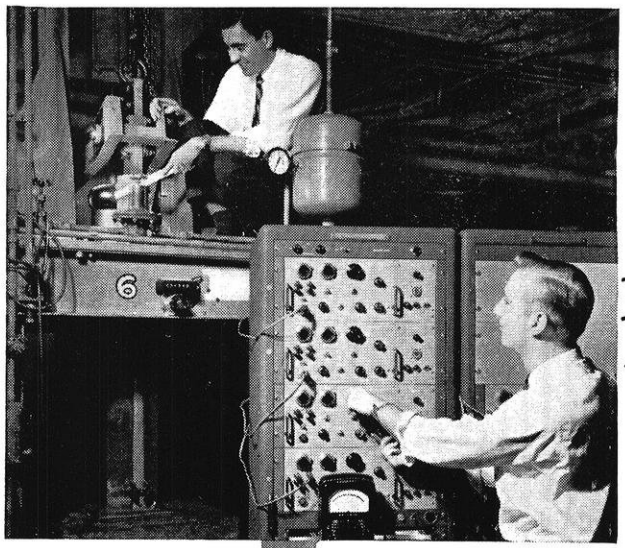
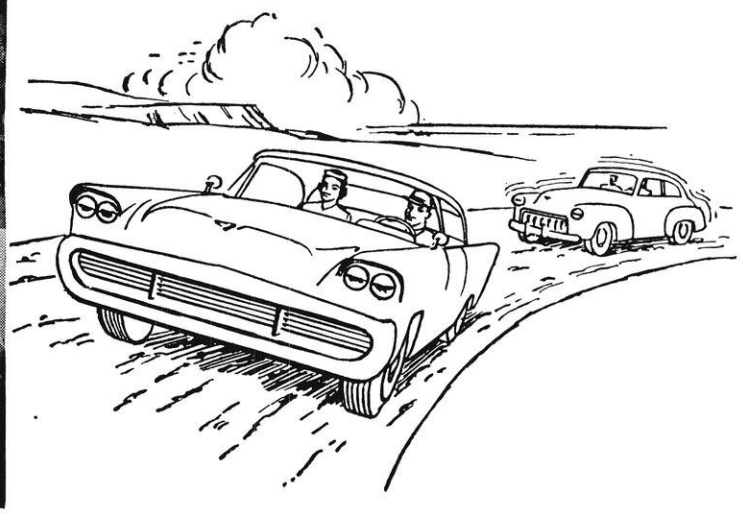


Goodyear engineers, using the latest in electronic equipment, record the dynamic characteristics of experimental air springs.



What's the low-down on next year's cars?

They'll be lower, smoother-riding than ever— and Goodyear engineers can tell you why

In the roaring twenties, not a little of the tumult was contributed by the cars of that era. How they throbbed and sputtered, and how they rocked and reeled on those pock-marked highways!

Then along came balloon tires, pioneered by Goodyear and other rubber companies, and automobiles really began to roll.

Today, there's another revolutionary change in ride engineering just getting under way, and once again Goodyear engineers are right in the middle of it.

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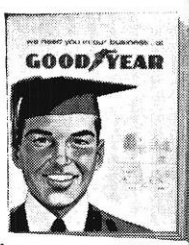
The rubber springs, mounted on each wheel, insure a smoother ride, of course. They maintain a vehicle at a constant height, no matter how heavily the rear is loaded. And they enable stylists to create still lower cars, without reducing ground clearance.

These new, bellowslike springs are one of the most excitingly different uses ever developed for rubber. They offer a challenge to the skills and imagination of a whole corps of engineers — electrical, mechanical, chemical and industrial.

Here at Goodyear, there's work aplenty for all types of technical graduates. And not just on rubber air springs. For a Goodyear engineer deals with a diversity of products scarcely matched in all U.S. industry — tires, chemicals, plastics, aviation products, atomic energy, and some things too top-secret to mention.

So whatever your own bent or professional training, the road ahead is wide open. The opportunities—and the need —are practically limitless. The horizon stretches just as far as your imagination can see.

Wouldn't you like to be a member of the Goodyear engineering team? We'd be glad to hear from you.



Send for your copy of this booklet. It describes in detail your career opportunities at Goodyear. Write Technical Personnel Dept. 806-W, The Goodyear Tire & Rubber Company, Akron 16, Ohio.

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GMR-235

THAT OLD PROVERB about necessity mothering invention certainly applies to the aircraft engine industry. Take these jet aircraft engine turbine blades, for instance.

New, higher thrust engines made it necessary to find—or develop—a material which would withstand the high temperature shock and stress conditions associated with these higher engine powers. Turbine blades turn at speeds over 13,000 rpm and are subjected to intense temperatures of over 1800°F. No ordinary metal would take that kind of punishment.

It was through the cooperative efforts of General Motors Research and Allison engineers that GMR-235 came into being. GMR-235 is a nickel-base alloy. Some of the outstanding high temperature mechanical properties requirements are combined with an inherent ability of the alloy to withstand momentary over-temperature exposures which are sometimes met in turbine engine operations. The results of such over-temperature exposure on GMR-235 are not reflected in deterioration of its normal expected properties when the engine is returned to normal operating temperatures. Previously, a 30 to 60 percent loss of blade life was encountered when such conditions existed. The superior qualities of GMR-235 have made possible a boost in engine temperature of about 150°F which can mean as much as 15% greater engine thrust. Since GMR-235 is a cast alloy, turbine parts can be mass-produced in controlled foundry facilities instead of being forged by highly skilled personnel.

★ ★ ★

Development of GMR-235 is typical of the interesting and challenging work going on at Allison. Want to know how you'll fit into the engineering picture at Allison? Arrange for an interview with our representative on your campus, or write for information: Personnel Department, College Relations, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

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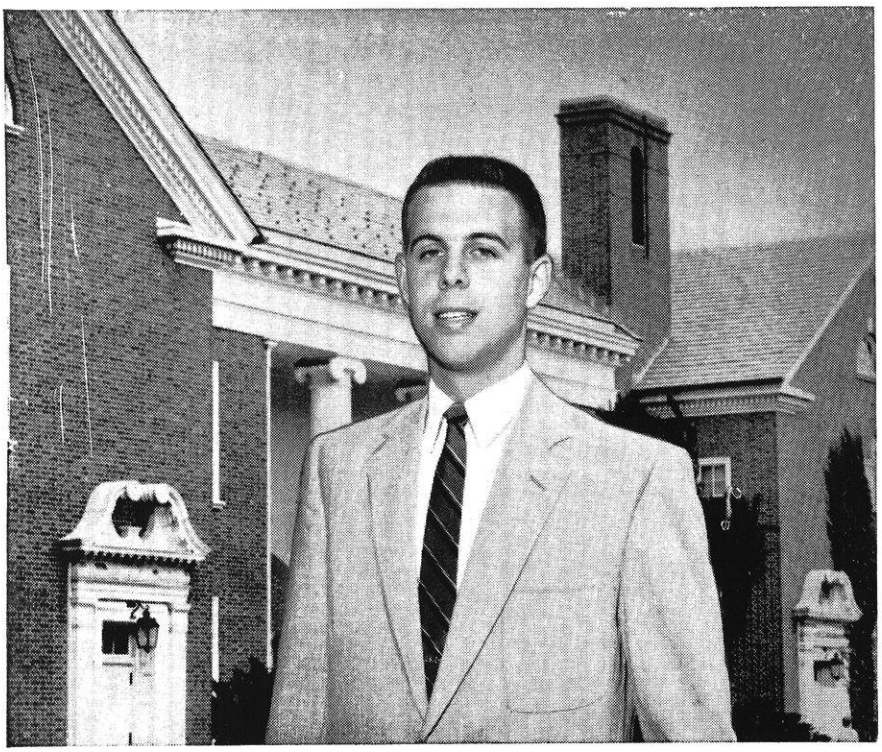

G. Edward Gearhart was graduated from the University of Delaware in June, 1956, with a B.S. in chemical engineering, and is now working for his Ph.D. in chemical engineering at Lehigh. At Delaware, he was editor-in-chief of the yearbook, "Blue Hen," active in sports and secretary of the Engineering Council.

Ed Gearhart asks:

What does Du Pont mean by "on-the-job" training?

Denton Harris answers:

Training is pretty much full-time at Du Pont, Ed. The main objective is to train men to reach their full capabilities as soon as possible. So we give the new man responsibility the day he arrives, and increase it as opportunities are available and he's ready for more responsibility.

That's the basic, guiding policy. But Du Pont has many departments. And training has many facets.

In some plants, the college graduate being trained for supervision is moved through all areas of the production cycle. In others, where the technical phases are more involved, he may spend time in a laboratory or development group before moving on to production.

It works the same way in sales. The graduate may first learn the laboratory side of the products he's going to sell. Or he may start right out on learning selling techniques. That all depends on the products and markets involved.

The same on-the-job principle applies to new men in specialized fields of research, development or design . . . including daily contacts with supervision, frequent lectures, discussions and conferences. Periodic changes in assignment, too.

It's carefully planned, *individualized* training, Ed. We've found it's the most effective way to broaden a man quickly. Du Pont is a growing organization. And men with leadership potential are always in demand.

Denton B. Harris joined Du Pont's Engineering Research Laboratory in June, 1952, after completing work for an M.S. in civil engineering at the University of Massachusetts. He's currently working on an unusual project—a broad study of the philosophy of design. The objective is to learn more about people's design preferences, and the trends behind new concepts in industrial design. This new assignment came after Denton gained several years of experience in various kinds of civil engineering at Du Pont.

Are you interested in research work? About 2000 Du Pont scientists and some 3500 other employees are now engaged in research. Laboratory facilities of the highest quality are available at the Du Pont Experimental Station near Wilmington, and elsewhere throughout the country. Full information about research work at Du Pont is given in "Du Pont Research." Write for your copy of this free booklet to E. I. du Pont de Nemours & Co. (Inc.), 2507C Nemours Building, Wilmington, Delaware.

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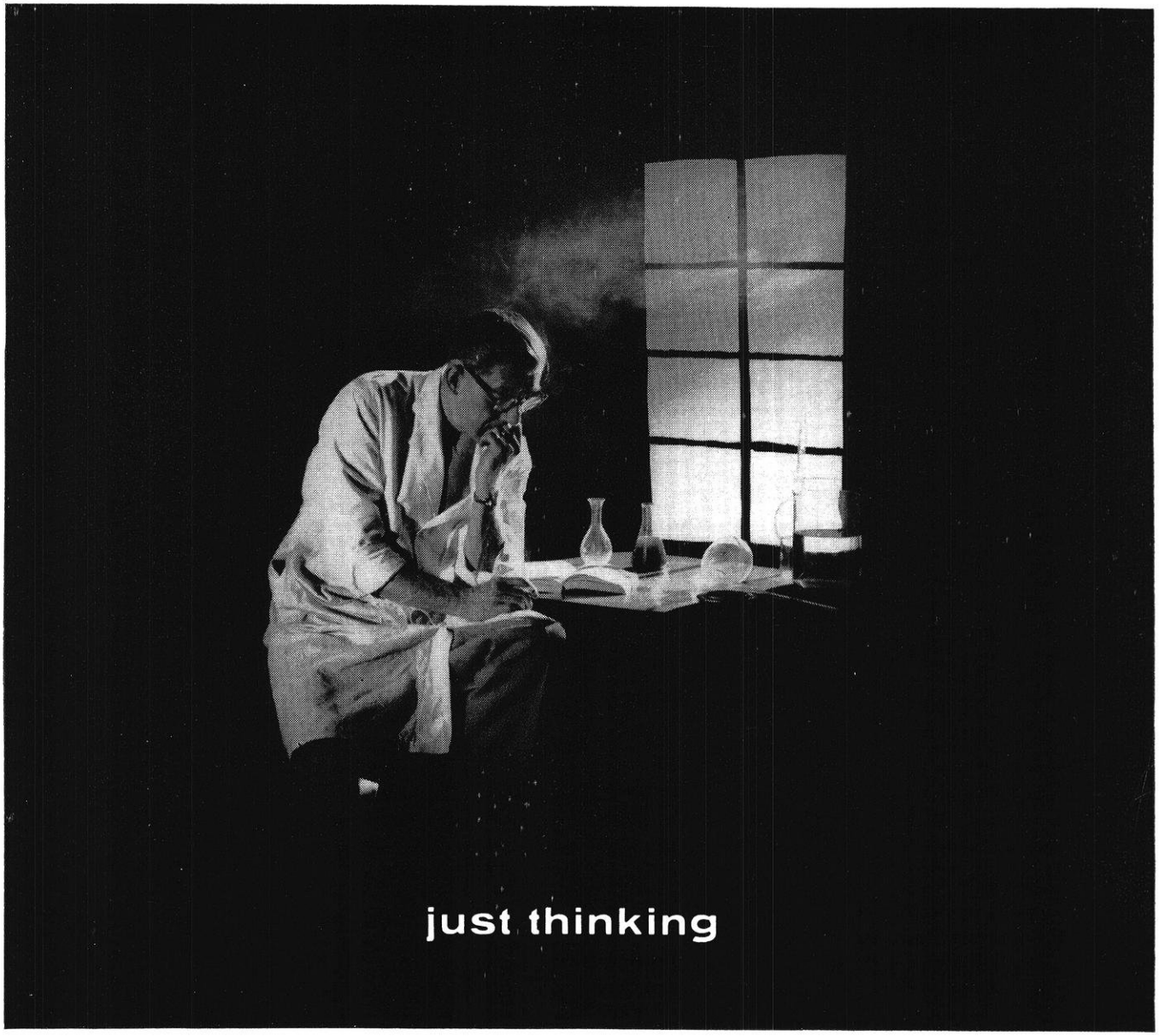
. . . THROUGH CHEMISTRY

Watch "Du Pont Theater" on Television



Chemical progress is autoclaves, test tubes, distillation towers . . . hydrocarbons, heterocyclic compounds . . . processes, polymerizations, products.

But mostly, chemical progress is thinking . . . men thinking. Little men, big men, medium size men . . . in lab coats, business suits, overalls . . . all of them, always, thinking.

Thinking up new products . . . new ways to make chemicals and new ways to use them. Thinking up more comfort, more convenience, better health, for everyone.

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At first glance, Field Engineering may not seem to possess the potential and stature often associated with other engineering activities.

At *Hughes*, however, nothing could be further from the truth.

Men who undertake the responsible task of evaluating Hughes-produced military equipment in the field are in the enviable position of becoming thoroughly familiar with the complete design and operation of the advanced electronics systems involved.

Essentially, Field Engineering embraces all phases of support required to assure maximum field performance of Hughes armament control systems and guided missiles. E.E. and Physics graduates selected for this highly important and respected phase of our engineering activities work with the armed forces and airframe manufacturers at operational bases and plants in continental United States and overseas.

The knowledge, background and experience so gained assure unusual opportunities for more specialized development in other divisions of the Research and Development Laboratories at Hughes. In fact, few openings in engineering today offer the rewards and opportunities which are available to the Technical Liaison Engineers, Field Engineers, Technical Training School Engineers, Technical Manuals Engineers, and Field Modifications Engineers who comprise the Field Service and Support Division.

Engineers and physicists selected for this highly respected phase of our activities at Hughes enjoy a number of distinct advantages. These include generous moving and travel allowances between present location and Culver City, California. For three months before field assignments you will be training at full salary. During the entire time away on assignments from Culver City, you'll receive a generous per diem allowance, in addition to your moving and travel expenses. Also, there are company-paid group and health insurance, retirement plan, sick leave and paid vacations . . . and reimbursement for after-hours courses at UCLA, USC, and other local universities.

E.E. or Physics graduates who feel they are qualified to join the Field Engineering staff at Hughes are invited to write for additional information about this exciting and rewarding opportunity to establish a challenging career in electronics. Write to:

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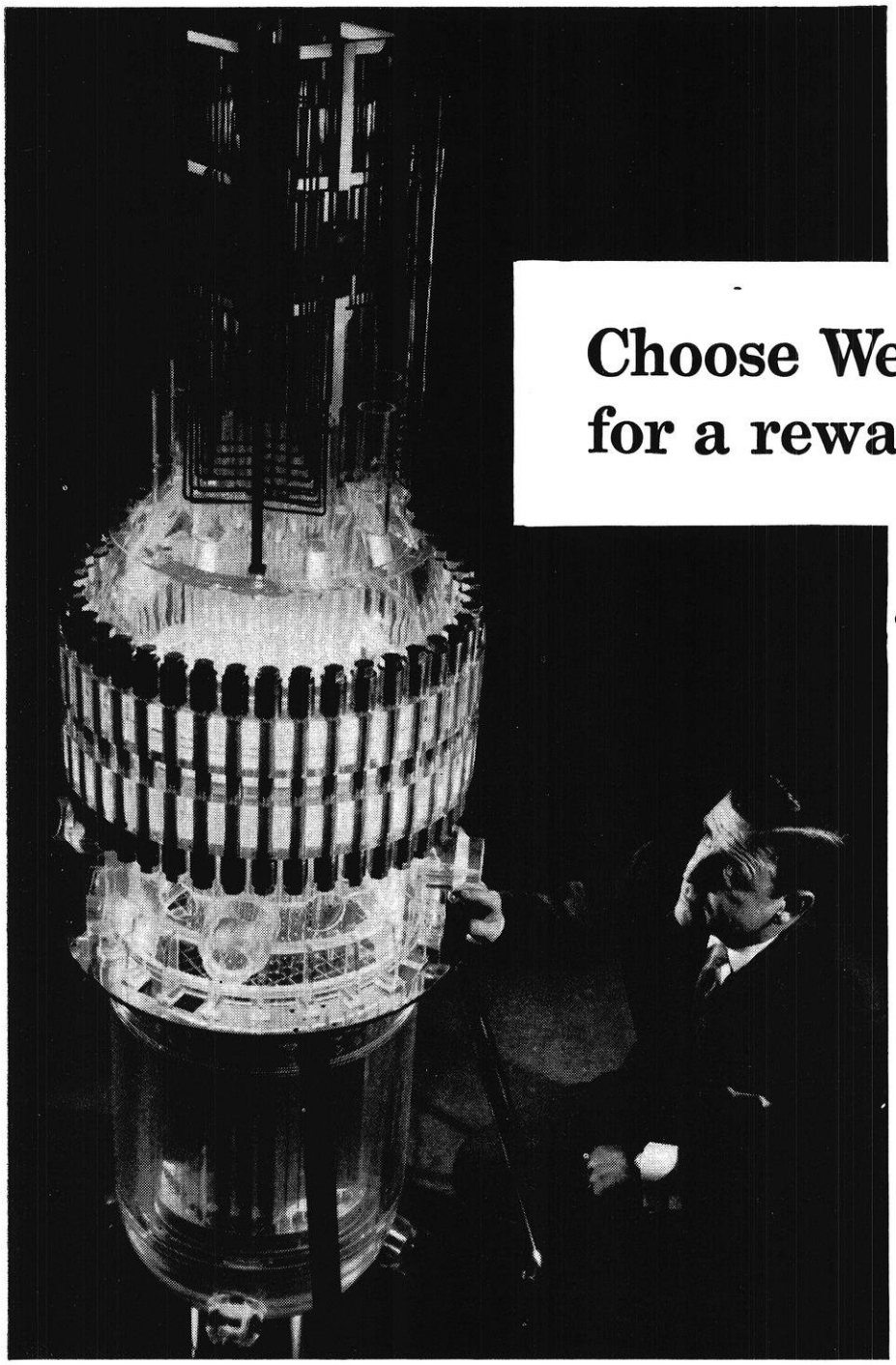

Paul Halpine, University of Pittsburgh '41, atomic engineer for Westinghouse, checking the operations of a model of the first nuclear reactor for the nation's first full-scale atomic power plant being built by Westinghouse for the AEC and the Duquesne Light Company.

Choose Westinghouse for a rewarding future

You are making a tough decision . . .

"where shall I start my career . . . which company offers me the best future?"

Your whole career can be affected by your decision, so choose carefully.

We sincerely believe you will make a wise decision in choosing Westinghouse, a company where big and exciting things are happening.

Here you can work with men who are outstanding leaders in fields such as:

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and dozens of others

You will have an opportunity to work with a company that is having spectacular growth in many fields . . . giving *you* room to grow.

We value our engineers highly, for we know our growth has been due largely to the high caliber of engineering personnel we have succeeded in attracting. Their development into scientists and managers has resulted in dynamic and progressive planning and policies.

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These are just a few of many reasons why you should choose Westinghouse. If you want more information, ask your Placement Officer for our booklets, or phone or write the Westinghouse interviewer, or Educational Coordinator named below.

Westinghouse

Mr. C. W. Mills
Regional Educational Co-ordinator
Westinghouse Electric Corporation
P.O. Box B
Chicago 9, Illinois

General Motors wants Good Men

THIS IS ABOUT the time of year when engineering seniors sit down to some serious thinking about their futures.

For now is the time when they must start to decide which company they would like to join.

And now is the time when they must begin taking definite steps toward joining it.

SO IF YOU'RE among those mulling over that problem—here is some interesting news for you:

General Motors is seeking outstanding engineering graduates in a wide variety of technical fields.

- GM offers you the untold advantages of its nearly boundless facilities and resources—including the fabulous new GM Technical Center.
- Training programs to help you grow professionally.
- Increasing responsibilities to match your growing talents.
- Rewards in line with your achievements.
- The chance to work closely with some of America's finest engineering minds in one of GM's 34 decentralized manufacturing divisions, 126 plants in 68 cities.
- Most especially, GM offers you the creative climate of a corporation dedicated to what GM President Harlow H. Curtice recently called, "The inquiring mind."

IF YOU FEEL these advantages can do for you what they've done for thousands of engineers who have carved richly rewarding careers with GM—now is the time to take steps.

If you believe that you have a great deal to offer General Motors in return—now is the time to let us know.

AS A STARTER, why not see your Placement Officer this very week? Ask him to put you in touch with the GM College Representative. Or write us directly.

GM positions now available in these fields

—in GM Divisions throughout the country

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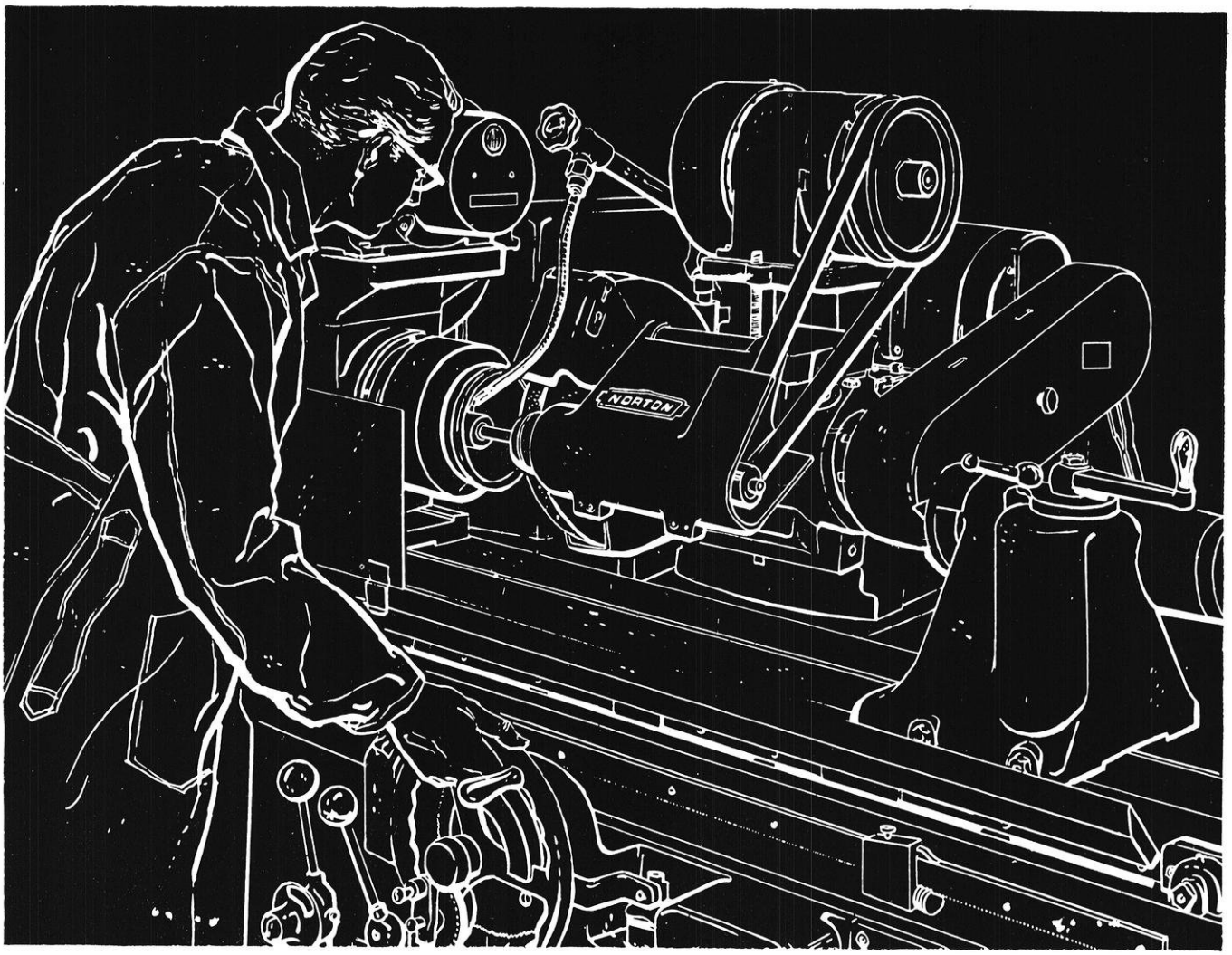
At Norton, The Daily Grind Is What The Products Do



Norton *people* can't get into a daily-grind frame of mind, because days are no more alike than lightning and lightning bugs. As the world's leading producer of grinding wheels, grinding machines and other abrasive products, Norton has an astonishingly various list of customers — and serving them all is what makes the days so different.

Norton doesn't serve just one industry — or two or even ten. It serves virtually all industry, and industry all over the world.

And, as though supplying the world with abrasives and grinding machines were not challenge enough, Norton is now extending its product lines far beyond those classifications. Exciting new materials born in Norton furnaces are carrying Norton men and women deep into the fields of jet propulsion, atomic energy and rocketry.

Square pegs looking for square holes and round pegs looking for round holes need not apply. Pegs in holes can never meet the challenges of each new day at Norton. Pegs in holes also have a way of losing their identities — something that will never happen to you at Norton.

If the Norton Company sounds like your kind of company, write to the Director of Personnel, NORTON COMPANY, Worcester 6, Massachusetts. Ask him for the new illustrated brochure, "Your Future at Norton."

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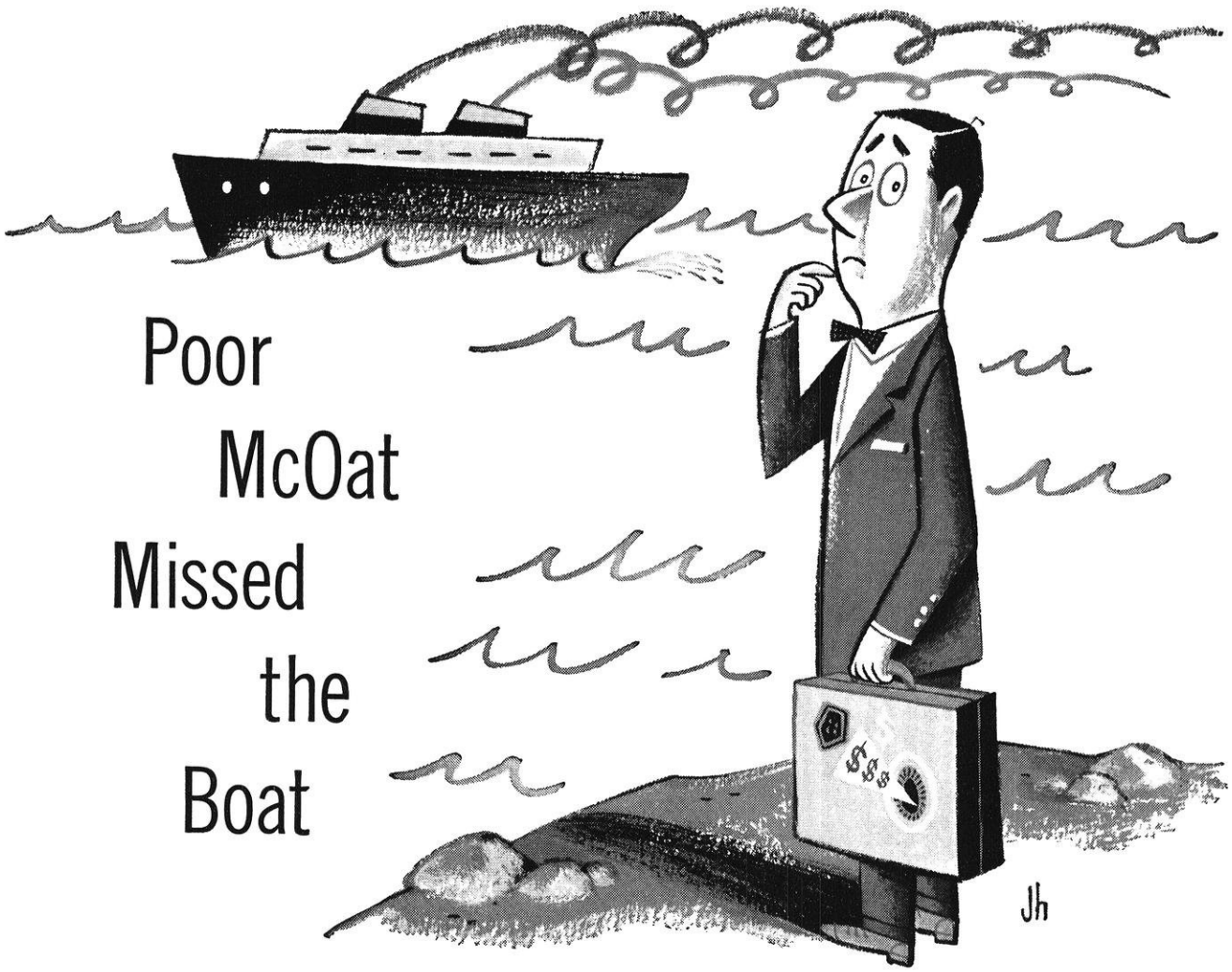

There was McOat, stuck in the sand, while the boat moved on to interesting new horizons. Every day of standing and watching, and waiting, left him just a little more frustrated.

McOat was an engineer with imagination, training and talent. Off to a bad start. Stuck where he couldn't make fullest use of what he had.

Fortunately, this wasn't fatal for him. It was merely discouraging, costly and wasteful.

And, as he discovered, there is a bright side to this picture for all engineers of his capabilities.

Creative imagination and talent are exactly the qualities most wanted at Chrysler Corporation. Engineers here enjoy the satisfaction of knowing that they're on the boat from the beginning . . . enjoying rewarding careers, making fullest use of their abilities to arrive at those interesting new horizons.

Such engineers have helped us develop many distinguished automotive *firsts*, including push-button driving . . . the first practical automotive gas turbine . . . and many others, all the way back to all-steel body construction and hydraulic brakes. Now they are helping us pioneer beyond the automotive horizon in the fields of atomic power and solar energy.

We'd like you to have the facts about an engineering career at Chrysler Corporation. Whatever your particular field may be—research, metallurgical, chemical, electrical or mechanical—we will gladly give you a complete run-down on the opportunities awaiting you.

Just drop a card or letter to:

Mr. L. C. Bettega, Technical Personnel Recruitment

CHRYSLER Corporation
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Arne Steivang and Charles Baumann of Federal Bakery Co., Winona, Minnesota, receive engineering service and product data from Stan Nelson (left), of Standard Oil, to help keep maintenance costs low on Federal's truck fleet.

How to write a success story

STANLEY NELSON, automotive engineer, is typical of many young men we like to tell about in the Standard Oil organization. He keeps proving to be the right man in the right job as he advances with us.

Stan likes engineering, of course. He graduated from the University of Minnesota with a B.S. degree in Mechanical Engineering in 1950.

He likes people. He especially likes to get into business problems with them where he and his company can help. Truck maintenance, lubrication, and fuel consumption are big items to fleet operators, large and small, who have found that help from Stan pays off—for them.

And he likes selling. He functions frequently as a key man for the sales department. His intelligent analysis of a problem in his field may either improve our service to a valued customer or help us to secure a new one.

He likes to keep moving, too, and he's done that. He held several sales positions in Minnesota and attended Standard's intensive Sales Engineering School in Chicago before being promoted to his present position in which he works out of the Mason City, Iowa, division office.

As men like Stanley Nelson earn their way upward in our organization we have frequent openings for ambitious college men to follow them. You might find a career in engineering, research or sales with this stable and progressive company rewarding, too.

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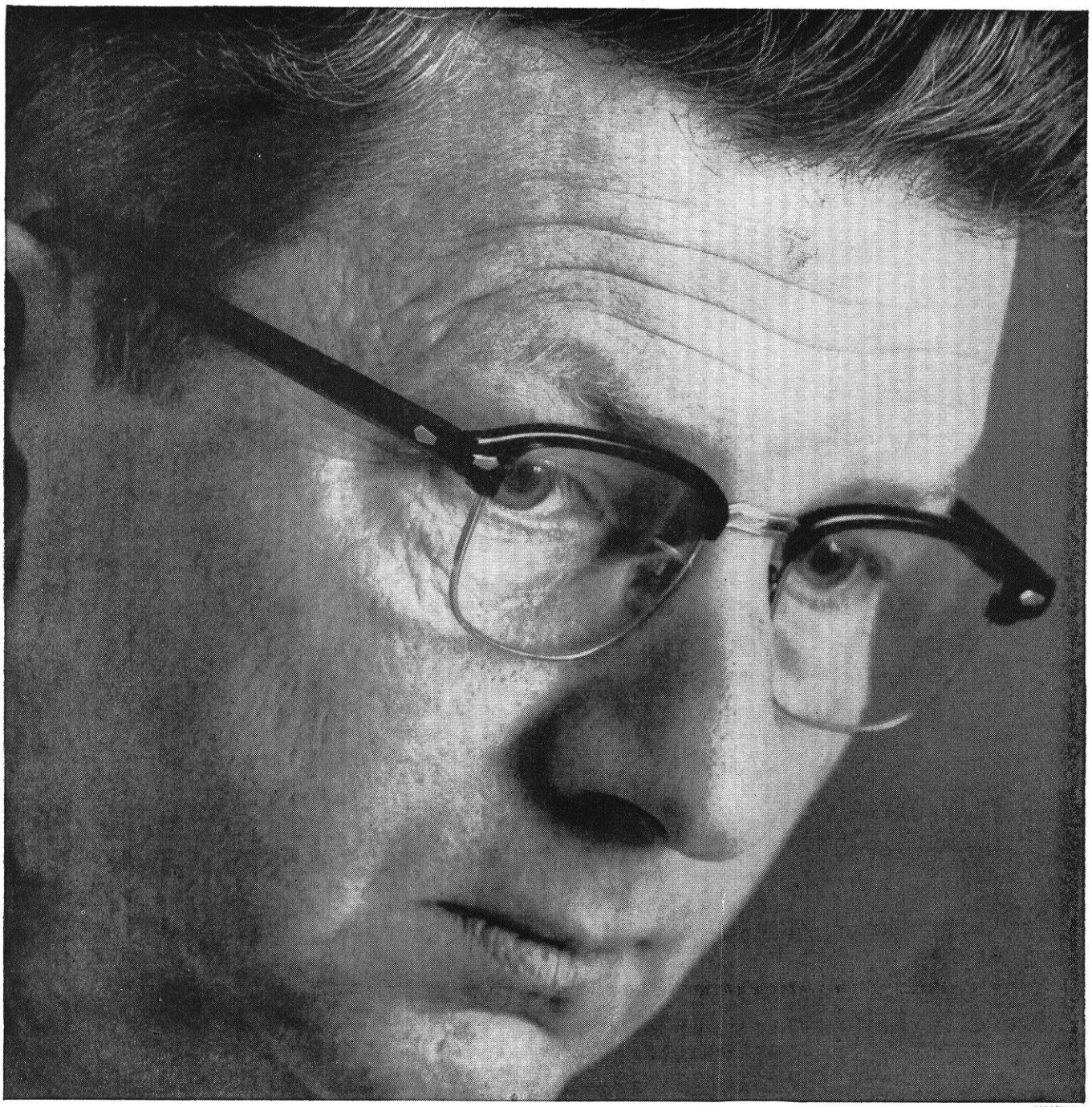

YAVNO

...on economy in national defense

"The widespread belief that there is an inherent conflict of interest between those who put national security first on the one hand and the taxpayer and his cost-conscious representatives on the other is simply erroneous—except when the level of the national security budget is at issue. Once the budget level has been fixed, the choice of weapons which maximizes our military capability is logically equivalent to the choice which minimizes the cost of attaining that capability. Moreover, the weapon characteristics so chosen are typically similar at different budget levels. In these circumstances economy and military effectiveness are not opposing objectives to be compromised; they are different but equivalent aspects of the same national objective."

—Charles Hitch, Head of the Economics Division

THE RAND CORPORATION SANTA MONICA, CALIFORNIA

A nonprofit organization engaged in research on problems related to national security and the public interest

Volume 61 APRIL 1957 Number 7

WISCONSIN ENGINEER

The Student Engineer's Magazine

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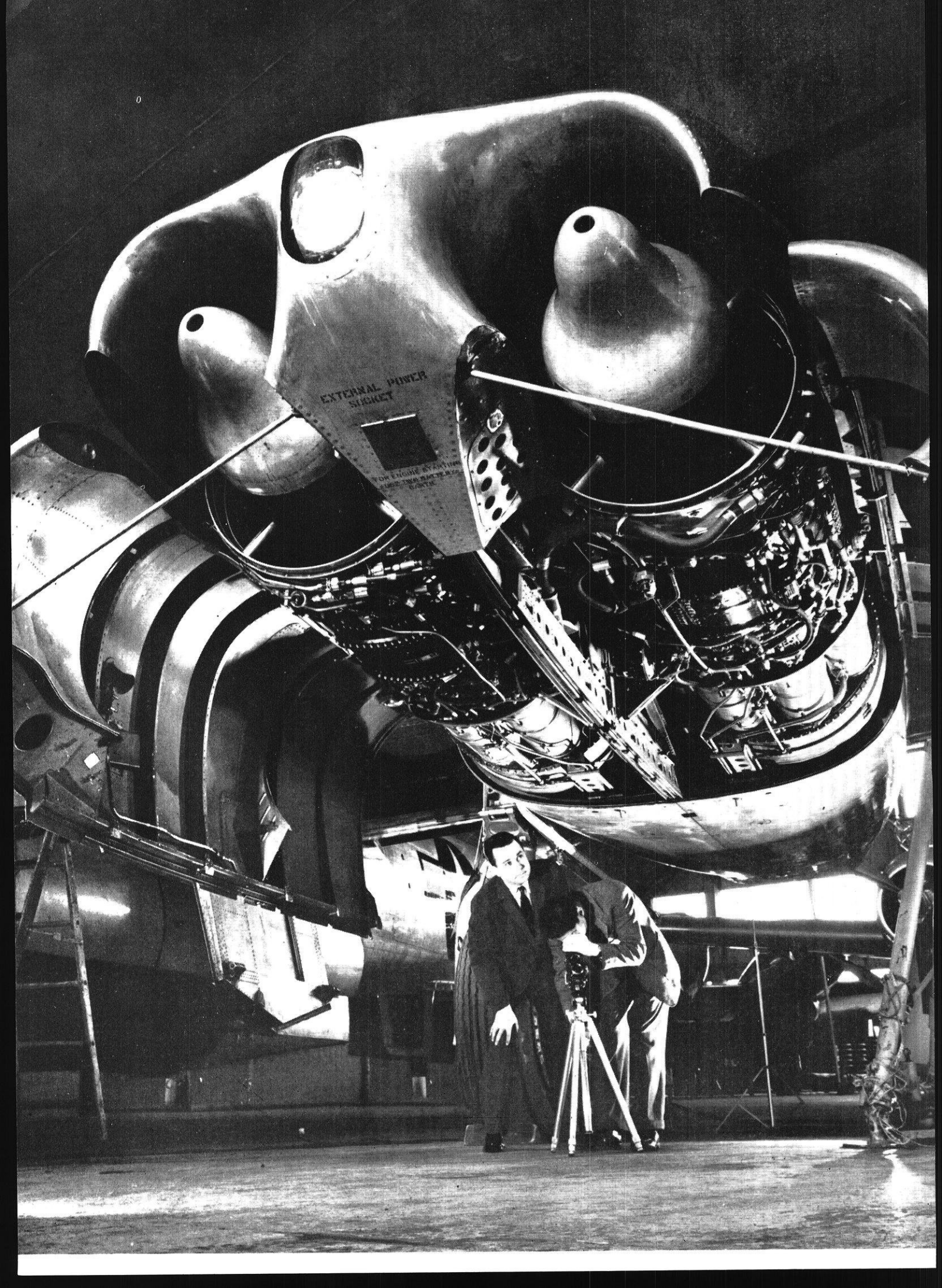

EXTERNAL POWER
SOCKET

Rambling WITH THE EDITOR

Do We Deserve To Be Ninth In The Nation?

In a recent survey conducted by the Chicago Tribune, the University of Wisconsin ranked ninth in the country on an overall basis. If the Engineering School has a comparative rating over other technical schools I am afraid that I would have to question the validity of the survey. Certainly the caliber of instructors at this institution has been on the downgrade during the last few years. Instructors and teaching assistants have been added in large numbers while the permanent staff has decreased to alarmingly low sizes. A recent example of this was shown in the Engineering Mathematics Committee report of March 25, 1957. Here are a few excerpts.

1. Currently, mathematics instruction is given by about 11 professors, 4 instructors, and about 60 teaching assistants.
2. The permanent mathematics staff has decreased in the past 5 years.
3. The freshman and sophomore engineering courses (Math. 51, 52, 102a, and 102b) are being taught by teaching assistants only. If no correction to this situation is made, the Department plans to use teaching assistants for instruction in Math. 111 (differential equations) next year. Moreover, they are contemplating employing undergraduates as teaching assistants.
4. The teaching assistants are admittedly not adequately supervised. This is the natural consequence of the high teaching assistant-to-professor ratio, and the fact that the senior staff is engaged in other essential duties and maintaining a certain amount of research. At the present time, the professor in charge of the assistants can only handle complaints.

Other similar examples are apparent to anybody who has been following an engineering course.

The result of this shift in teaching load has produced results that draw comments from students such as:

"How can I understand the material when I can't understand what the instructor is saying?"
"My instructor doesn't have enough knowledge and experience to ....."
"This instructor knows nothing about teaching techniques and he always speaks in a monotone, usually to the blackboard."

These comments point out the following deficiencies in Engineering teaching.

1. Inability of instructors to communicate effectively because of language barriers or poor speach techniques.
2. Lack of knowledge on the part of instructors who are primarily undergraduate or graduate students who teach part time.
3. Lack of preparation. Use of stereotyped agendas including the giving of stereotyped assignments to students which seem to encourage plagarism.

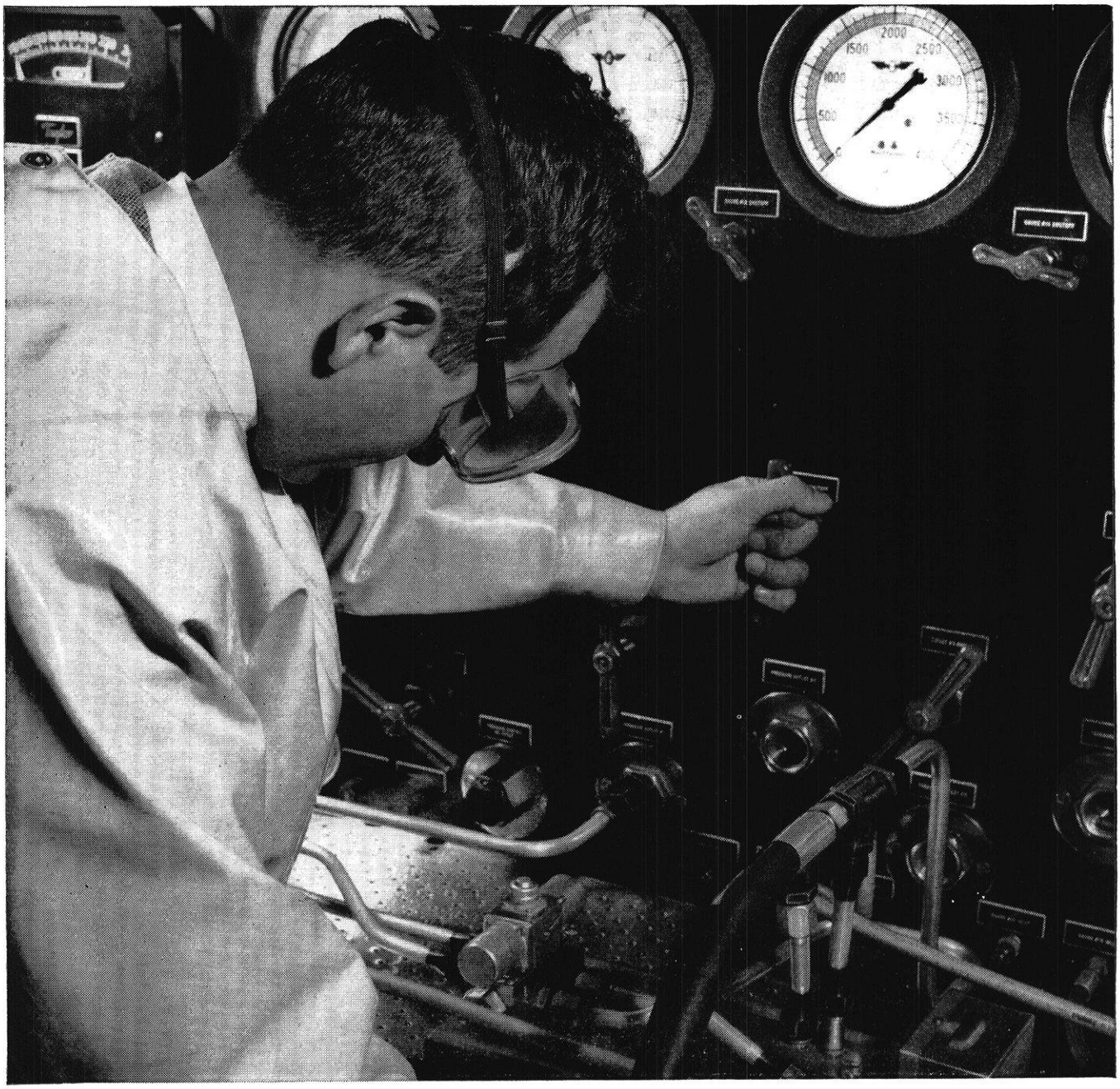
Who is to blame for this? First, increases in enrollment have brought on the need for more instructors. Industry has been making top offers to permanent staff people and has been successful in luring them away from the school. The State Legislature has not provided sufficient funds to the University to allow them to compete salary-ways with industry. The departments seem to be hiring far too many people with no teaching experience, including an increasing number of foreign people, some of whom can hardly speak English. A common joke around the M. E. building is that if we see a foreign student we can lay down pretty good odds that he is a graduate student in Mechanical Engineering.

What is the solution? The college could limit enrollment to fit the teaching facilities. This would be an exact reversal to industry and their drive to recruit more technically trained people. Some type of limit that would be compromising is necessary. Industry in their drive for technical people will have to be called on to further subsidize educational institutions. More discretion should be used by department heads in signing up instructors to teach undergraduate courses. Instructors who do not fulfill their obligation to teach the subject manner properly should be dropped from the staff and not kept on, teaching in a hap-hazard fashion, until they finish their graduate work.

In the very near future this problem will reach a head. Enrollments are expected to go up by leaps and bounds in the next couple of years and industry will continue to draw the top professors. Unless the University of Wisconsin starts on the road to recovery in the next year or two, the schools obligation to the country as a whole will be sadly unfulfilled.

—R.F.S.

Dual-mounted J-47 jet engines on a B-45 Bomber at General Electric's Flight Test Center, Schenectady, New York.



Engineering? Or **IMAGINEERING?**

Many capable engineers are perfectly content to go through life doing routine jobs over and over again. Frankly, such engineers wouldn't be interested in Sperry—and Sperry wouldn't be interested in them!

▪ Engineering, at Sperry, requires a combination of fine technical training plus *imagination* – the desire to help solve anticipated problems of the future and pioneer in new methods and developments. You can see the results of such "imagineering" in the impressive list of Sperry "firsts" in such exciting fields as missiles, inertial guidance, radar, computers, microwaves and gunfire control systems.

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▪ Your Placement Office will tell you the times when Sperry representatives will visit your school. In the meantime, get more of the Sperry story by writing direct to J. W. Dwyer, Sperry Gyroscope Company, Section 1B5.

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MAN-MADE DIAMONDS

For ages men have prized diamonds. They have collected them, studied them, smuggled them, stolen them, fought wars over them, and invented legends about them. In times past, the diamond has been valued mostly as a gem. Today, however, it is as highly valued for its use in industry in the cutting, grinding, and polishing of hard materials. Modern technology could hardly do without it. The distinguishing feature of diamond that makes it so useful is that it is by far the hardest material in the world.

by Kenneth Joslin che'58

When in February, 1955, the General Electric Company displayed the first man-made diamonds, they climaxed nearly 125 years of effort in this field. Often during this period, as a result of wishful thinking, self deception, fraud and even chance, many claims of successful diamond synthesis have appeared, but at present only G.E.'s claim is accepted as valid.

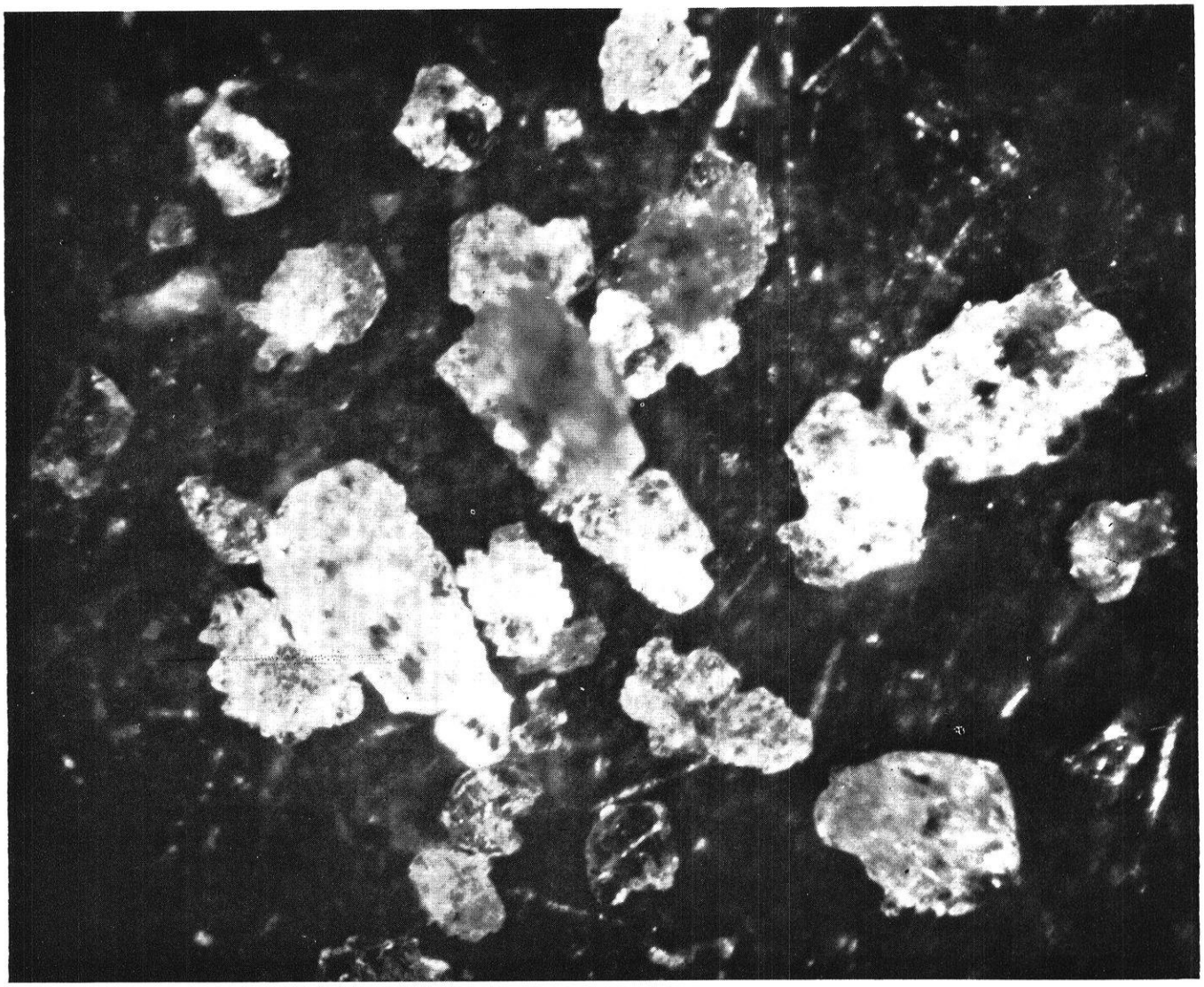
Now that this era of scientific endeavor is over it is perhaps of interest to briefly survey some historical and theoretical aspects of the problem.

In 1797, Smithson Tennant laid the basis for diamond synthesis when he showed that diamonds were an elementary form of carbon. He did this by igniting pure diamonds in pure oxygen and obtaining carbon dioxide with no residue, as is the case with pure carbon. A physical property of diamond that is also very important is its specific gravity, which equaled 3.51 while graphite (which is, of course, the crystalline form of carbon) equaled 2.25.

By X-ray analysis it has been proven that diamond crystallizes in a cubic system with each atom placed in the center of four other atoms that are arranged about it at the corners of a regular tetrahedron. Graphite crystallizes in layers, having a pattern similar to that of diamond; however, these layers are separated by comparatively large intervals.

The primary historical claims of successful diamond formation were made by J. B. Hannay and Henri Moissan. Many other scientists attempted to produce diamonds with previously successful methods and through their own methods. However, in this article they will be mentioned only with respect to Hannary and Moissan's methods. Theoretical work in the field of thermodynamics, such as that by Willard Gibbs, combined with the research of P. W. Bridgman and G.E.'s physists really made diamond synthesis possible.

J. B. Hannay's attempt to produce diamonds was one of the earliest and most widely discussed. He felt that



A photomicrograph showing diamonds made in the GE Research Laboratory by the Hall-Wentorf process.

if he could compress graphite to the point that its specific gravity equaled that of diamonds it would actually be a diamond. To obtain the high pressure necessary he placed hydrocarbons (primarily light paraffin), "bone oil" (probably pyridine) and lithium in a wrought iron tube which he sealed on both ends. By heating the tube to red heat Hannay felt extreme pressures would result due to the expanding liquids.

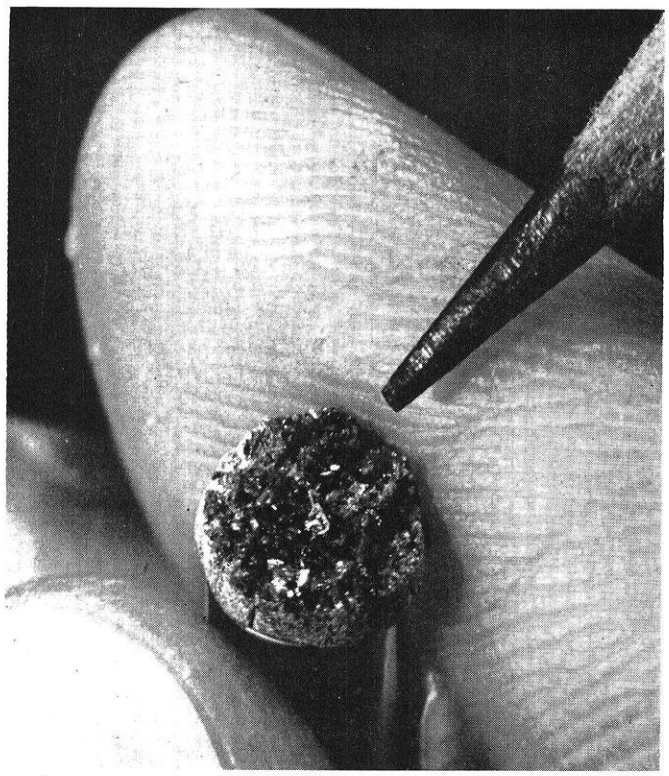
When 77 of the 80 tubes he used exploded under these conditions he felt sure that the remaining three had experienced sufficient pressure to produce diamonds (Actually it is estimated that a pressure of 2,000 to 3,000 atmospheres could be obtained in this manner.) When Hannay found particles in the three unexploded tubes having the specific gravity of diamond he concluded that his synthesis was successful.

At first, Hannay's claim met with wide acceptance, when the London Times published the news. Then, other scientists reported that they were unable to reproduce Hannay's results and the claim became questioned.

In 1943, Hannay's synthesis was strengthened when F. A. Bannister and Kathleen Lonsdale discovered, in the British Museum, a display labeled "Hannay's Diamond" and through X-ray analysis the particles were proven to be diamonds of a rare variety. Bannister and Mrs. Lonsdale felt that it was unlikely that in an attempted fraud such a rare variety of diamonds would have been used. Lord Rayleigh and others, however, pointed out known instances of bad faith by Hannay which proved Hannay to be dishonest. As a result of his bad reputation and the inability to duplicate his results Hannay's claim is generally belived to have been fraudulent.

Henri Moissan, who invented the electric furnace, also attempted diamond synthesis on the basis of high pressure. His method involved heating iron and sugar charcoal to white heat and then cooling suddenly. He predicted high pressures in the mass on the assumption that on cooling, the exterior of the mass hardened and contracted, while the inner core expanded. Of course it is now known that both inner and outer layers contract on cooling and therefore the high pressure he assumed was non-existent.

When Moissan dissolved the solid obtained, he discovered particles having a specific gravity of 3.51,



This cluster, about ¼-inch in diameter, is composed of a large number of some of the first tiny diamonds produced. The historic stones were presented to the Smithsonian on a plaque, surrounded by 100 carats of man-made industrial diamonds.

which he determined were diamonds. In the attempts to verify Moissan's claim a great deal of confusion developed. First of all, the researcher would publish an account of having successfully produced diamonds in this way and then he'd retract his statement. One of the cases illustrating this uncertainty involved J. W. Hershey, who was a professor at McPherson's College in Kansas.

Around 1940, Hershey reported that his senior chemistry class had successfully produced fifty diamonds, with the largest measuring 2.0 by 1.5 by 1.0 millimeter, using Moissan's method. Shortly after his initial claim appeared, Hershey was misquoted by a German paper as having retracted his original claim while actually he was reporting on his inability to produce diamonds by another method. Hershey's failure to have the misquote corrected has thrown considerable doubt on the validity of his initial claim that his class had reproduced Moissan's results.

In addition to the uncertainty of the ability to reproduce Moissan's results, doubt was thrown on this method when Moissan's widow told how one of her husband's assistants had deceived him. It seems the assistant inserted diamonds in the product to satisfy Moissan and thereby conclude the tedious experimentation.

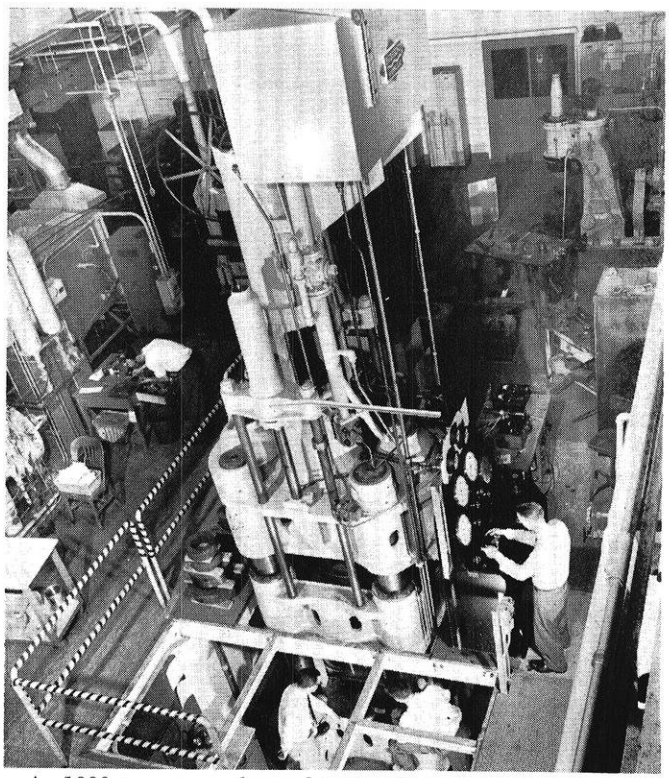
At the turn of the nineteenth century, Willard Gibbs work in thermodynamics gave a theoretical basis for the graphite to diamond transformation. It is theoretically known that a body tends to go from a state of high thermodynamic potential to one of lower thermodynamic potential in a manner analogous to the way objects fall from higher to lower positions under the influence of gravity.

Gibbs derived a mathematical equation that expressed thermodynamic potential in terms of specific heat, thermal expansion, and other measurable properties of materials. On the basis of this equation, Gibbs predicted that graphite is more stable than diamond at normal temperature and pressure. At higher temperature and pressure Gibbs assumed diamond would become the most stable phase.

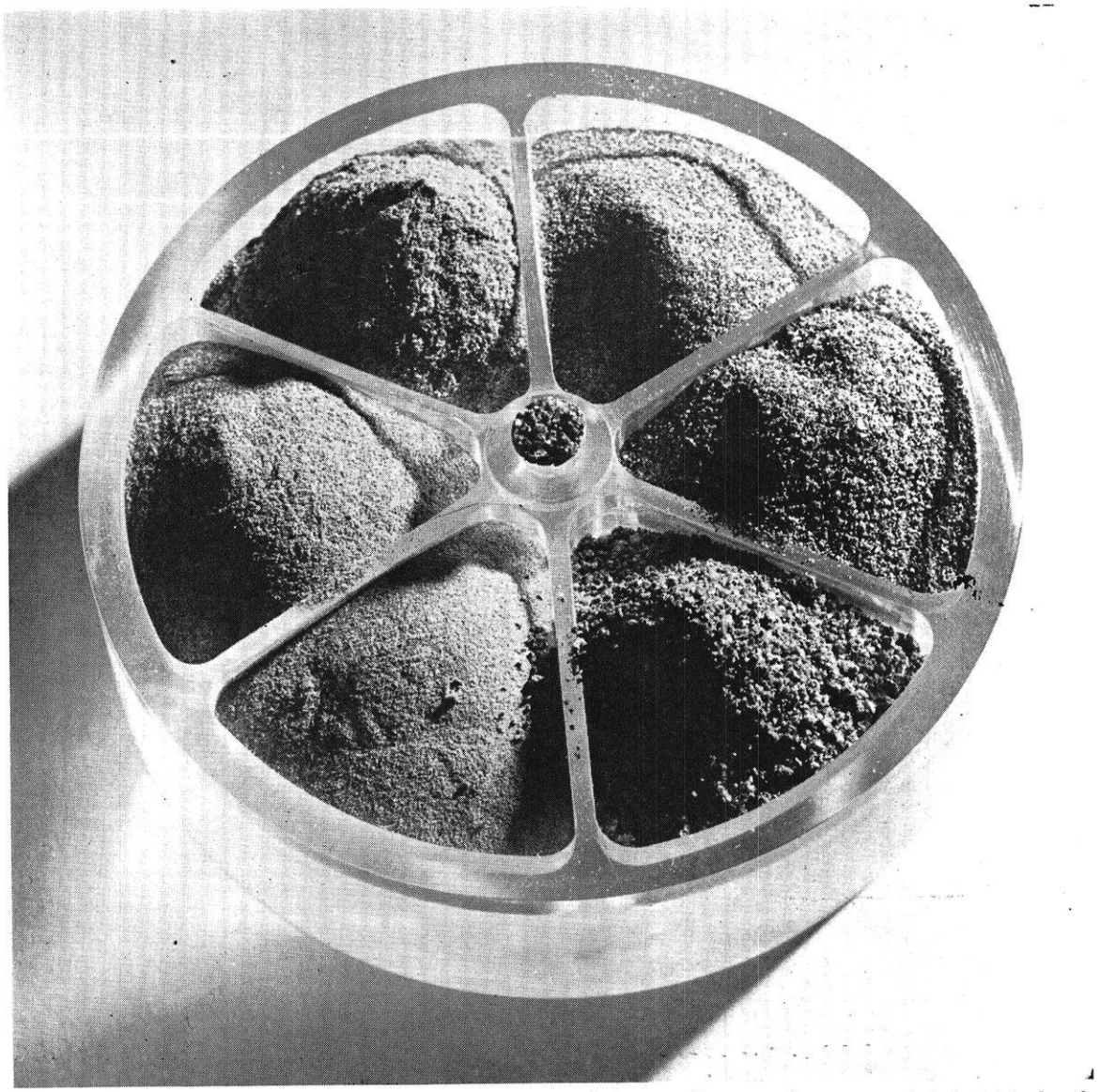
Of course, to get the results predicted, theoretically it is necessary to have the compounds present under ideal conditions (i.e., they are present in the elementary form.) Since this is not generally the case, the rule does not say the transformation must occur, but simply that it can occur. This explains the failure of diamond to become graphite at room temperature and atmospheric pressure as is theoretically dictated.

In 1938, R. S. Jessup and F. D. Rossini, working for the U. S. Bureau of Standards, extended Gibbs' work by publishing data that indicated with fair certainty the thermodynamic limits between the graphite and diamond phase. Their experiments located the points where the thermodynamic potential of graphite is just greater than that of diamond for temperatures up to 1000° C. At temperatures greater than 1000° C they extrapolated estimates. The data they obtained are indicated by the blue band on Figure 1. A band is used to indicate the limits of uncertainty in their experimental and extrapolated values.

Perhaps the most extensive research on the synthesis of diamond through high pressure was carried out by



A 1000-ton press for achieving high pressures (100,000 atmospheres or 1.6 million pounds per square inch [psi]). This is the apparatus in which man-made diamonds were first produced.



In the photo above, the man-made diamonds are separated into grades according to usual industrial classifications. The plastic container is approximately three and one-half inches in diameter.

P. W. Bridgman at Harvard University. The red line on Figure 1 indicates the pressure-temperature range made possible through his research.

It will be noted from the illustration that Dr. Bridgman developed pressures near room temperatures that were well above those theoretically necessary for diamonds to form. However, he did not obtain any diamond. This Dr. Bridgman decided was due to the low temperature causing insufficient agitation to break down the graphite lattice and give the elementary particles necessary for the rules of thermodynamics to hold. On the basis of this he decided to work at higher temperature.

In an attempt to determine the temperature and pressure necessary for the transformation to occur, P. W. Bridgman decided to attack the problem from a new angle. In earlier experimentation he had observed that at atmospheric pressure and 1500° C the transformation of diamond to graphite began to occur. Bridgman assumed that by increasing the temperature and pressure sufficiently he would reach the point where this transformation occurred completely, and at higher temperature and pressure the graphite to diamond transformation would begin. On the basis of this assumption General Electric's Carboloy Department, Norton Company and Carborundum Company sponsored Bridgman in a five year research program.

During this five-year period he tried both external and internal methods of heating the graphite. The external heating was dropped since due to rapid cooling it was impossible to operate in the desired temperature range. For internal heating Bridgman developed a stepped up thermite type reaction that made possible simultaneous temperature of 3000° C and at pressures of 30,000 atmospheres for a few seconds.

Despite the high temperature and pressure no diamonds were formed, but Dr. Bridgman did learn that his basic assumption was correct. He observed that at this temperature and pressure the transformation from

(Continued on page 80)

RADIANT HEATING

An analysis of one method of man's campaign to keep comfortable—Why radiant heating is better.

by Stephen D. Perry m'57

Ever since civilization began, man has been confronted with the problem of heating his home. Until Ben Franklin arrived on the scene and invented the stove, man had to be contented with the fireplace, which was notorious for warming one side excellently while completely neglecting the other.

Today there are several methods of providing the body with the proper heat to remain comfortable. These are convections currents, evaporation, exhalation, and radiation.

Convection currents are generated on the principle that hot air rises and cold air descends. The establishment to be heated would have warm air circulating up and cold air circulating down throughout the room. Exhalation is the expenditure of heat in the air that is exhaled through the nose or mouth. Evaporation is a cooling process. As water evaporates from a surface, it cools the surface. Radiation is the principle of the heat traveling a straight line from its source until it is absorbed by an object. This is the same manner in which the sun's heat is transferred to the earth.

The minimum normal heat developed by the body approximates 500 BTU per hour. Of this amount, 100 BTU are used in maintaining the body and making repairs. The remaining 400 BTU have to be dissipated; otherwise the body would overheat, exactly as would an internal combustion engine. Under normal conditions, nature maintains a proper balance in accordance with the following table of heat dissipation:

190 BTU per hour by radiation
110 BTU per hour by convection and evaporation
100 BTU per hour by exhalation

The body has other methods of disposing heat, but these are negligible. With the heat dissipated as mentioned, the body temperature will remain at a normal 98.6° F.

If it is assumed that a body is subjected to an environment of normal conditions, such as 70° F. air temperature, 50 per cent relative humidity, no direct radiant heating, no air currents, that the body is reasonably clothed, and that the heat dissipation is in accordance with the preceding table, then, under these conditions, the body would be comfortable, feeling neither heat nor cold.

Now, if the environment should change so that the body can no longer radiate heat at 190 BTU per hour, the body temperature would either go up or down. To counteract this condition, the body would either begin to perspire, for cooling, or the blood vessels near the surface of the skin would expand to release more heat. Both of these conditions are automatic and can cause an uncomfortable sensation in the body. It is the purpose of proper heating or cooling of a building to eliminate these uncomfortable sensations.

The heating systems that employ either hot air circulation or the use of the radiator generate convection currents to maintain the desired temperature. This method has a tendency to take effect after the body's automatic system of perspiration or expanding of the blood vessels has begun to operate. Until an equilibrium is established, there is a period of being uncomfortable. On the other hand, if a radiant heating system is used, this uncomfortable period is eliminated.

—All Photos Courtesy A. M. Beyers Co.

A residential wrought iron pipe radiant heating installation.

Radiant heating and cooling are directed toward the control of comfort by influencing the radiant component of the body's heat output rather than by adjusting the convection and evaporation elements to secure bodily heat balance as is the method used by convectional systems. Hence, radiant heating is not simply another type of heating, but is a distinctly different method of providing comfort from any or all of the presently known conventional methods. The prime difference being that, in a radiant heating system, comfort can be had independently of the air temperature. This is not true of any other method of heating. Another way of illustrating the difference between conventional methods of heating and radiant heating resides in the fact that in all conventional methods the subject is present in the space to be heated or cooled, or is immersed in the heating or cooling medium, the air. In a radiant system, the necessary effects are supplied or removed by radiation independently, if necessary, of the air temperatures.

As an illustration of this subject of heat balance with respect to human beings within an enclosed controllable environment, consider the following example. The individual is standing within a space having an air temperature of 75° F and a mean radiant temperature of 65° F for the walls. Note that the air temperature is higher than the wall temperature. This relation represents the normal comfort conditions with conventionl heating systems, whereby the air in the room being warmed is heated to an average temperature above the mean radiation temperature of the walls, which are assumed to have one side exposed to outdoor temperatures lower than that required for comfort.

The body under this condition, will lose heat to the cool walls by radiation so that, to maintain bodily heat balance, additional heat must be supplied to the body. In this case, the heat is supplied by convection from the warm air, which must be heated sufficiently to properly warm the inside surface of the walls so that, with the heat conducted to the body, comfort is obtained.

Now consider this next example. In this case the air temperature is 65° F and the mean radiant temperature is 75° F. This condition more closely approximates the

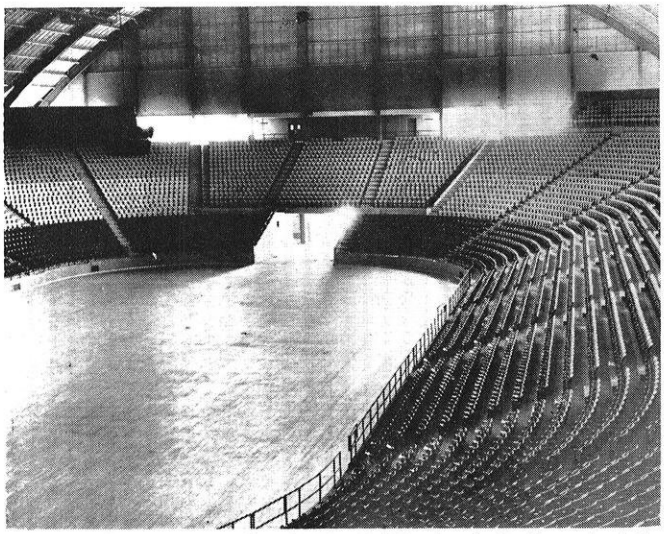


Photo showing completed U. of Maryland Student Activity Building, probably the first of its kind with a specifically designed radiant heating system.

natural outdoor relationship of air and radiant temperatures and hence gives a greater sense of comfort than the previous condition explained.

Consider now the condition that would exist in the same space with air temperature of 50° F and a mean radiant temperature of the same value. It is rather obvious that an individual exposed to these conditions without proper clothing would soon become cold. However, if the walls could be heated to a temperature of 88° F, with a room temperature of 52° F, the individual would be comfortable. The heat loss by exhalation and convection would be made up by the increase in the mean radiant temperature. These foregoing illustrations should establish some of the advantages of radiant heating.

As was pointed out before, radiant heat is the means by which heat is transferred from the sun to the earth. This heat travels in straight lines, at the same speed as light and in the same manner.

When the temperature of the ceiling, walls, floor, or any other object in a room is higher than the average temperature of surrounding objects, heat is then transferred to these areas by radiation, and also to a certain extent by convection. When a floor in a room is at a temperature in excess of the surrounding air and objects, heat will be radiated from the floor to the other surfaces of the room and the temperature of these surfaces will be raised. At the same time, the air in contact with the floor will be heated, and convection currents will begin.

The relative percentages of heat transfer by radiation and convection, with reference to ceiling, wall and floor installation are given in the following table:

Type of Surface	Heat Transfer By Convection	Heat Transfer By Radiation
Floor	50%	50%
Wall	43%	57%
Ceiling	30%	70%

However, with the exception of the first 10″ or 12″ from the heated surface of the wall, floor or ceiling, the remaining distribution of temperature throughout the room will be constant.

Radiant heating installations give greater comfort than other heating systems to the occupants in the h ated area owing to the improved temperature relationship and absence of noticeable air currents. The following examples will illustrate this.

Lets consider the direction of air currents and the approximate resulting temperatures within a room heated by conventional method with a concealed type of converter placed beneath the windows. With the heat transfer surfaces of convectors at a temperature approximating 180° F, air warmed to a temperature considerably above average will rise from the convectors and pass up in front of the windows, with the result that air at maximum temperature will pass areas of high heat conductivity exposed on the other side to low outdoor temperatures, resulting in a maximum rate of heat loss at that point. The rising air will circulate up to and along the ceiling and down toward the floor at points most distant from the radiators.

The same situation would prevail if a radiator were used, whether it were heated by warm air or steam. It is almost impossible to eliminate convection currents when hot air or radiators are used to warm the room. Convection currents are undesirable because they can deposit dust or germs throughout the whole area.

Consider the temperature and direction of radiation that may be presumed to be present in a room radiantly heated from the floor.

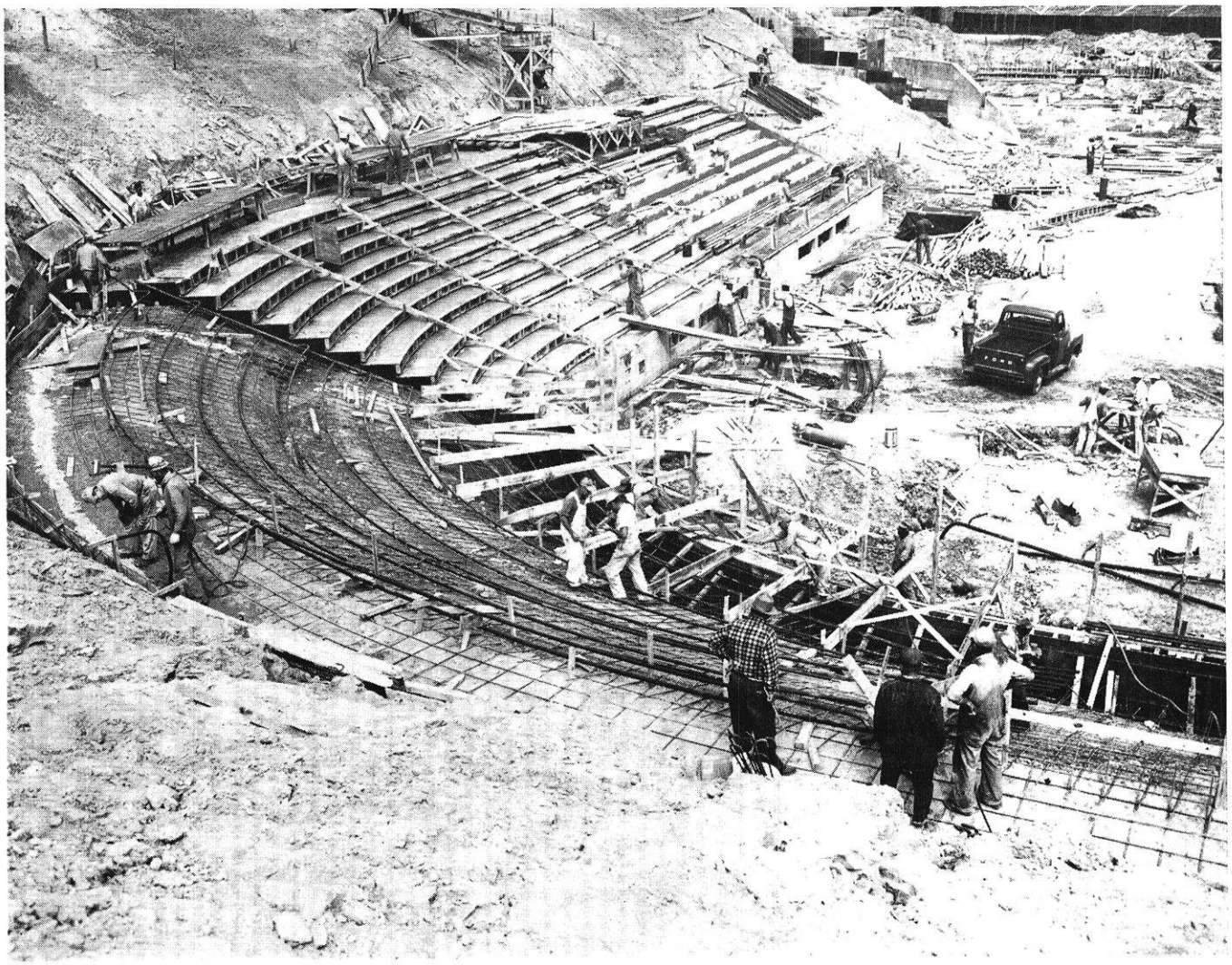
Let's compare that to the same condition existing in the room where use is made of the ceiling as the heating medium.

Finally let's consider the direction of radiation and convection currents when use is made of the space below a window for installation of radiant heating. It must be remembered that every infinitesimal area of the heat-transferring surface, such as the floor, wall, or ceiling, radiates heat in all directions to any surface that is below the temperature of the radiant source.

It is to be observed that in radiation, a temperature of 64° is assumed, and that the temperature is favorably comparable to a temperature of 70° F. in a room heated by convection currents.

In addition to the greater comfort obtainable with radiant heating, there are other advantages concerning mechanical construction and operation of the system.

There is a great saving in floor space effected by the absence of radiators. If proper consideration is given to the space lost by standard radiators, the cost for installing a radiant heating plant will be largely offset by this saving. Considering this fact further, it will be realized that space taken up by a radiator will reduce the versatility of furniture arrangement. Even if concealed radiators with grills are used, furniture cannot be placed in front of these areas. All of these difficulties are eliminated with radiant heating.



In this progress photo of early construction, the wrought iron piping for radiant heating the University of Maryland Student Activity Building is shown being installed.

A further advantage of radiant heating resides in the fact that greater cleanliness in enclosed spaces is obtained. This is because, with the lower temperature and greater areas involved in radiant heating, there are very low velocity convection currents to transmit dust. The discoloration behind the radiators and above the radiators is not present with the radiant heating installation.

The cost of operating a radiant heating system is less than that of conventional methods to the extent of 20 to 30 percent, basically for the reason that comfort is obtained with lower indoor temperatures. With lower indoor temperatures, there is less differential between indoors and outdoors; consequently, less heat is lost through the walls.

With the basementless type of building, radiant heating in the floor is almost a necessity to keep the floors at a comfortable temperature. Convection currents passing over the floor, are the coldest air in the room and would be insufficient to warm the floor properly.

A further advantage of radiant heating is the ease with which it can be installed in an old building. This is particularly true if the building is a historical type, where the heating was originally by fireplaces and the presence of radiators in such an environment would be an architectural anachronism.

Pipes and tubes are embedded in the wall, floor, or ceiling, in a radiant heating system. Hot water, steam, or hot air may be passed through the pipes to transfer the heat energy from the fuel to the space to be heated. Of these three, hot water is the most effective, the chief reason being the high thermal capacity of hot water and the ease with which its temperature can be regulated and controlled to suit the conditions of the radiant heating installation.

Because of the fact that very moderate temperatures are required, steam at normal pressure does not lend itself to radiant heating application. The maximum temperature required for hot water is about 160° F., whereas, the normal temperature for steam in a conventional system is 220° F. If low cost steam were available, it would be advisable to use the steam as a heat exchange to the water, so that the hot water actu-

(Continued on page 68)

SIMPLIFIED DRAFTING

Economy is in the news. Herein is pointed out the value of simplified drafting followed by a summary of suggested changes.

by John Follett m'57

"Since drafting is a key function in the engineering operation and is responsible for the expenditure of a large portion of the engineering budget, we must search for new and better methods . . . to effectively reduce the time and effort to make drawings," says Mr. A. H. Rau of General Electric, one of the fathers of simplified drafting.

Dean J. Gerardi, of the University of Detroit School of Engineering, is opposed to simplified drafting in its present form. He says, "A competent draftsman . . . must be an expert on dimensioning, tolerances, and know something about planning, tools, manufacturing, inspection . . . algebra, trigonometry, descriptive and analytic geometry. No books or brochures on simplified drafting can do all this."

These views, expressed at a drafting institute at the University of Wisconsin on November 9, 1956, represent a major controversy in industry today.

But what is simplified drafting? It can be defined as a technique of presenting mechanical drawings without any unnecessary detail, maintaining accuracy, and increasing clarity. The Navy (Naval Shipyard Design Division) calls its program of simplified drafting "functional drafting." American Machine and Foundry and General Electric call their program "simplified drafting."

The examples given here are taken directly from materials published by the U.S. Navy, American Machine Foundry, and General Electric. Most opposition to simplified drafting is outlined in certain ASME, ASEE, and SAE joint recommendations not yet available.

American industry today is faced with a shortage of 35 to 40 thousand engineers and draftsmen, according to a recent report issued by the Engineering Manpower Commission. No substantial increase in the number of engineering graduates is anticipated during the next ten years, although technological advances and higher standards of living have created a greater-than-ever demand for these technical men.

Drafting costs are high and draftsmen scarce. Since a change in that situation is not expected soon, ways must be found to increase the output of draftsmen now available.

Simplified drafting offers one solution to the problem of not having enough available draftsmen.

The savings due to simplified drafting programs are principally in time, and therefore money. In an investigation at the American Machine and Foundry Company's Greenwich Laboratories, 144,000 man hours per

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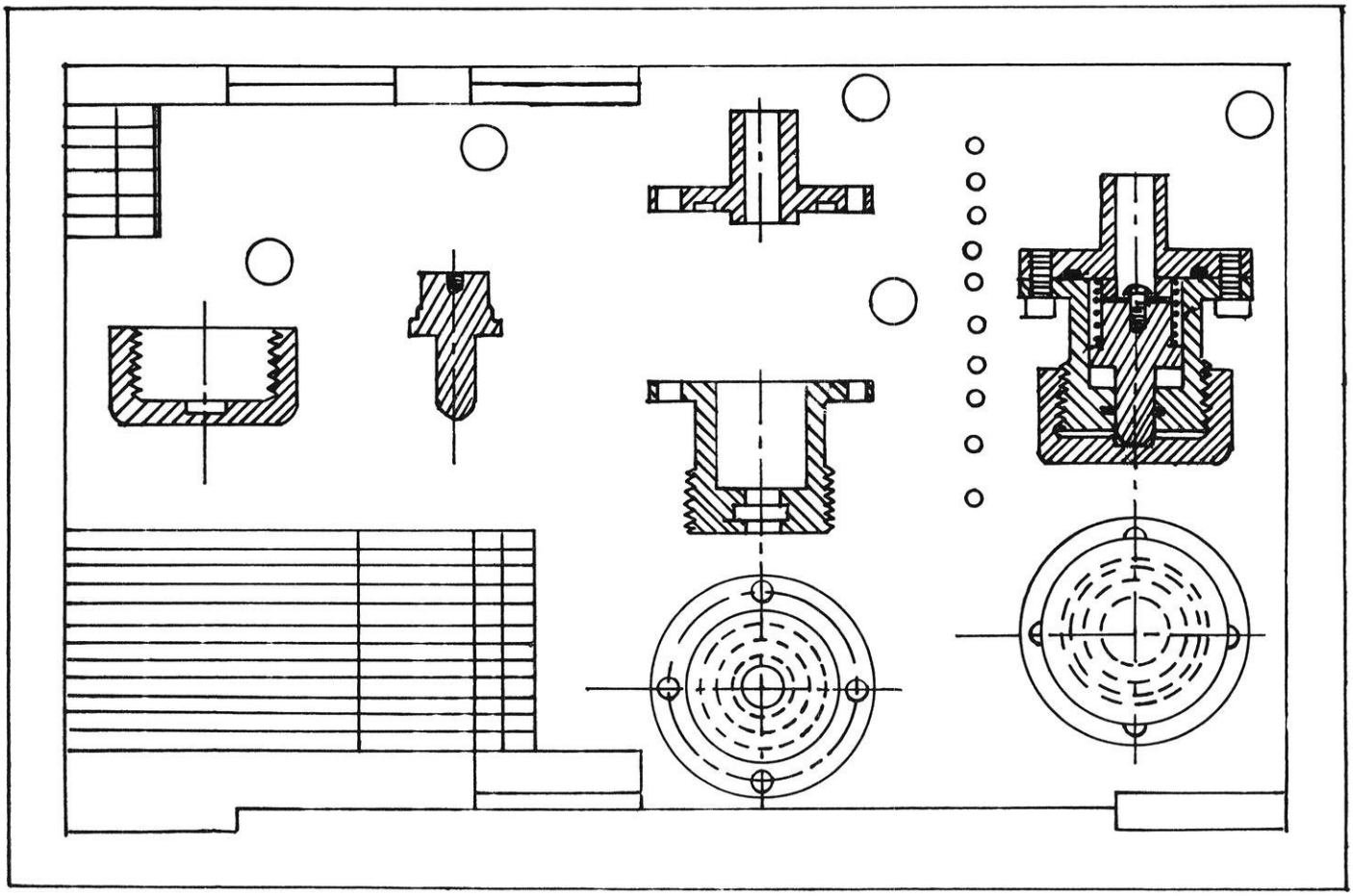


Fig. 1.—Examples of Conventional Drafting. Dimensions left out for clarity.

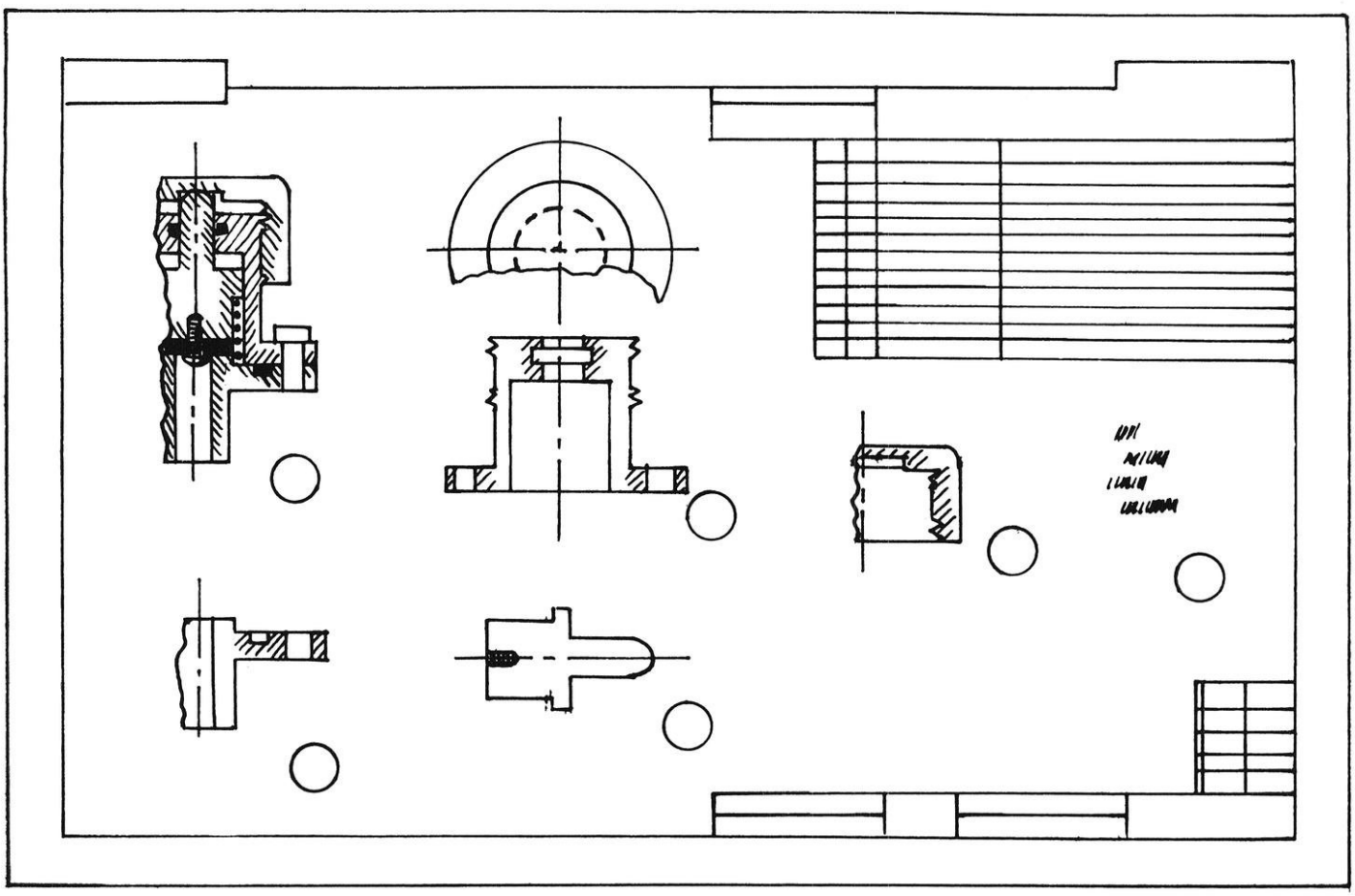


Fig. 2.—Examples of Simplified Drafting. Dimensions left out for clarity.

Simplified Drafting

(Continued from page 32)

year were saved. The company, itself, estimated a savings of at least 30% in the number of draftsmen used.

Conventional and simplified drafting techniques are alike in that they both require accuracy and completeness of vital information. If time is saved on the drafting board, but lost on the floor due to lack of these essentials, there is no savings.

An experienced draftsman is likely to protest simplified techniques. But this same man has the necessary training and is best equipped to use and interpret simplified drafting. A draftsman must first understand methods of conventional drafting before he can intelligently use simplification.

American Machine and Foundry reported training time was saved by using simplified drafting and the Navy (Shipyard Division) instituted a training program consisting of 10 lectures of 20 to 40 minutes duration for training its personnel.

In both cases, however, it was re-training or modifying the training of skilled draftsmen—men who could turn a free-hand sketch into a useable tool for production—not beginners. It is doubtful that the basic training of a draftsman in the fundamentals of mathematics, mechanics, and chemistry could be shortened because of the importance of the draftsman as a "check-point" to the designer.

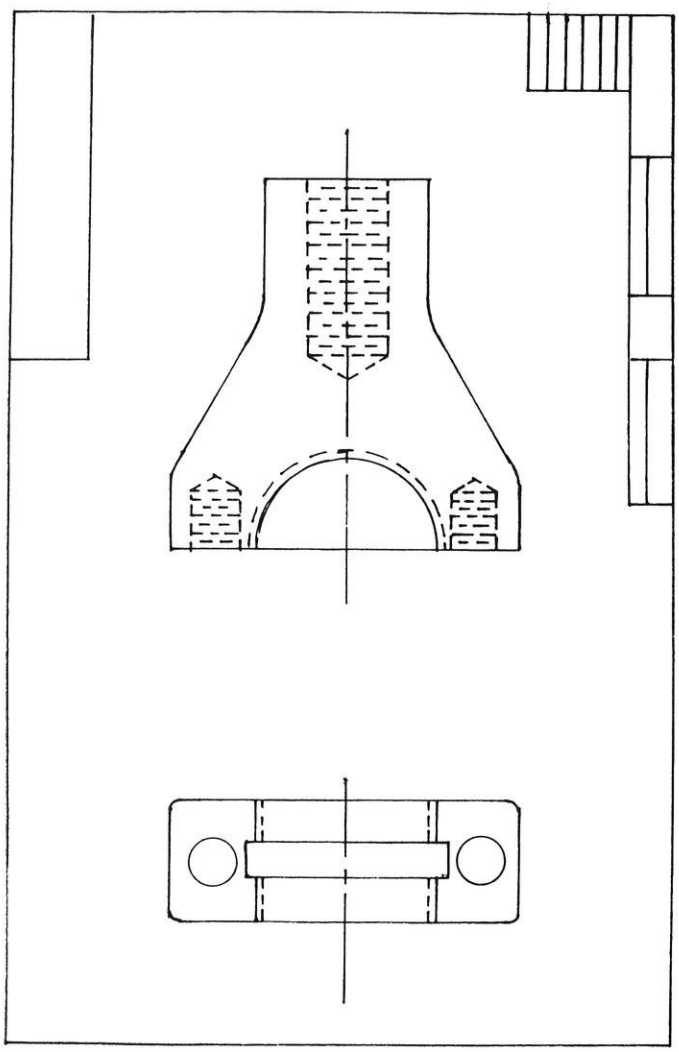


Fig. 3.—Examples of Conventional Drafting.

Simplification generally falls into four classes: 1. Simplifying delineation—i.e., substituting word descriptions and symbols for some views, 2. Using free-hand drawings, 3. Decreasing size of drawings, and 4. Correcting and transferring methods.

The reduction in size of large drawings is important. Large drawings are hard to handle, require more postage, are seldom kept clean, and usually have more detail than one department can use. The 4-inch side of a photographic reduction to 4 x 11 inches can be enlarged to 30 inches maintaining clarity. The Navy estimates this system to show a savings of $1,288,000 annually.

Another way of saving time is to use correction fluids, intermediates, etc. in reproduction. The changes may be made on the original by blocking out, masking, and using non-reproducible blue. Repeated detail may be transferred by using Transfer Matte tape. For example, block out unwanted parts, or use non-reproducible blue on parts of the master that are not needed for production.

One important objection to simplified drafting is the lack of standardization throughout industry and within the factory itself. Many simplified techniques cannot be readily understood by other departments or other companies and thus cause confusion. Industry must give its draftsmen training in simplified drafting they can use elsewhere.

The effective use of engineers and draftsmen is important now more than ever before because of their shortage. The fast pace of industry puts a heavier workload on these technical men.

A manufacturer who pays high wages to the technical man must use him to the best advantage—that is, to produce new methods, new products, and new designs. There can be no waste of manpower if industry is to meet the accelerating need for services and prducts.

It is estimated that the population of the United States will be 190,000,000 by 1966. Forty per cent more goods and services will be required, but there will be only 14% increase in the work force. Standardizing simplified drafting and using it extensively will help to release more engineers to meet the present and forthcoming demands on technical service.

The American Machine and Foundry Company reported no rejects due to simplified drawings from its Inspection Department. Its Production Group stated that training time was reduced. Foremen favored the program. They stated that time was saved in reading and interpreting drawings and requested redrawings using the new methods.

The government has already instituted simplified

drawings in the Navy, and it is indicated that Ordinance Weapons Command is initiating the system experimentally.

A drawing is a record, a tool, and an instruction and must be exact and correct to be used. But extra views, unnecessary lines, cross-hatching, shading, repetition, and gigantic drawings are costly and do not add accuracy or clarity.

Through use of simplified drafting, the output of the draftsman will be increased by a savings in time. The engineer will have fewer drafting worries and more time to "think."

TABLE I. — LIST OF SIMPLIFIED DRAFTING METHODS CONTAINED IN AMERICAN MACHINE AND FOUNDRY BOOKLET "ELEVEN RULES FOR SIMPLIFIED DRAFTING"

1. Use description to eliminate delineation.
2. Use description to eliminate projected views.
3. Omit elaborate, pictorial, or repetitive detail.
4. Use keyed legend.
5. Only use dotted lines to add clarification.
6. Only use cross-sectioning to add clarification.
7. Use symbols to indicate various hole sizes.
8. Avoid the use of hand lettering.
9. Avoid the use of arrow heads.
10. Use datum lines.
11. Make free hand drawings where possible.

TABLE II. — A SUMMARY OF TIME-SAVING PRACTICES TAKEN FROM GENERAL ELECTRIC

1. Use description wherever practical to completely eliminate delineation.
2. Use description wherever practical to eliminate projected views.
3. Eliminate views where the shape can be given by description; for example, hex, sq, dia, on C_L, thk, etc.
4. Show only partial views of symmetrical objects.
5. Avoid the use of elaborate, pictorial or repetitive detail.
6. Where it is necessary to detail threads, do not carry it out completely over the full length of a stud, bolt or tapped hole.
7. Omit detail of nuts, bolt heads and other hardware. Show plain outlines where it is necessary to indicate position.
8. Omit detail of parts on assembly drawings the function of which is to simply show the part location.
9. Avoid the use of unnecessary dotted lines which do not add clarification.
10. Cross-sectioning should be employed only when the clarity of the drawing depends upon it. Partial cross-sectioning is recommended.
11. Use simplified delineation of holes and tapped holes by use of symbols.
12. Views with no dimensional or written instruction thereon can usually be omitted.
13. Within limits, a small drawing is usually made more easily and quickly than a large one.
14. When two parts are different to a slight degree, complete delineation of both parts is not required.
    (Inscribe "same as except . . .")
    (*or* "otherwise same as . . .")
15. Drawings made to modify stock or commercial parts should be as plain as possible, avoid detail.
16. Draw objects to scale only when absolutely necessary. Otherwise, draw objects out of scale but proportionately to the size so as not to confuse the user.
17. Enlarge small details on larger parts for clarity when necessary.
18. Omit reference part circles and arrows on leader lines when it will not cause confusion with other data on the drawing.
19. Do not duplicate dimensions.
20. The delineation of commonly used objects can be greatly simplified by substituting recognized symbols.
21. Omit inch marks when the dimension cannot be confused for a quantity or other data.
22. Eliminate repetitive data by use of general notes.
23. Omit center lines except when necessary for processing.
24. When delineating, use as much free-hand drawing as the work permits in preference to using instruments.
25. Do not use hand lettering wherever typing will save time.
26. Use tabulated arrangement instead of unnecessary repetitive views.

TABLE III. — TEN FUNCTIONAL DRAFTING RULES TAKEN FROM BUSHIPS

1. If it is easier to describe it, don't draw it.
2. Use word description to eliminate projected views.
3. Omit elaborate or pictorial detail.
4. Use numbered symbols for nuts, etc.
5. Avoid use of dotted lines.
6. Use cross-hatching for clarification only.
7. Avoid hand lettering.
8. Make free hand drawings where possible.
9. Use ordinate dimensioning.
10. Make drawings suitable for issuing half-size prints.

THE END

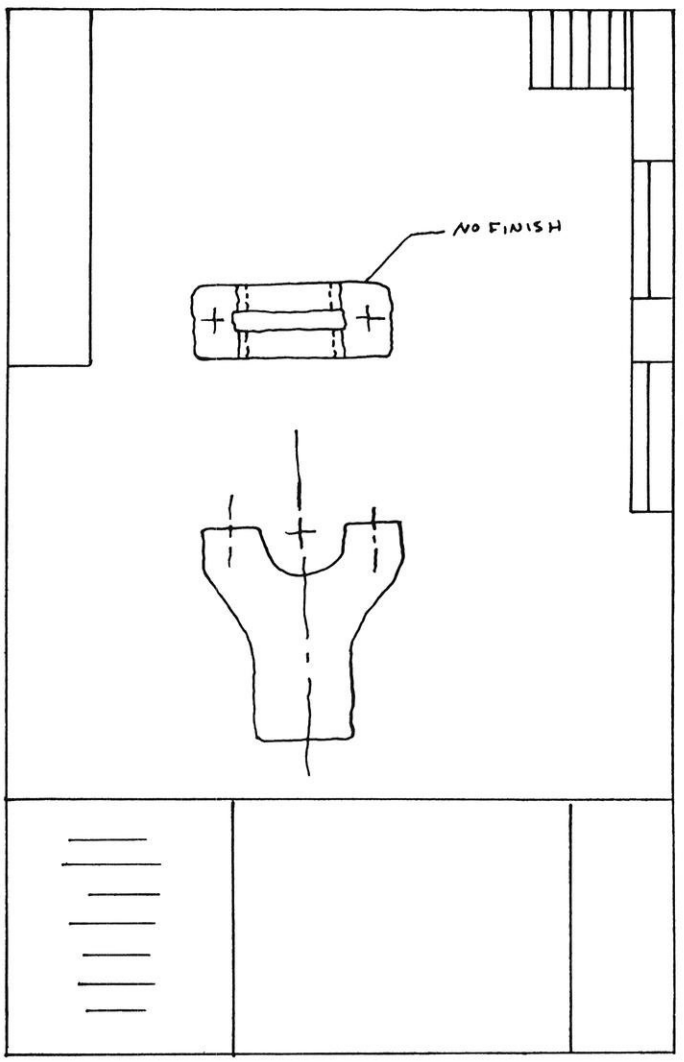
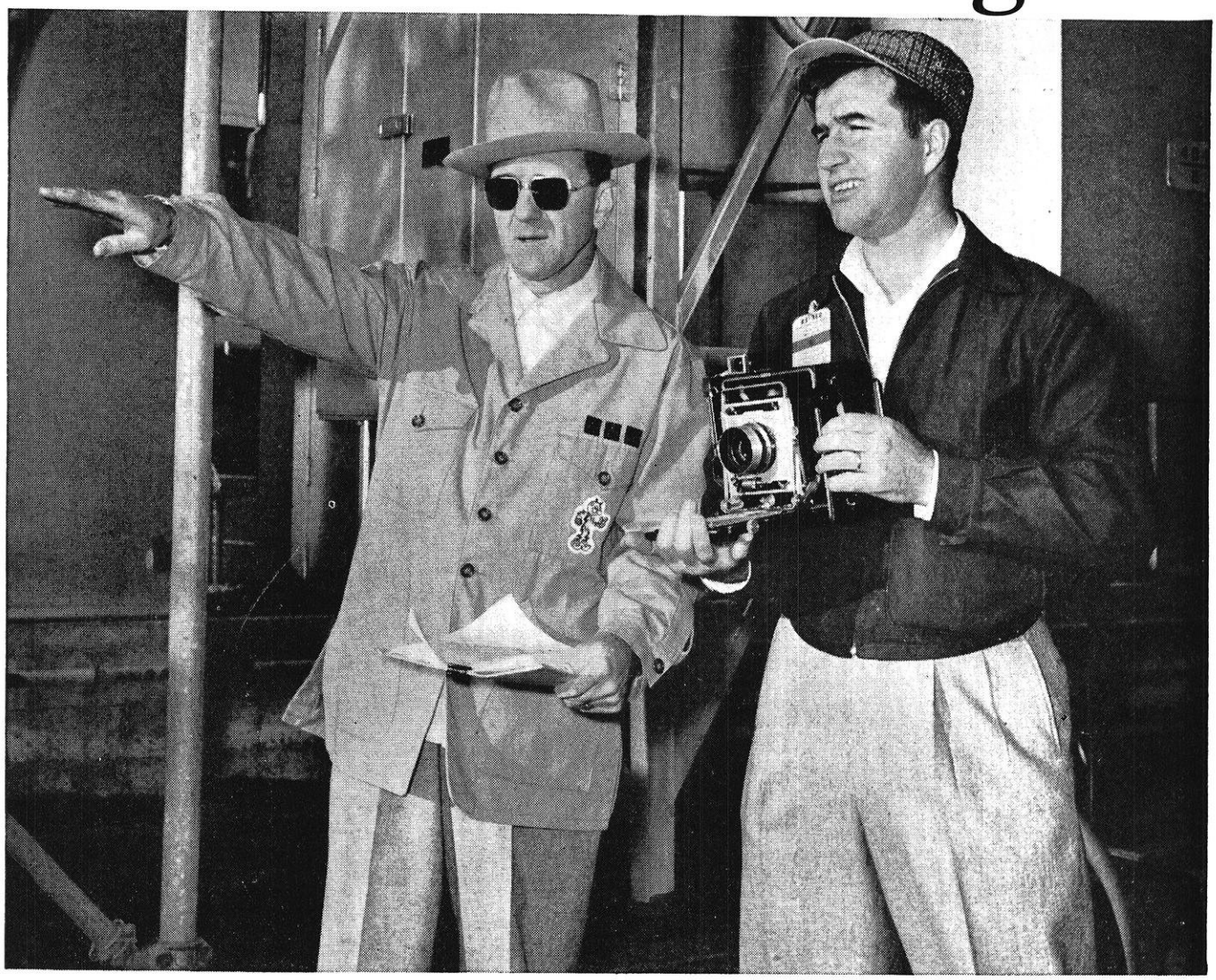
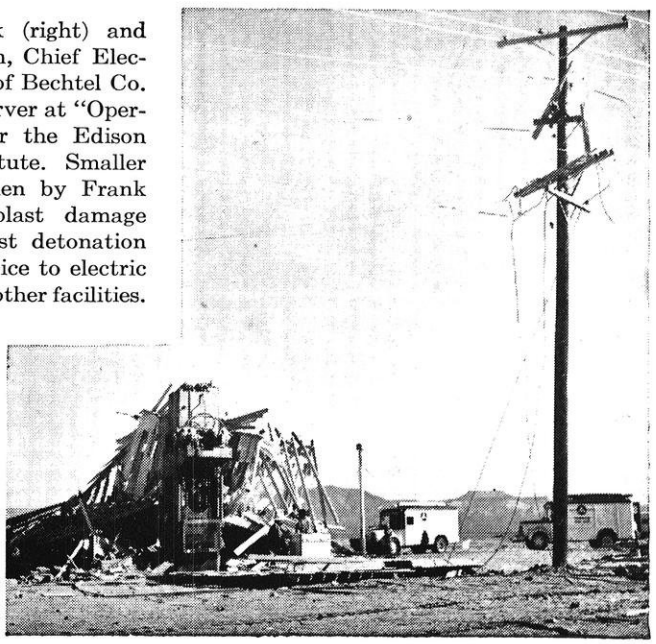


Fig. 4.—Examples of Free-Hand Sketching.

...an editor on the go



Frank Kovalcik (right) and Karl M. Bausch, Chief Electrical Engineer of Bechtel Co. and official observer at "Operation CUE" for the Edison Electrical Institute. Smaller illustrations taken by Frank show typical blast damage caused by a test detonation of a nuclear device to electric utility lines and other facilities.



TO THE CONTRARY:

SHOULD ENGINEERS

Professional Power Through Bargaining

by Robert J. Walter met'57

According to a news release of September 23, 1956 many engineers attending Lehigh University are not returning to receive their degree despite the scramble for 1957 college graduates. It also mentioned that other engineering schools report the same.

When we look at the engineers in industry the same confusion exists. J. J. Burke in his article "The High Cost of Thinking" expresses the viewpoint of engineers as: "You're a sucker if you've been on a job for more than a year and are not actually shopping around for more money; only by this technique can you advance your salary and keep ahead, percentage-wise, with comparable industry increases in other non-engineering fields".

It seems that both the engineer and the student are beginning to realize the relatively poor bargaining position of the engineer. Industry realizes this, and it is rediculous to expect it to pay any more than it must for technical personnel.

The bargaining position of a graduate looking for his first job is good, and his starting wage adequate, but after he settles with one company he finds himself relatively powerless with his only weapon being a change of companies. This situation is common not only to engineers, but to all who work in industry. Let us see how other people have overcome this dilemma. We all know the answer. From laborers to such highly skilled men as engravers, from construction men to high school teachers—men have found that they increased their bargaining power by banding together in a union.

Why can't engineers do the same? Their problem is identical to the others. Whenever such a proposal is mentioned, the loud response "Professionals forming a union. How degrading. We receive prestige on our own worth and are not dependent on a union to help us." is heard.

On the surface this sounds plausible, but let's look into it. Doctors and lawyers, all known as professionals, have their organizations, which are to all intents and purposes, unions. The lawyer has the bar, which he is forced to join to practice law. This organization has its entrance requirement, a fee, and also some jurisdiction over its members. The doctors have one of the strongest organizations known. They have entrance requirements, control the number of students enrolling in medical schools, and in order to remain a member, the doctor must better himself by continuous learning. Both of these are unions and if their members were confined to industry, each organization would exert considerable amounts of pressure and influence on behalf of their members. This influence would not be degrading, but uplifting for a professional man.

The next step follows easily. Why not take the Professional Engineer Society, give it more authority, require all engineers to belong and make it as much a part of the engineer as the bar is a part of the lawyer. In other words let it be a union.

What would be the results? First, because they are now an organized body, the average wage of the engineer would increase. Secondly, the overall standards of engineers would rise, because the organization can demand both a minimum professional requirement to belong and continual professional betterment. Thirdly, problems such as the shortage of good teachers would be partially solved because of close work between schools and industry, similar to the relationship between the doctor and his hospital and university.

Thus this "union" would be degrading only if it is allowed to be, and would otherwise raise the engineers to even higher professional esteem and wages.

THE END

BE UNIONIZED?

Amalgamation is Not the Answer

by Lawrence D. Barr m'57

In pre-historic time, as one story goes, an aging cave-man killed a saber-tooth tiger to prove to his fellow men that he was still an able hunter. How he did this is open for speculation, but at any rate, upon accomplishing this feat, the problem confronting him was how to get the carcass back home to prove he had done it. He was an old man with little strength, but desperation spurred his mind, and after thinking a long time, he devised a crude cart, using hollow logs as wheels. With this he was able to do the job, and we assume he received the credit he richly deserved. So it happened that the wheel was created to solve a problem and the field of engineering was born.

In the centuries to follow, engineers of various titles and nationalities were to create new things to solve old and new problems, and today, the very structure of modern civilization is founded upon this heritage of ideas. To say that the engineer is essential to our technical civilization is certainly true, but the fact also exists that his contribution is often unrecognized, essential though it may be. To much of the engineering world, this poses a problem and the current means of solution are up for discussion here.

That the engineer is not well-organized is a problem in human behavior and thought processes, and points out a rather thorny situation to be faced. The engineer is perpetually a man with a problem and is usually not content without one. An essential part of his occupation is solving these problems and he has become so

(Continued on page 76)

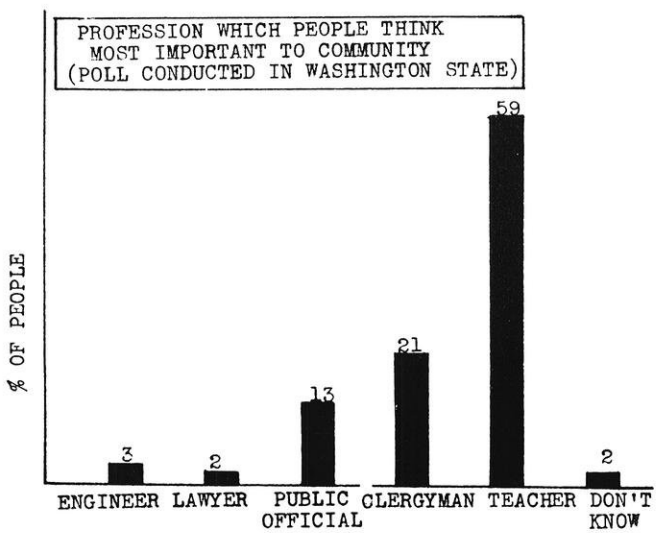


Fig. 1.

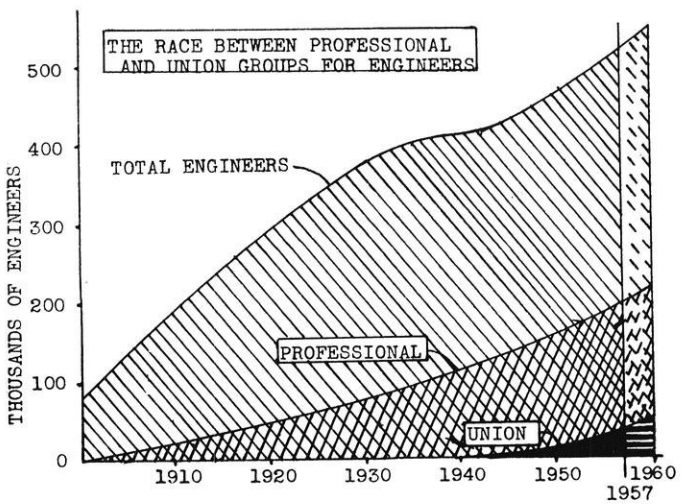
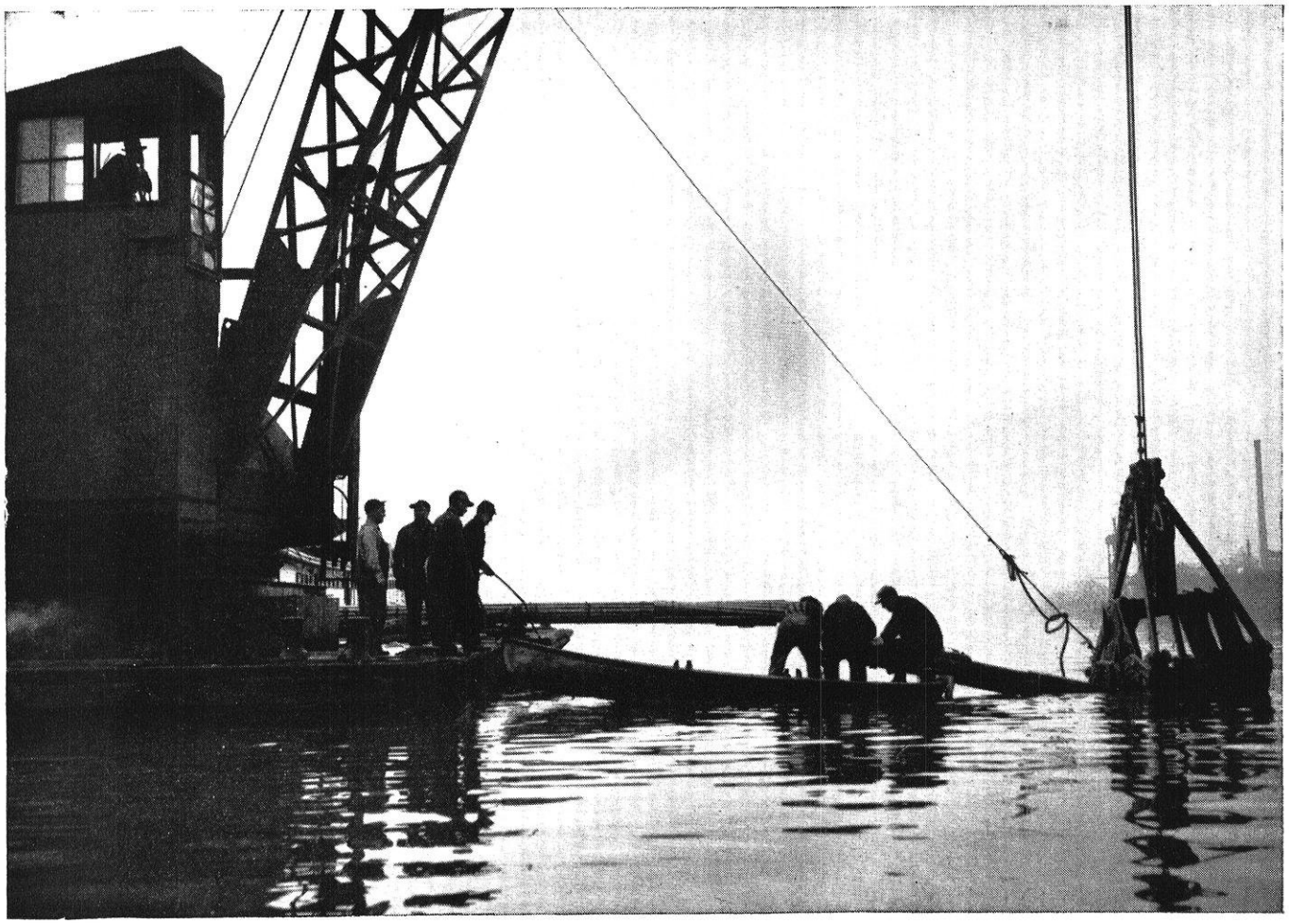


Fig. 2.



Work with the GAS industry... the nation's sixth largest

H. BROWN BALDWIN
B. S. Mech. Eng., U. of Vermont, 1949.
Began as Cadet Engineer, Boston Gas Co., 1950. Became Staff Engineer in Distribution Development Section, 1952; Staff Engineer in charge of Development. 1955; Distribution planning Engineer, 1956. Worked closely with company's natural gas conversion programs. Now advisor to Distribution Department charged with developing processes, machines, specifications. Assists management in preparing cost estimates, job analyses, other projects.

W. C. DAHLMAN
B. S. Gas Eng., Texas A. & I., 1938.
Began as Engineer trainee with Lone Star Gas Company after graduation from Texas A. & I. with first four-year Gas Engineering degree offered by institution. Joined Houston Natural Gas Company in 1942. Became District Engineer in Texas City and then District Manager in Beeville and El Campo. Dahlman is currently Chief Engineer with full engineering responsibility throughout the twenty counties in the company's Texas Gulf Coast System.

The Gas industry—the sixth largest in the nation—has a total investment of over $15 billion. Last year the industry set a new all-time record in number of customers, volume of Gas sold, and dollar revenue. In fact, Gas contributed 25% of the total energy needs of the nation as compared with 11.3% in 1940. The Gas industry is a major force in the growth development and economic health of this country.

There are many opportunities for you in the Gas industry. The industry needs engineers, and does not over-hire. You won't be regimented. There's always room for advancement. With utility companies and with manufacturers of Gas equipment, there's a future for you as an engineer. Call your nearest Gas Utility. They'll be glad to talk with you about your opportunity in the Gas industry. *American Gas Association.*

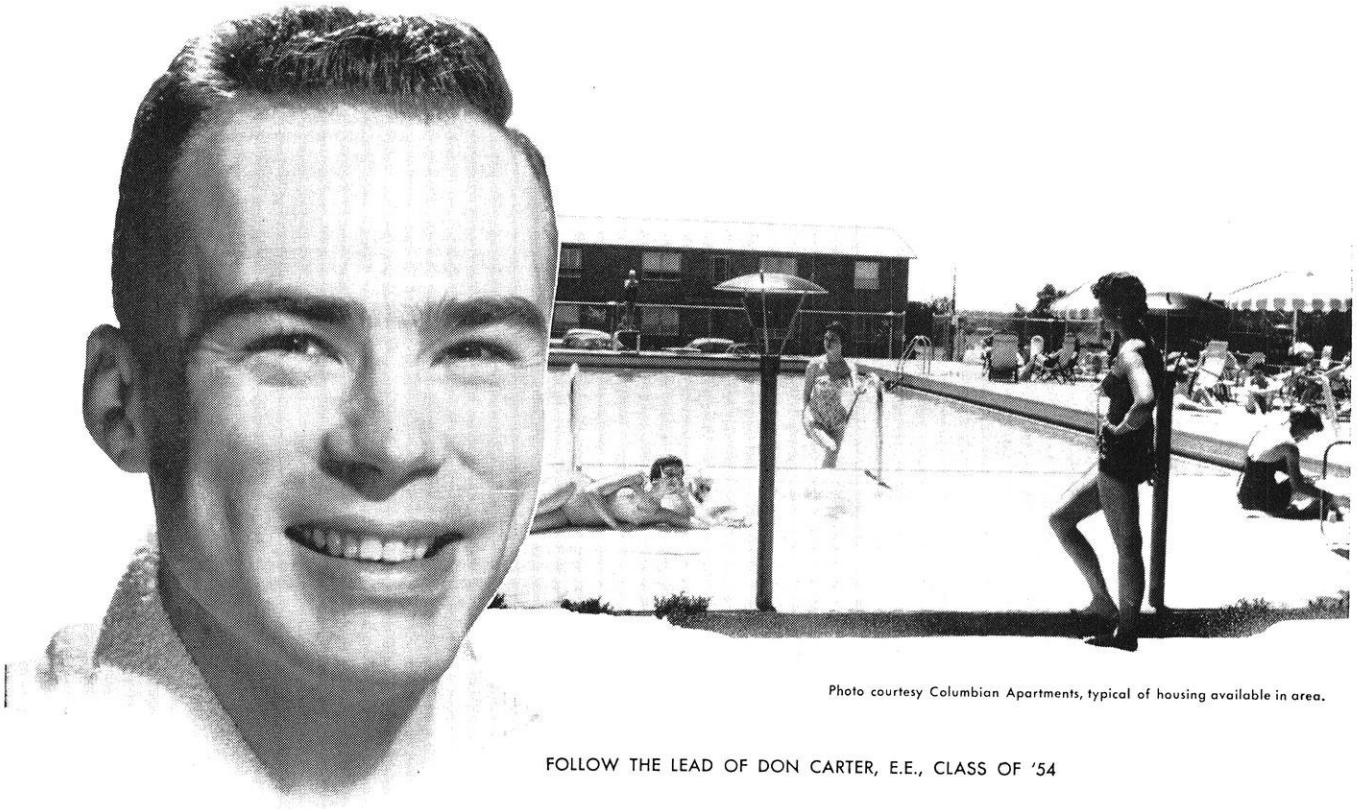
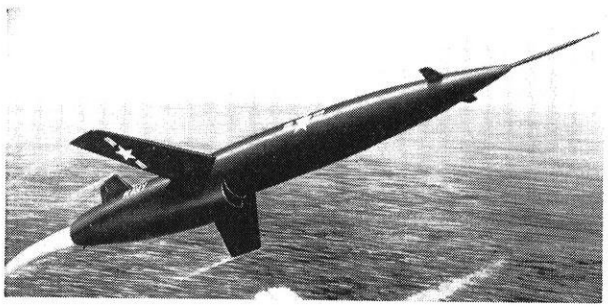


Photo courtesy Columbian Apartments, typical of housing available in area.

FOLLOW THE LEAD OF DON CARTER, E.E., CLASS OF '54

Live a little as you build an Engineering Career in Dallas

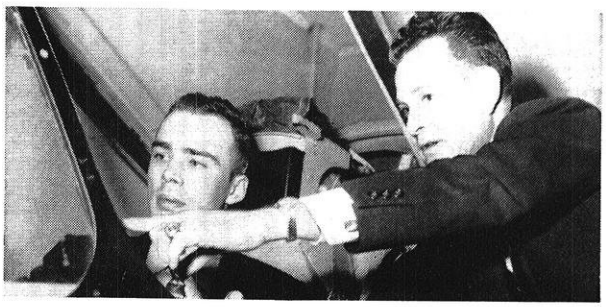


Don helps Chance Vought designers create producible, easy-to-maintain electronic gear for products like this Regulus II surface-to-surface missile.

IT'S AN OLD VOUGHT CUSTOM, helping young engineers. Our symposiums on creative thinking and expert career counseling have started some spectacular careers. And there's longstanding agreement in bachelor circles that Dallas is a good place to live. For details about living and advancing in Dallas, write to:

Mr. C. A. Besio, *Supervisor*
Engineering Personnel Dept. CM-2

TALK SHOP OR SPORTS CARS to Don Carter, and you'll find his keenest interests. At Chance Vought, in Dallas, Don keeps up with both subjects. He's *living* while he's building his professional career. Fun, to Don, means sports car races at nearby Eagle Mountain Lake, or a splash in his swank apartment pool. Fun means *career*, too, because Vought helped Don find a field he thoroughly enjoys – exploring new applications for human engineering in the design of complex electronic gear. Here, Don's electronics training comes in handy, and so would a good grasp of psychology. So Don's working toward an M.A. in Psychology, and Chance Vought's helping with tuition.



Part of Don's assignment is to simplify instrument arrangement in supersonic fighter cockpits. Here he and a Vought psychologist study a problem in human engineering.

CHANCE VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS

ENGINE EARS

by Pete DeWitt che'60

RESERVIST DAVIDSON VISITS EUROPE

Wiesbaden, Mar. 6, 1957—Six Air Force reserve officers visited U. S. Air Forces in Europe headquarters today at the start of an extensive tour of USAFE facilities during their annual two week tour of active duty, and while here they met with Maj. Gen. Herbert B. Thatcher, Vice Commander in Chief, USAFE.

At USAFE headquarters, the reservists also received a command briefing before departing to visit bases in Germany, France, and the United Kingdom.

Selection of the officers for this special tour of duty is made by the Assistant Chief of Staff for Reserve Forces in Washington under a plan designed to keep key reservists informed on the global responsibilities of the United States Air Force.

LELAND WINS BELL FELLOWSHIP

Bell Telephone Laboratories, research and development organization of the Bell System, recently announced the names of the recipients of its 1957–58 college fellowships. Established in 1955, the grants go to outstanding students pursuing graduate studies leading to Ph.D. degrees in branches of mathematics, physics, chemistry, and engineering.

Harold R. Leland, who is now working towards a Doctor of Philosophy degree in electrical engineering here at the University of Wisconsin, was one of those who received one of these fellowships. Leland, whose home is in Wausau, is one of four others who have received this award for the second consecutive year.

Each fellowship carries a grant of $2,000 to the fellow and an additional $2,000 to cover tuition, fees, and other costs to the institution where he elects to study.

(Left to Right) seated: Col. Chalmers A. Peairs, (Haven st.) Dover, Massachusetts; Col. Thomas B. Morrow, (Mt. Oaks Park) La Crescenta, California; Maj. Gen. Herbert B. Thatcher, USAFE Vice Commander in Chief. Standing, (L to R) Maj. James D. Abbott, Jr., (746 Gaylord st.) Denver, Colorado; Maj. Bruce M. Davidson, (4142 Mandan Crescent) Madison, Wisconsin; Col. Irving D. Hirschfield, (1900 Fox Hills Drive) Los Angeles, California; and Col. Hamlin Smithdeal, (Cheyenne Mountain) Colorado Springs, Colorado.

KAPPA ETA KAPPA ANNOUNCES NEW PLEDGES AND INITIATES

Al Boehme, publicity chairman announced that the following students have pledged Delta Chapter of Kappa Eta Kappa, professional electrical engineering fraternity:

Clarence Butenhoff
William R. Hanke
Bruce Zuckerman
Burt Beer
Dale R. Lowe
William W. Steit
Jim Teppo
John T. VanRoo
Gary W. Orberg

The following people were initiated into the chapter recently.

James Grube
Carl H. Kaack
Lee E. Eichenseer
Karel Olson

FOUR WISCONSIN ALUMNI CITED

The four sons of one of the University of Wisconsin's faculty "giants" of the past, all of them Wisconsin graduates, will be cited for outstanding accomplishments at the annual Wisconsin Engineers Day celebration to be held on the UW campus May 3.

They are the four Slichter brothers—Allen M., Donald C., Louis B., and Sumner H.—sons of Charles Sumner Slichter who, as dean of the UW Graduate School from 1920 until his retirement in 1934, helped to build Wisconsin's school of advanced study into one of the strongest in the nation.

Slichter Hall, a UW dormitory, now bears his name.

All four of the Slichter sons are Wisconsin natives. They were born in Madison, educated in Wisconsin schools, received their UW degrees —in mechanical and chemical engineering, physics, geology, and economics—and have made names for themselves in education, engineering, business, industry, and science.

The four were recommended for the distinguished service citations by the UW College of Engineering faculty and Pres. E. B. Fred. The recommendations were approved by the Board of Regents Saturday.

The citations will be presented at the ninth annual Engineers Day dinner in Great Hall of Wisconsin's Memorial Union at 6:30 p.m. Friday, May 3. More than 400 of the state's and nation's leading engineers and industrialists will attend.

A WISCONSIN ENGINEER VISITS MAYTAG PLANT

Five senior engineering students, recipients of special scholarships awarded by the Maytag Company Foundation, Inc., are shown above during their recent visit here as guests of the Maytag company. In the above photo, Burt Livingston (right), construction engineer, and Art Vonderhaar of the Maytag research division are shown with the students as they toured the control room of the chemical waste treatment plant at Maytag Plant 2, where automatic washers and dryers are manufactured. In addition to their tour of Plant 2, members of the group were also guests at a luncheon at the Newton Country club and toured Maytag's Plant 1, where wringer washers are made. A photo of the group is shown below.

NEW STAFF POSITIONS ANNOUNCED

Recently the Board of Directors of the *Wisconsin Engineer* announced new staff assignments for the 57–58 school year. Allan Clauer was named Business Manager taking over for Robert Walter and Jim Schilling was named Editor-in-Chief relieving Ron Schroeder. These new people will officially take over for the next issue but have been doing most of the work on this issue during their break-in period. Other new people will be added to the staff and the complete list of new assignments will appear in the May issue.

INSTITUTES

The following Engineering Institutes will be offered by the University of Wisconsin on the Madison campus in April.

INDUSTRIAL NOISE CONTROL

May 1–2

This institute will include discussions on what noise is, how you measure it, and the effect of noise on the individual. Ways of reducing or controlling noise in equipment, offices, and working areas will also be discussed. Sessions will be included on legislative and compensation trends in this field.

Fee: $20.00. Ralph D. Smith, Institute Coordinator.

INDUSTRIAL ENGINEERS' SEMINAR ON HUMAN ENGINEERING

May 7–8

This seminar will be devoted to discussions of the physiological and psychological nature of the worker. Learning curves, motivation, fa-

(Continued on page 44)

Pictured above, from left, are Bruce Lindahl, University of Minnesota; Robert Knox, Purdue university, Lafayette, Ind.; Ralph Onsager, University of Wisconsin, Madison; Vonderhaar; Robert Davis, Iowa State college, Ames; Harry Jacobs, University of Iowa, Iowa City, and Burt Livingston.

Campus News

(Continued from page 43)

tigue, and creativity will be some of the topics discussed. Chief industrial engineers, training specialists and production supervisors will be interested in this meeting.

Fee: $25.00. Robert A. Ratner, Institute Coordinator.

ENGINEERING PHOTOGRAPHY

May 9–10

Discussion and demonstrations of the latest photographic techniques available to the engineer to help him do his job quickly, easily and more efficiently will be discussed. Experts from the field will discuss costs and benefits of photography in engineering. The institute will be of interest to engineers in all fields, administrators looking for better methods, and industrial photographers.

Fee: $20.00. Lewis E. Johnston, Institute Coordinator.

PLASTIC LAMINATES

May 13–14

This institute is directed towards the material supplier, molder or fabricator, and end user of laminates. Subjects to be discussed include fiberglas reinforced plastics, high and low pressure laminates, sandwich construction, equipment, and problems in lamination of dissimilar materials.

Fee: $20.00. Ralph D. Smith, Institute Coordinator.

WATER CONDITIONING

May 15–16

Discussion topics at this meeting will include the water cycle, properties of water, nature of water impurities, water tests and analyses, water treatment methods, nature and identification of deposits, boiler water treatment, boiler scale and corrosion protection, boiler carry-over and embrittlement protection, return line protection, cooling water systems and treatments. Persons responsible for the operation of heating, process of power equipment will find this program helpful. The rapidly developing application of recirculating cooling waters will receive proper emphasis in this meeting.

Fee: $25.00. Paul J. Grogan, Institute Coordinator.

ENGINEERING ORGANIZATION

May 21–22

Chief engineers, works' managers, managers of research and development departments, and others holding similar positions have the problem of making the best use of the time of the engineers in their department. Current information in three general areas will be stressed: (1) management controls, (2) operating techniques and (3) understanding of the human relationships involved.

Fee: $20.00. Robert A. Ratner, Institute Coordinator.

INSIDE S. A. E.

DON BECKER

The Society of Automotive Engineers here on Campus has her eyes on the future. In the last two meetings she has placed at the feet of her members, vast stores of information, both general and technical, on the Vanguard space satellite, the C-130 turbo-prop air freighter, and the free piston engine.

On Wednesday, March 6, 1957, a joint meeting with A.I.E.E. and I.R.E. was held in B-19 of the Commerce building. During a very short meeting, the members were reminded about the availability of the S.A.E. handbook and were asked to give their approval or disapproval to the proposed Polygon radio station and the lockers in the M.E. building.

The speaker for the evening was Mr. Daniel Pasik of the Glen L. Martin Company, Baltimore, Maryland. Mr. Pasik is in the simulation section in analog computer work on the Vanguard project. His subject was the Vanguard rocket that will be used to propel the satellite into space. Slides and movies illustrated his talk.

Our most recent meeting was held on April 4, 1957, in the Loft of the Memorial Union. Will Ebel and Ron Fenske gave the Polygon report and the bill of 1960 was voted to stay in. Gil Soldat and Bruce Ebert reported definite progress on the "ralley" scheduled for this spring. About twenty drivers are expected to compete in this test of driving skill.

Mr. Robert Karlin, a representative of our parent S.A.E. branch extended an invitation to graduating student members to join the professional society upon completion of their studies.

The speaker was Dr. Gordon Millard, section supervisor, mechanical department, scientific laboratory, of the Ford Motor Company, gave his talk on the prospects and advancement made thus far on the free piston engine. The meeting was adjourned at 10 o'clock and refreshments were served during a brief question period.

Don't miss the last meeting of S.A.E. this year. It will be held during the first week in May. Watch the bulletin boards on the Engineering Campus for further details.

ASME REPORT

ROGER UMLAND

The February meeting of the ASME, consisting of about 70 student members and visitors, had the opportunity to listen to an interesting talk by Mr. E. W. Radke, Design Engineer for Hamilton

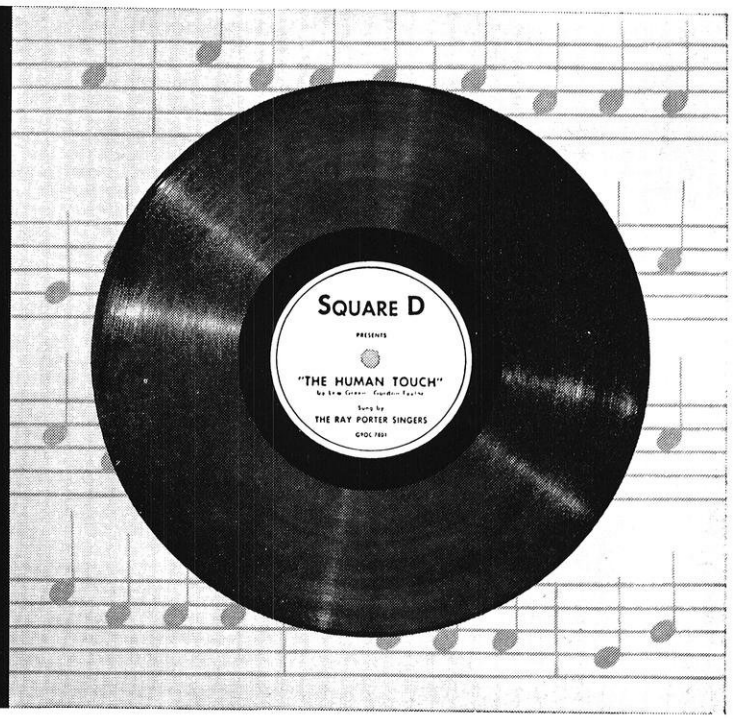
(Continued on page 46)

Question:

What makes a company a good place to work?

Answer:

Among other things, we think "the Human Touch" rates high...



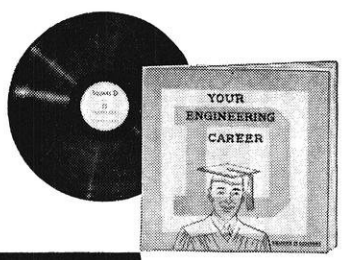
This record tells why—musically

— we'd like to send you a platter

There are a lot of things to consider in selecting the organization with which you will stake your future. For example, how is the company rated in its field? Is it known as a "quality" company? Is it growing? Is it aggressive? Is it big enough to offer you the opportunities you want? Is it too big—to the point where, of necessity, it deals with numbers instead of individuals?

...We think that last factor is mighty important. We call it the "*human touch*" element and it's pretty well explained, *musically*, in a theme song we had recorded for a recent national sales conference. The Ray Porter singers do some rather unusual vocalizing you'll probably enjoy. Clip the coupon and let us send you a record. It's good listening with a little food for thought thrown in.

mail this coupon for your "*Human Touch*" record



Square D Company, Dept. EM
6060 Rivard Street, Detroit 11, Michigan

I'd like a "*Human Touch*" record and a copy of Square D's brochure, "YOUR ENGINEERING CAREER"

I am primarily interested in ☐ Research, Design & Development Engineering ☐ Manufacturing Engineering ☐ Sales Application and Field Engineering

NAME_____

SCHOOL_____ CLASS_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

SQUARE D COMPANY

Campus News

(Continued from page 44)

Standard, Inc. The topic was "Cool Pilots and Hot Airplanes". The word "hot" was used in the literal sense. Unbelievably high temperatures are developed in airplanes and rockets because of air friction. This is especially true when they reach or exceed the speed of sound. The talk dealt with the problem of designing air conditioning units to maintain comfortable temperatures for the pilot inside the cockpit. Air conditioning is also required to cool the electrical and mechanical gadgets, to keep them functioning properly.

The speaker at the March 13 meeting was Mr. R. R. Robinson, Assistant Chief Engineer for the Caterpillar Tractor Company. His topic, "The Challenge to the Design Engineer", was an eye-opener to students who have previously dreaded entering the design field of engineering. The work of the design engineer, contrary to popular belief, means more than being chained to a drawing board. The designer will constantly be consulting experts in special fields, for assistance in solving problems connected with his particular design project. Thus, the ability to get along with people is an important requirement of the design engineer. This is only one of the many instances when the designer will have to do more than merely draw lines on a piece of paper.

Both meetings were very informative to the students attending. One of the hardest problems for the student engineer to solve is his choice of a particular engineering career. The talks by speakers from industry can be especially beneficial to beginning student engineers, to aid them in choosing a career after graduation.

The hectic activity has receded back to normal in ASME circles since April 5 and 6, when the Region 6 ASME Convention was held in Madison. The planning for the convention presented a real challenge to those involved. One of the main objects of the convention was to have a series of speech contests to obtain speakers for the ASME National Convention, which is to be held later in the spring. Students from ten mid-western universities participated, and some very interesting speeches resulted. Activities included a Friday luncheon and dinner and a Saturday luncheon, at which awards were made to all winners of the contest. At each dinner there was an interesting speaker, either from industry or from the University of Wisconsin. Also, several industries generously donated door prizes at each dinner. A special feature of the convention was a tour through the Gisholt Machine Company of Madison.

A discussion of the convention in more detail will be included in the next ASME report.

ALUMNI NEWS

Wesley J. Burmeister has been named chief maintenance engineer of the State Highway Department. Harold L. Plummer chairman of the Highway Commission announced Dec. 29, 1956. Mr. Burmeister was formerly assistant district engineer for the Highway Department, District One in Madison. He was transferred to Milwaukee in January of 1954 and has been district engineer for the Waukesha District. Mr. Burmeister graduated from the University of Wisconsin with a degree in civil engineering.

At the time of his transfer to the Waukesha District, Mr. Burmeister was president of the Southwest Chapter of W.S.P.E. at Madison. While a member of the Southwest Chapter, he was an active member serving on various committees including the capacity of program chairman and member of the board. He has been active in the Southeast Chapter while in Waukesha.

Walter H. Porth, '23, former director of A. O. Smith Corp., international division, has been appointed assistant to the president for international development. The Porths are living in Milwaukee.

The UW Board of Regents accepted the retirement of associate professor of mechanical engineering **Reed Rose,** '25.

C. J. Schmidt, '23, is executive vice president of the J. O. Ross Engineering Corporation of New York. He has been with the organization for 26 years.

J. J. Chyle, '24, Milwaukee, has been elected president of the American Welding Society. He is director of welding research of the A. O. Smith Corp.

Francis W. Swantz, '26, was recently elected chairman of the St. Louis section of the Institute of Radio Engineers.

Richard W. Leach, '28, Racine, is the new president of the Wisconsin Utilities Association. He is vice president and general manager of the Wisconsin Natural Gas Co., and vice president of the Wisconsin Electric Power Co. extension system.

Dr. George J. Mueller, '28, top authority on guided missiles, has accepted the position of chief engineer for the technical products division of the Packard–Bell Co.

Arnold W. Hartig, '31, a native of Reedsburg, has been appointed to the staff of R. S. Bright, Chrysler Corp. group vice-president of basic manufacturing.

All research activities in the industrial chemicals division of Olin Mathieson Chemical Corp. have been combined under the direction of **Dr. Bruno H. Wojcik,** '34, who has been named manager of research and development for the division. Dr. Wojcik joined the company in 1950 and is known for his work in the polymerization and high pressure hydrogenation fields. He holds a number of patents on the preparation of organic sulfides.

Col. Aldro Lingard, '38, has left his position as chief of the Wright Air Development center aeronautical research laboratory to attend the Air War college at Maxwell Air Force Base, Ala.

Ellis P. Hansen, '33, has been

(Continued on page 66)

"Take my advice...

"Before I left school I just didn't know where to look for a job in engineering that offered the greatest opportunity. First of all I wanted to make sure of getting into an industry that wasn't overcrowded... where I wouldn't be lost.

"Also, I wanted to hook up with a firm that had pioneered in its field, yet was young enough to go places and take me along with it. And, I wanted to be certain that salary would be right and there'd be a good chance of lasting security for my family.

"After looking around, I decided to get into the aircraft industry because of the bright future it offered. That's particularly true now with the development of supersonic aircraft and missiles. To my way of thinking there's no greater opportunity in engineering—anywhere!

"So take my advice... your best bet is in the aircraft industry where you can build a real career for yourself and have something worth-while to show for it the rest of your life."

In choosing an engineering career, there is particular satisfaction in being with a recognized leader. At Northrop Aircraft, you will be with a forefront company that for more than seventeen years has pioneered in the development of entire weapon systems, manned and pilotless aircraft, all of them distinctive contributions to our aerial supremacy.

Northrop ingenuity is continually applied on new and revolutionary programs. Significant advances are being made in the important field of boundary layer control. Northrop is also world pioneer in the development of the first operational inertial and celestial guidance systems. Other vital projects include Northrop's new supersonic jet trainer plane, the T-38, and the Snark SM-62, first intercontinental guided missile for the Strategic Air Command of the U.S.A.F.

At Northrop, your capabilities and accomplishments will be reviewed regularly for higher rating. On the financial side, you'll find the salary right, plus many company-paid benefits for extra security for yourself and family. And if you wish to continue your engineering studies, Northrop's cooperative educational program is available to you.

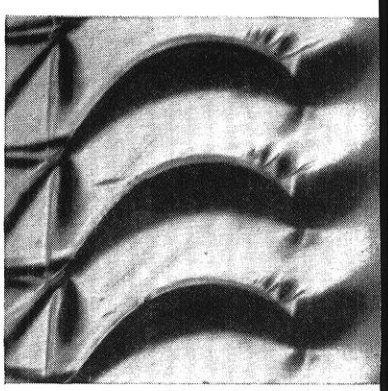
Northrop's great new air-conditioned engineering center at Hawthorne, California, offers the latest in scientific equipment and comfortable working conditions. There you'll be among top engineers and scientists with whom you'll be proud to work... brilliant men who will be ready and willing to help you.

Write now and ask us questions as they apply to your engineering objectives. Tell us your ambitions ...we believe we can relate them to opportunities at Northrop. Address Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., 1019 East Broadway, Hawthorne, California.

NORTHROP

NORTHROP AIRCRAFT, INC., HAWTHORNE, CALIFORNIA
Builders of the First Intercontinental Guided Missile

What's doing.



Schlieren photographs, above and left, illus
trate different phases of airflow investigatio
Development of inlets, compressors and tu
bines requires many such studies in cascad
test rigs, subsonic or supersonic wind tunnel

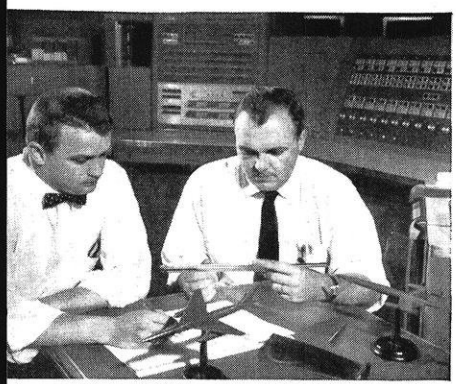
...at Pratt & Whitney Aircraft in the field of Aerodynamics

Although each successive chapter in the history of aircraft engines has assigned new and greater importance to the problems of aerodynamics, perhaps the most significant developments came with the dawn of the jet age. Today, aerodynamics is one of the primary factors influencing design and performance of an aircraft powerplant. It follows, then, that Pratt & Whitney Aircraft — world's foremost designer and builder of aircraft engines — is as active in the broad field of aerodynamics as any such company *could* be.

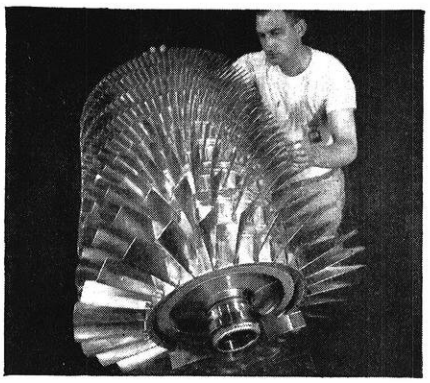
Although the work is demanding, by its very nature it offers virtually unlimited opportunity for the aerodynamicist at P & W A. He deals with airflow conditions in the engine inlet, compressor, burner, turbine and afterburner. From both the theoretical and applied viewpoints, he is engrossed in the problems of perfect, viscous and compressible flow. Problems concerning boundary layers, diffusion, transonic flow, shock waves, jet and wake phenomena, airfoil theory, flutter and stall propagation — all must be attacked through profound theoretical and detailed experimental processes. Adding further to the challenge and complexity of these assignments at P & W A is this fact: the engines developed must ultimately perform in varieties of aircraft ranging from supersonic fighters to intercontinental bombers and transports, functioning throughout a wide range of operational conditions for each type.

Moreover, since every aircraft is literally designed around a powerplant, the aerodynamicist must continually project his thinking in such a way as to anticipate the timely application of tomorrow's engines to tomorrow's airframes. At his service are one of industry's foremost computing laboratories and the finest experimental facilities.

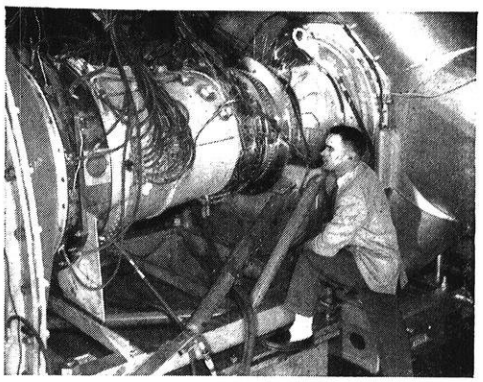
Aerodynamics, of course, is only one part of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program — with other far-reaching activities in the fields of instrumentation, combustion, materials problems and mechanical design — spells out a gratifying future for many of today's engineering students.



electronic computers accelerate both the analyd the solution of aerodynamic problems. Some of problems include studies of airplane performance permit evaluation of engine-to-airframe applications,



Design of a multi-stage, axial-flow compressor involves some of the most complex problems in the entire field of aerodynamics. The work of aerodynamicists ultimately determines those aspects of blade and total rotor design that are crucial.



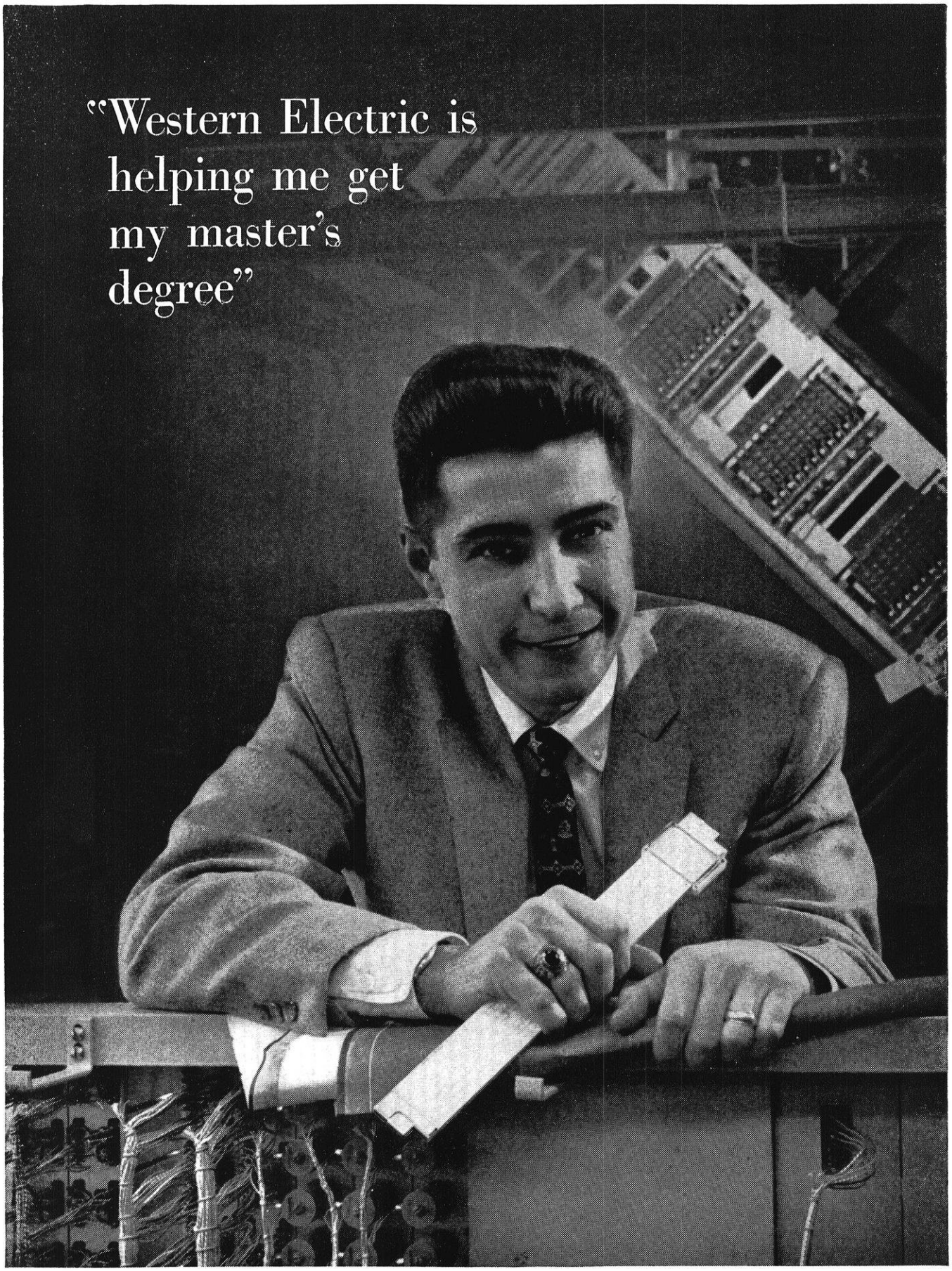
Mounting a compressor in a special high-altitude test chamber in P & W A's Willgoos Turbine Laboratory permits study of a variety of performance problems that may be encountered during later development stages.

World's foremost designer and builder of aircraft engines

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

EAST HARTFORD 8, CONNECTICUT



JOHN MORAN, who joined Western Electric's engineering staff at the Kearny Works recently, is now studying for his M.S.M.E. under the new Tuition Refund Plan. Western Electric expects to refund the tuition for John's graduate study at the Newark College of Engineering this year.

Western Electric's new TUITION REFUND PLAN can help you continue your studies while launching an exciting career

Under the new plan, Western Electric will refund tuition costs for after-hours study at graduate or undergraduate level, up to a maximum of $250 for each school year.

Say, for example, that you decide on a career at Western Electric in one of many rewarding phases of telephony—electronics, development engineering, design, manufacturing production, plant engineering, or some other. You may be eligible for financial assistance to help defray the cost of graduate or other study from the very first day. Choose engineering, science or any course that is appropriate to your job or that adds to your ability to accept greater responsibility, and the Company will refund to you up to $250 a year for tuition. (You'll note from the map on this page that Western Electric's work locations are well situated in terms of major population areas. That means that many of the nation's best schools are close by.)

Plus values, like the new Tuition Refund Plan, give Western Electric engineers many opportunities that others never have. There's specialized training both in the classroom and on the job . . . a formal program of advanced engineering study that includes full-time, off-job courses of up to 10 weeks' duration . . . a retirement and benefit program that's one of the best known and most liberal in industry . . . low-cost life insurance that would appeal to any man with his eye on the future. And of paramount importance is the chance to work alongside top men in the field of communications.

There's a good deal more for which there isn't space here. Why not write us or contact your placement office to schedule an interview when Bell System representatives visit your campus.

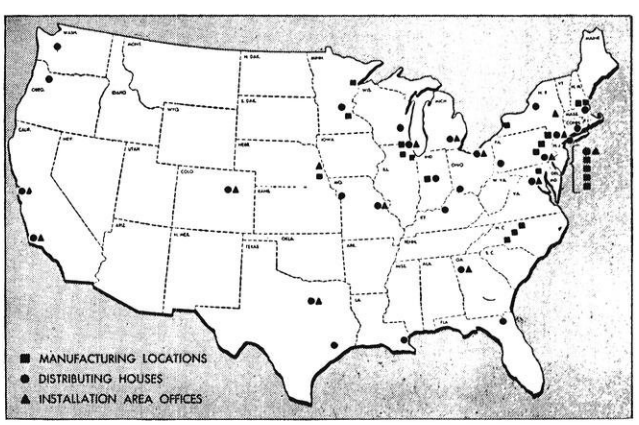
As one of us, you'd help engineer the manufacture, distribution or installation of the equipment needed for the nation-wide communications network of 49 million Bell telephones.

Here—where transistors were first developed for production; where repeaters for the new transatlantic telephone cable were tailor-made—there's a constant need for new products and new processes. Two-thirds of the equipment we make today for the Bell telephone companies is of types developed since World War II.

Besides telephone work, Western Electric—over the years – has been responsible for a continuous flow of defense jobs for the government such as the Nike guided missile system and the DEW Line.

There's plenty of room for advancement . . . whatever your field of specialization. So—whether you'd be helping with our telephone job, or working on a major defense project like guided missile systems—with Western Electric you can expect to grow!

For our College Tuition Refund Plan booklet and additional information about Western Electric write: College Relations, Room 1030, Western Electric Company, 195 Broadway, New York 7, N. Y.



Western Electric has major manufacturing plants located at Chicago, Ill., Kearny, N. J., Baltimore, Md., Indianapolis, Ind., Allentown, Pa., Winston-Salem, N. C., Buffalo, N. Y., North Andover, Mass. Distribution Centers in 30 cities. Installation headquarters in 16 cities. General headquarters: 195 Broadway, New York, N. Y. Also Teletype Corporation, Chicago 14, Illinois

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

W. S. P. E.

WISCONSIN SOCIETY OF PROFESSIONAL ENGINEERS

ENGINEERS' CREED

As a professional engineer, I dedicate my professional knowledge and skill to the advancement and betterment of human welfare.

I PLEDGE

To give the utmost of performance, to participate in none but honest enterprise, to live and work according to the laws of and the highest standards of professional conduct. To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations. In humility and with need for Divine Guidance, I make this pledge.

National Director's Report to Annual W.S.P.E. Meeting

Your National Society of Professional Engineers has continued to make significant progress during the last two and one-half years I have been familiar with its activities as your National Director. The following report will try to review some of the highlights of its activities and indicate the progress that has been made.

1. Budget. The budget for 1957 has been established at $430,000 established on the following income:

Dues income	$367,000
Advertising	48,000
Miscellaneous	15,000
Total income	$430,000

Budget requests together with administrative and operation costs resulted in a budget of $470,000—thus requiring a cutting of desirable projects. Some of the projects for which funds are not available are the—

Professional Engrs. Conference Board for Industry,
State Secretaries Conference,
Additional programs in the fields of Chapter Activities, Engineering Preparation, Employment Practices, Membership, Public Relations, and Young Engineers.

Any excess funds which will accrue during the year due to receipts beyond the estimated income will, of course, be applied to those projects of greatest need.

Contrast this year's budget with that of 1954 which amounted to $311,500—and the steady growth of NSPE activities is obvious.

2. Membership. The membership of NSPE has grown from 29,393 PE's and 3,293 EIT's for a total of 32,686 members in July, 1954 to 35,892 PE's and 3,697 EIT's for a total of 39,589 members as of December 31, 1956. While the PE members have increased by 6,500 during this period, the EIT members have only increased by 400. It is obvious that there is much to be done to attract the young registered engineer to NSPE—for therein lies the future of NSPE.

During this same period, according to NSPE records, Wisconsin has advanced from 9th place in State society membership to 8th place.

While Wisconsin has lost its membership contest with Michigan, who won first place in our division nationally, our successful efforts of the year before paid dividends. Wisconsin received a check in the amount of $916.20 for dues reimbursement from NSPE for membership gains. The dues reimbursement for 1956 will be small, but another good opportunity lies ahead for this year if we but turn on the heat in getting new members, keep dues paid up, and bring the delinquents back into the fold. This year, also, is the last opportunity to bring home the bacon as far as the dues refunds from NSPE are concerned.

Membership has always been, is now, and will continue to be a vital activity for our society.

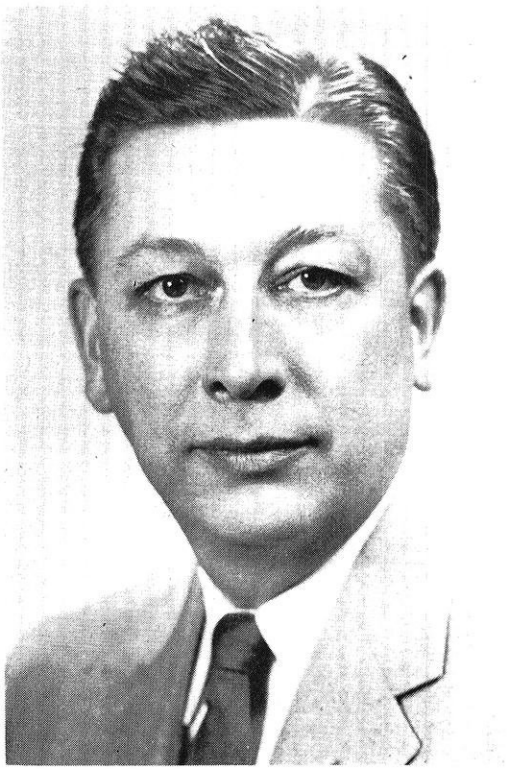
3. NSPE Headquarters Building. The NSPE headquarters building, dedicated in February of 1956, has been another significant step forward during this period.

The $440,000 financing for this building was subscribed entirely by the members of NSPE. Members of WSPE contributed to the initial solicitation and also met their quota established for the various state societies after the initial solicitation.

When in Washington, D. C., be sure to stop at 2029 K Street, N. W.

(Continued on page 54)

Meet the President



VIRGIL M. DUFECK
Northwest Chapter

Virgil M. Dufeck, President of the Northwest Chapter of W.S.P.E., was born in Denmark, Wisconsin on June 26, 1916. He received his B.S. in Electrical Engineering from the College of Electrical Engineering of the Milwaukee School of Engineering in 1937. From 1937 to 1942 he was employed by the Wisconsin Public Service Corporation in Manitowoc. His next three years were spent with the U. S. Navy Department at Manitowoc where he was employed as Electrical Engineer. From 1945 to 1948 he was employed by the Rural Electrification Administration as Field Engineer in the northern half of Wisconsin and the Michigan peninsula. Since 1948 he has been Manager of the Eau Claire Electric Cooperative at Eau Claire.

He was married to Virginia C. Meany of Manitowoc on November 13, 1943. They have a three year old daughter, Ann Gilbert.

Mr. Dufeck is a charter member of the Northwest Chapter of W.S.P.E. and served on various chapter committees. He was program chairman during 1954 and served as Vice-President of the chapter during 1955. Mr. Dufeck will complete an 18 month term as President of the chapter on June 30.

W.S.P.E.

(Continued from page 52)

to see your beautiful headquarters building. You will be cordially received by the staff.

4. Functional Sections. Another significant step forward has been taken by NSPE in the development of a functional section program within its framework. The first such section to be organized at the national level is that for consulting engineers, and it has been my privilege and pleasure to have had an active part in this development.

Four task forces of the section have been actively working on such items as:

a. Rules of organization and budget.
b. Fee schedule.
c. Ethics and practice.
d. Professional liability insurance.

The executive committee, itself, is busy planning the day long conference to be held in Dallas next June, 1957.

5. Registration. This period has also witnessed activity in the field of registration.

A book "Compendium of Registration Laws" by Senator McCauley of Missouri was successfully underwritten by the NSPE.

Another forward step consists of the "Ideal Law" proposed by NSPE which comes during the 50th anniversary of engineering registration in these United States. The first law was enacted by Wyoming in 1907.

"The fight for engineering recognition is so big and important that we can no longer take refuge in the fact that registration is not required in our present work" (end quote).

6. Interprofessional Relations. During this period, the NSPE interprofessional committee has been working in conjunction with a committee of A.I.A. on both contractual agreements and an Interprofessional Code of Practice.

The NSPE has approved both of these documents. A.I.A. has approved the contractual agreements with some minor changes, but has taken on action on the Interprofessional Code of Practice, as yet, although it had been approved and recommended by their committee.

7. Engineers' Week. The theme for the 1957 observance, February 17–23, is "Engineering – America's Great Resource". This was chosen on the basis of the fact that the country's real resources are not buried in the ground but are actually walking around 6 feet above ground—in the minds and attitudes of the people.

A total of 1,500 kits were prepared and sent to presidents and secretaries of all state societies and chapters.

In addition to the kits, individual letters were sent to 800 newspaper publishers and 500 industrial executives calling attention to the week and asking for their cooperation with local engineering groups.

WISCONSIN VALLEY CHAPTER

We have just concluded a most successful "Engineers Week" as far as the Wisconsin Valley Chapter, W.S.P.E. is concerned.

The first activity of the week was the signing of proclamations by mayors of our cities. Several such signings took place. Enclosed is a picture carried in the Wausau Record–Herald of the Wausau signing and an article on the Wisconsin Rapids signing.

The next event took place on Sunday night February 17, 1957 When WSAU–TV gave us the 9:00–9:30 P. M. spot to show "The American Engineer" to about 75,000 viewers in Central Wisconsin. TV station break slides were made up with the Engineer Week Symbol on them and these were used on the Wausau station along with quite a few spot announcements.

WSAU radio and WOSA–WLIN radio in Wausau and WDLB in Marshfield gave us several spot announcements throughout the week.

A very attractive Engineers' Week window display was set up in the main show window of the Wisconsin Public Service Corporation. This window ran all week and carried the mayor's proclamation, President Eisenhower's letter, a transit, rod, electrical instruments, drawing boards and drawing instruments, literature, etc. Snap shots of this display are available.

A very important part of the Engineers' Week here at Wausau was the February 21 dinner meeting of the Society Chapter at the Hotel Wausau. After dinner about 40 students from D. C. Everest and Wausau Senior High Schools met with us to view the American Engineer Film, and took part in a panel discussion on engineering. A period of questions and answers followed and refreshments were served to close the session. All who took part feel that it was a very worthwhile program that should be repeated next year.

Buttons were worn by engineers and some students. Stickers were used on mail during the week.

Material was furnished for bulletin boards in all of the high schools in the Wisconsin Valley cities and some of the schools arranged rather attractive displays making use of this material and newspaper engineers wanted sections.

FOX RIVER VALLEY

George P. Steinmetz, chairman of the Wisconsin Public Service Commission and "Wisconsin's Engineer of the Year", was featured speaker at Oshkosh on Wednesday, February 20, at a meeting of the Fox River Valley Chapter, Wisconsin Society of Professional Engineers. The occasion was a dinner meeting held at the Oshkosh American Legion Club in observance of National Engineers' Week.

Speaking on the engineers' week theme, "Engineering, America's Greatest Resource", Mr. Steinmetz stated that America's greatest resource was its people, particularly its young engineers and scientists. After recollecting some of the great scientific contributions and contributors of the past and present, he emphasized the need for an ade-

(Continued on page 56)

The Electronic Classroom–RCA adds a new world of sight and sound to the "3 R's"

Today's classroom is no longer bounded by books and blackboards. For our children, school is big as the world of sight and sound itself.

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Picture a civics class listening to a vital debate in the UN . . . a youngster improving his diction with the help of a tape recorder... kindergartners dancing to folk music of a faraway country... internes watching an operation close-up on closed-circuit TV. . . . The applications are endless.

Through its leadership in electronics, RCA contributes a great deal to the success of this new and broader kind of education. In fact, helping our oncoming generation to see, to hear... to understand... is one of the most important jobs we do. TMK(S) ®

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RCA offers careers in research, development, design and manufacturing for engineers with Bachelor or advanced degrees in E. E., M. E. or Physics. For full information, write: Mr. R. Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, N. J.

RADIO CORPORATION OF AMERICA
Electronics for Living

W.S.P.E.

(Continued from page 54)

quate corps of competent technologists to assure continued technological superiority for all freedom-loving peoples. He stressed the importance of young people with natural abilities and the need for enlightened parental encouragement and guidance of these potential technologists that they might successfully enter and pursue a career in either an engineering or scientific profession.

The National Society of Professional Engineers and each of its local affiliated chapters, one of which is the Fox River Valley Chapter, is dedicated to the protection and the promotion of the engineering profession as a social and economic influence vital to the affairs of men and of the United States. Founded in 1934, the national organization enrolls more than 36,000 professional engineers in all technical branches who are registered to practice engineering according to the laws of their states and territories.

LAKE SUPERIOR CHAPTER

The Lake Superior Chapter of the Wisconsin Society of Professional Engineers held its "Engineers' Week" meeting on February 18, 1957 at 6:30 P. M. in the Badger Room of Hotel Superior.

After a social hour and dinner, a very instructive and interesting film entitled "The Eighth Sea" was shown. This was a forty-five minute presentation, depicting outstanding features of the forthcoming St. Lawrence Seaway. As the building of the seaway is probably the outstanding engineering accomplishment of the present generation, it was appropriate to the celebration of "Engineers' Week"; a week which had been set aside to call attention to the importance of the Engineer in our present day life.

The film was presented by Mr. Mike Conroy through the courtesy of the Nagle-Hart Equipment Company of Eau Claire, Wisconsin.

NORTHWEST CHAPTER

The March meeting was held on March 6 in Eau Claire.

Guest speaker was Mr. Karl Roesser Structural Engineer for the Portland Cement Association. Mr. Roesser was born and educated in Germany, and maintained his private practice there before coming to the United States in 1950. He designed the Telefunken factories after the war, portions of the Maginot and Seigfried Lines, and the US Army 96th Quartermaster Dept.

Mr. Roesser showed films which presented in detail the latest techniques in the construction of prestressed concrete structures. According to Mr. Roesser, the labor/material ration had been such that prestressed structures were economical in Europe, but not in the United States until recently. New techniques permit economical use of prestressed concrete in this country when the girder in question is 40′ between supports or longer.

Mr. Roesser answered a great many detailed questions from the floor during the discussion period following his talk.

Reports were submitted by Professional Registration and Future Engineers of America Committees. Mr. George Young, Chairman of a temporary committee formed to study a group insurance plan for members in private practice, reported progress and set a meeting for interested members. Mr. Cooper, NW's representative on the Functional Group, WSPE, executive committee, reported on the Milwaukee and Madison meetings.

WAUKESHA COUNTY CHAPTER

Engineers' Week in the Waukesha Chapter area was celebrated in a number of different ways.

Waukesha radio station WAUX featured spot announcements throughout the week recorded by Chapter members Joe Kuranz, Don Bengs, Fritz Fosdal, Howard Wurst, and Richard Jahnke.

President Kuranz contacted various industries in and around Waukesha which hire engineers, and with their cooperation and that of the Waukesha newspaper put out a special Engineers' Week section which appeared on Friday, February 22. Featured were articles and pictures showing engineers in their work, "America's greatest resource". Much favorable comment has been heard regarding the section.

On Wednesday, February 20, the Chapter held a dinner meeting at the Avalon Hotel in Waukesha. Following dinner, a short business meeting was held and a film about a California vacation shown.

Highlight of the meeting was the presentation of a plaque to John Mielke of the firm of Reukert and Mielke, consulting engineers, as an outstanding engineer born and educated in Waukesha County and at a Wisconsin University and now practicing his profession in Waukesha County in an outstanding manner.

SOUTHWEST CHAPTER

John Gammell, director of graduate training at Allis-Chalmers Manufacturing Co., Milwaukee, was the speaker at the Engineers' Week banquet at the Memorial Union on the University campus. The program was sponsored by the southwest chapter, Wisconsin Society of Professional Engineers.

Among the guests were officers of student chapters of engineering groups.

Mr. Gammell has been with Allis-Chalmers since 1928 with the exception of three years during World War II when he was chief of the electrical equipment branch of the War Production Board. He talked on "The Professional Responsibilities of the Engineering Graduate."

IDEAL REGISTRATION LAW

RESOLUTION ON THE N. S. P. E. PROPOSED IDEAL REGISTRATION LAW

WHEREAS: Engineering registration laws, as enacted by various states, permit registration of cer-

(Continued on page 88)

Keeping water out in the rain

MASONRY WALLS made of brick, stone, or concrete have long stood the test of time. But today, they can be made even better with a coating of silicone water repellents. These amazing materials prevent damaging rainwater from entering the countless tiny pores or openings in masonry structures.

When the water freezes after penetrating, it can cause spalling—cracks off small pieces. And, if it seeps all the way through to the inside of a building, paint peels . . . woodwork warps . . . plaster stains and cracks.

Now, silicone water repellents provide the answer. Brushed or sprayed on the surface, they line—not seal—the pores in masonry. Even heavy rain driven by hurricane winds cannot break through this invisible raincoat . . . yet, because the pores are not sealed, moisture from within can evaporate freely.

The people of Union Carbide produce silicones for other uses, too . . . automobile and furniture polishes, lubricants, electrical insulation, and new rubber-like products . . . all of which help bring more and better things for all of us.

STUDENTS AND STUDENT ADVISERS: *Learn more about career opportunities with Union Carbide in* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Write for "Products and Processes" booklet C-2.*

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Collins Radio Company *Confidential Application for Technical Employment*

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STREET ADDRESS	CITY	STATE	PLACE

EMPLOYMENT RECORD

FROM MO.	FROM YR.	TO MO.	TO YR.	EMPLOYER'S NAME, BUSINESS, LOCATION	SALARY	POSITION AND NATURE OF DUTIES
PRESENT OR LAST EMPLOYER						
FORMER EMPLOYER						

STATE NATURE OF YOUR MOST RESPONSIBLE POSITION

EDUCATIONAL RECORD

COLLEGE OR UNIVERSITY	MAJOR	DEGREE	GRADE PT. AV.

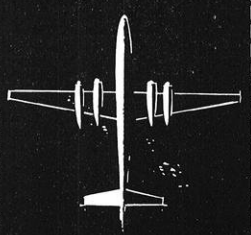
MILITARY SERVICE RECORD

BRANCH OF SERVICE	RANK OR RATING	ACTIVE SERVICE ENTRY DATE	DISCHARGE DATE

Signature _____

COLLINS in Aviation

Collins completely outfits airline, military and business aircraft with the most advanced communication, navigation, flight control and instrumentation systems in aviation. Many new lightweight, reduced-size versions are now being delivered. Collins designed the original Integrated Flight System, leads in combining comm/nav/ident units into a single compact "CNI" package for new military aircraft, and continues to pace the industry in developments in airborne radar, ADF, ILS, VOR, HF and VHF communication.



COLLINS in Ground Communication

Collins engineers, designs and supplies the equipment, installs, and puts into operation integrated point-to-point communication systems of any scope. The Collins system engineering staff is backed by the finest equipment in the world, whether standard MF, HF or VHF, Transhorizon "scatter," microwave relay and multiplex or single sideband HF. Typical of Collins communication progress is "Kineplex" — a high speed data transmission system doubling communication capacity.

Send your application to:

L. R. Nuss
Collins Radio Co.
Cedar Rapids,
Iowa

Fred Aiken
Collins Radio Co.
2700 W. Olive Ave.
Burbank, California

Harold McDaniel
Collins Radio Co.
1930 Hi-Line Drive
Dallas, Texas

as a Collins engineer?

You've got to be good to

✔Command highest salary

✔Advance rapidly in a strong, growing company

✔Work with highest caliber development groups

✔Use the world's finest engineering facilities

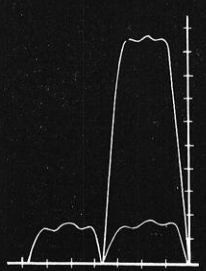
✔Maintain Collins creative reputation

Collins depends on its engineers. That's why you have to be good to earn a place on a Collins Research and Development team. Collins hard earned reputation was built on a solid foundation of engineering talent. The sales growth of the Company has justified Collins emphasis on engineering. Sales have increased 10 fold in the last 10 years. And employment of research and development personnel has more than kept pace. Collins growth will continue, and *you* can be a part of this growth.

Send the application form printed on the opposite page as an expression of your interest in knowing more about the opportunities at Collins. Your application will be held in the *strictest* confidence and will be answered immediately by a personal letter. Take only a few minutes now to fill out the application and mail to one of the addresses listed. This can be the turning point in your career.

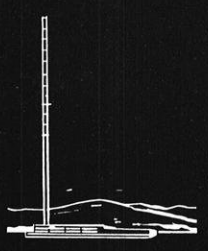
COLLINS in Amateur Radio

In the early 1930's Collins set the standard in Amateur radio and, through continuous design and development, has raised this standard to its present single sideband station — the most honored and prized in the Amateur fraternity. This station is the top performing rig on the air with its kilowatt KWS-1 transmitter and highly selective 75A-4 receiver. Many of the leaders in the electronics industry became acquainted with Collins through the Company's superior Amateur equipment.



COLLINS in Broadcast

Collins supplies a complete new AM station from mike to antenna or modernizes existing facilities. Besides the superior line of transmitters, Collins supplies the broadcaster's needs with such advanced additions as TV-STL microwave relay system, the lightest 4-channel remote amplifier on the market, phasing equipment and audio consoles. Collins field service organization has built an enviable reputation in assisting the broadcaster in installation or in times of emergency.



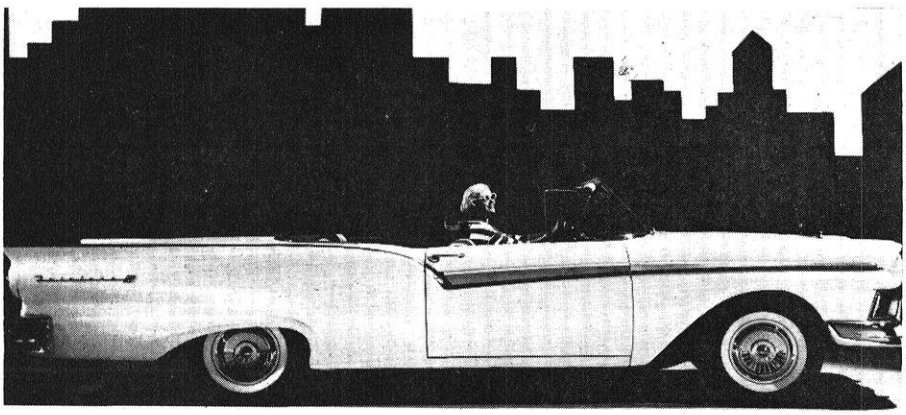
Collins CREATIVE LEADER IN ELECTRONICS

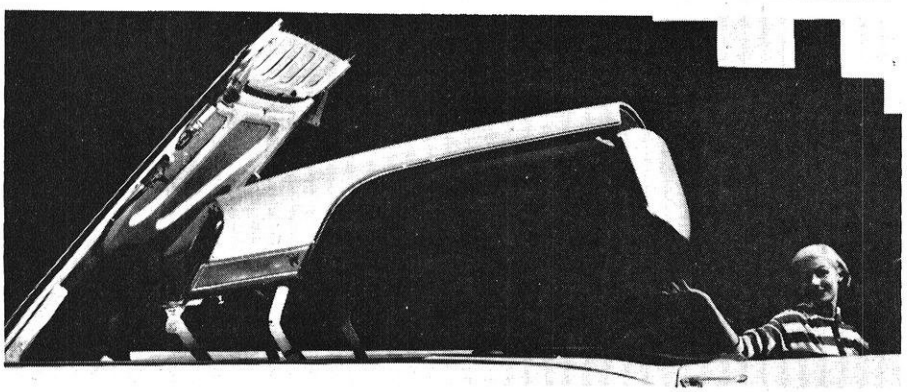
COLLINS

Collins Radio Company — Cedar Rapids • Dallas • Burbank

SCIENCE HIGHLIGHTS

by Ted Witzel e'57





All-weather traveling is a pleasure in the world's first fully automatic steel-top convertible, the Ford "Skyliner," which is making its eagerly-awaited appearance at Ford dealerships. Its suggested list price of $2702 is lower than 85 per cent of the conventional convertibles on the market today. The six-passenger Skyliner, heralded as the first really new car design in 40 years, sets a model trend for future automobiles. Originally engineered for higher priced cars, it was introduced as a Ford because only Ford could spread developmental costs over a larger number of units, making it commercially feasible.

OPERATING ATOMIC REACTOR TO BE ON DISPLAY IN PHILADELPHIA IN MARCH

Next March 11th to 15th, visitors to the International Atomic Exposition and 1957 Nuclear Congress will be able to walk around and inspect a critical nuclear reactor in actual operation in Philadelphia's Convention Hall.

Now in quantity production at Aerojet–General Nucleonics, the reactor has been approved by the Atomic Energy Commission as completely safe for public exhibition without special shielding.

Developing a normal output of 100 milliwatts with a peak of 3 watts, the reactor, which includes a remote control console, is designed for use in hospitals, educational institutions and industry for production of radio-active isotopes. All shielding required has been

built into the reactor so that it is completely self-contained.

The reactor is about 9½ feet high and looks a bit like a giant upside-down milk-can. Weight is 22,000 lbs. The enriched U-235 uranium is in the form of a powder dispersed in solid polyethylene plastic.

This will be the first time that an actual "critical" reactor has been on public exhibit except for the U. S. reactor in Geneva, Switzerland. At the previous International Atomic Exposition in Cleveland a pickle-barrel type of reactor was on display but that unit was non-critical and thus unable to maintain fission without the presence of a separate neutron producing source.

The Aerojet reactor, except for size, is similar in principle to some of the giant power-producing installations planned in various parts of the U. S. and abroad. Its 6½ lbs. of fuel is estimated to have a useful life of around 300 years.

QUARTZ INFRARED LAMP HAILED FOR VERSATILITY

In two and one half years, the smallest, hottest electrical heat source on the market—the General Electric tubular quartz infrared lamp—has developed almost unbelievable versatility.

This lamp is three-eighths of an inch in diameter and comes in lighted lengths of 5, 10, 16, 25, 38 and 50 inches at 100 watts per inch! And its applications, according to the manufacturer, are legion.

It is used for cooking and food warming—from a hamburger to a roast—but it is also used by railroads and machine shops for shrink-fitting pinions and bearings.

It is used by thousands of secretaries—although they may not know it—in office copying machines.

It touches the lives of millions of people because it is used in the printing industry to set ink in high-speed presses. In the textile industry, this radiant energy source—with other drying facilities—speeds up and improves textile processing.

It is used to produce supersonic wing-surface temperatures for the aircraft industry in a developmental quartz infrared oven with adjustable segments to fit aerodynamic contours. In this application, special 1000-watt quartz lamps, designed for intermittent burning only, are mounted in a closely meshed two-layer grid and operated to produce a total energy concentration of more than 150,000 watts per square foot.

It bakes lacquers, enamels and varnishes in a fraction of the time required by other baking processes.

In drying processes – where liquids must be evaporated – the quartz infrared lamp is replacing gas and oil ovens, electric heaters, and even blowtorches.

Some of the reasons for this expanding and diversified use of quartz infrared lamps are:

1. Quicker heat—Infrared lamps warm up almost instantly. Their energy creates immediate heat when it reaches a product that can absorb it. Even more important in many processes, the time has been reduced from hours to minutes.

2. Efficient operation – Old-type ovens burned fuel that heated the air which in turn heated the product. Direct infrared heating is more efficient.

3. Uniformity—The compactness and simplicity of the quartz infrared lamps permit ready installations providing uniform, constant energy.

4. Cost—Infrared systems are economical to install, simple in construction, and are made largely of standard parts. Maintenance is easy and inexpensive, operating cost is low. No power is used when the unit is not in use. Expensive controls are not needed.

5. Space—Infrared ovens require substantially less space than other types.

6. Comfort and safety—Employees work in a comfortable temperature because infrared adds little heat to the air. Hazards are minimized because the source of heat is enclosed in the bulb.

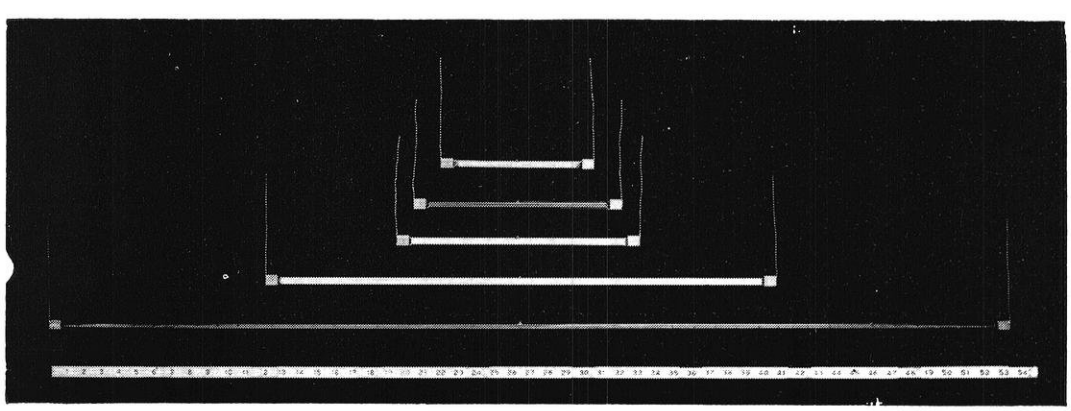
The amazing versatility of the quartz infrared lamp, according to G-E engineers, is due to its small size, high operating temperature, and ability to withstand the shock of violent temperature change.

The tube is made of fused translucent quartz which has high mechanical strength, low coefficient of expansion, high melting point, superior insulating properties, and resistance to acid and thermal shock. Even when the tube is heated to a cherry red, it almost never cracks when subjected to such extreme abuse as being doused with water or touched with a piece of ice.

The lamp is designed to last more than 5000 hours.

SKIS RESIST ARCTIC FREEZE-DOWN

The effect of a thin plastic film, fastened to the bottoms of the largest aircraft skis ever made, is being examined closely by Lockheed Air-



Various lengths in which infrared quartz lamps are available.

craft in tests of its C-130 polar troop carrier.

The C-130 skis, resembling miniature landing craft, are covered with a skin of "Teflon" tetrafluoroethylene resin, a Du Pont plastic with a surface so slick virtually nothing will stick to it.

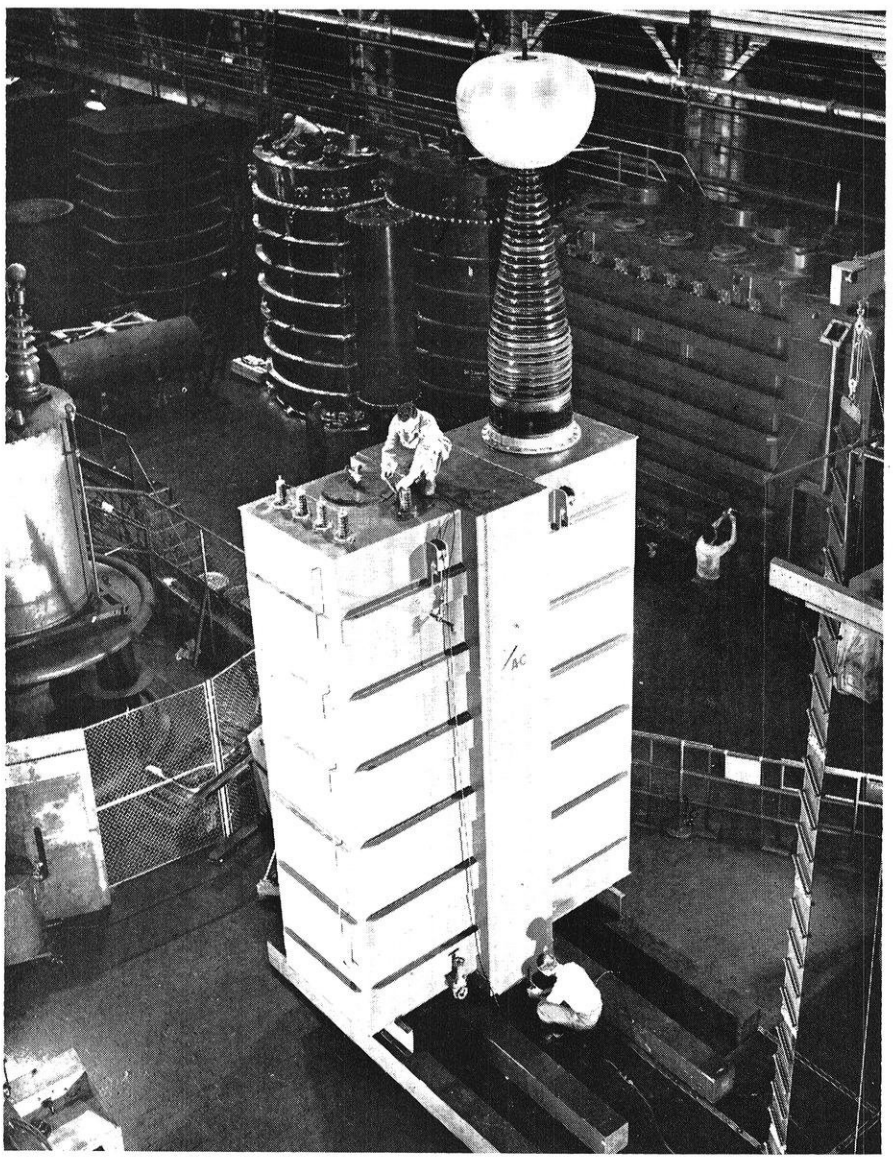
The underside of "Teflon" reduces the friction of bare metal on snow by 50 per cent and resists the adhesion of ice, a factor which can immobilize the most powerful aircraft by causing the skis to freeze fast.

At Bemidji, Minn., the unique undercarriage is being tested for its ability to pillow the 62-ton, four-engined craft over a variety of snow conditions ranging from deep, soft slush to hard, weathered ice.

To meet these rugged requirements, engineers designed a three-part undercarriage. The main load is distributed between two main skis approximately 19 feet long and five feet wide. The nose ski, used to steer the plane on the ground, is approximately nine feet long and five feet wide.

In covering the skis, sheets of "Teflon" three thirty-seconds of an inch thick were treated on one side in a sodium-ammonia bath to produce a cemetable surface. After bonding the skin to the ski with an epoxy resin adhesive, runners were mounted on the outer surface with mechanical fasteners. More than 190 pounds of "Teflon" are used to cover the C-130 undercarriage.

In spite of their size, the three skis are completely retractable. For landings on concrete runways, the skis may be replaced with wheels by the flick of a small control switch.



Experienced gained in building and successfully testing this 600,000-volt, single-phase power transformer was put to use by Allis-Chalmers in constructing six 345-kv, 200,000-kva auto transformers, among the largest single-phase transformers in the United States.

CLEAN HEAT

Atomic Heating of Buildings Developed

Within a few decades, factories, office buildings and other large structures may be heated atomically "without a speck of soot, an ounce of ash or a cubic foot of smog," a General Electric Company engineer predicts.

S. L. Nelson, manager of one of the processing operations at the Hanford atomic plant, says that successful use of reactor waste heat for Hanford buildings has shown that dirt-free atomic heating is technically feasible.

He pointed out, however, that success of his predictions depends on making atomic fuel available for heating purposes, design of a reactor specifically for low-energy heat production and over-all reductions in costs of building and operating reactors.

"Atomic technology is fully capable of producing a long-life, low powered safe reactor, suitable for space heating," he stated. "Although not enough work has been done on the economic aspects of atomic space heating to make any evaluation, a preliminary glance indicates that for some applications it would be attractive even now."

He said that the Atomic Energy Commission already has laid the ground work for standardization and control of such systems, but that "the remaining problem is fuel." He said that fuel now is channeled into "more urgent projects."

He said that the Hanford heating system works this way.

Water from the Columbia River is pumped through Hanford reactors used in producing plutonium.

This water cools the reactor and picks up immense amounts of heat, along with a slight amount of radioactivity.

The reactor cooling water then is pumped to an outside heat exchanger, where it gives up its heat to an ethylene glycol water solution. The ethylene glycol solution is circulated to air conditioning systems in reactor buildings, operations buildings, administrative offices and maintenance shops.

Ethylene glycol is used to prevent freezing in outside air conditioner coils during sub-freezing weather.

Safety of the system is assured by maintenance of higher pressure in the secondary ethylene glycol system than in the reactor coolant water. If a leak should develop, the flow would be from the non-radioactive fluid into the radioactive fluid, thus preventing radioactive water from getting into the heating system.

Nelson said that the Hanford installation has shown itself to be "remarkably sound and trouble-free system."

"Although development projects often operate at a loss," he stated, "this system will make a profit, saving the taxpayers a net of about $60,000 a year after a three to seven-year amortization."

Enough heat is recovered in the system to heat more than 1,000 average-size houses during the winter season, he added.

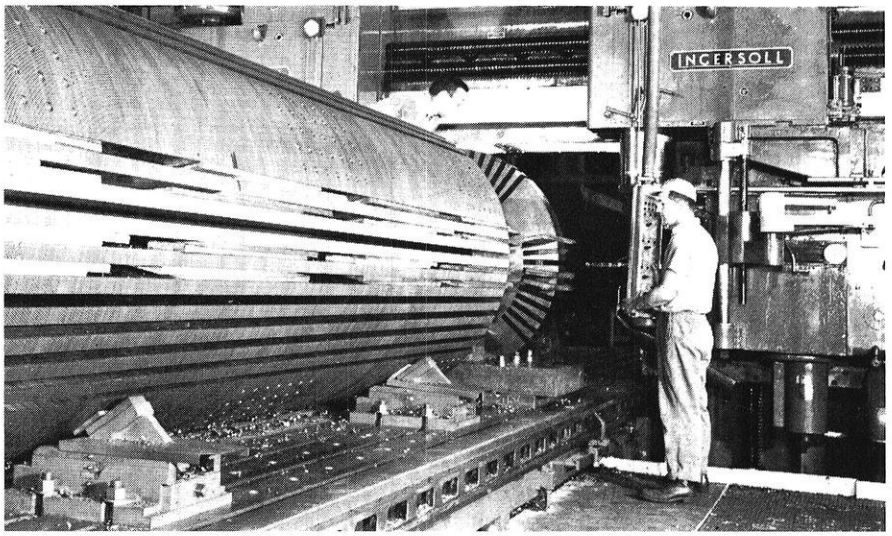
SAFE SOLVENTS

New Solvent Solves Industrial Cleaning Problems

Nonflammable solvents that will bite into and remove oil, grease, and dirt without harming delicate metal parts or electrical insulation, yet are safe enough to use in ordinary work areas with conventional ventilating equipment, are now available to solve a wide range of special industrial cleaning problems.

Adaptable to vapor degreasing or cleaning by liquid immersion, the solvents will be marketed by

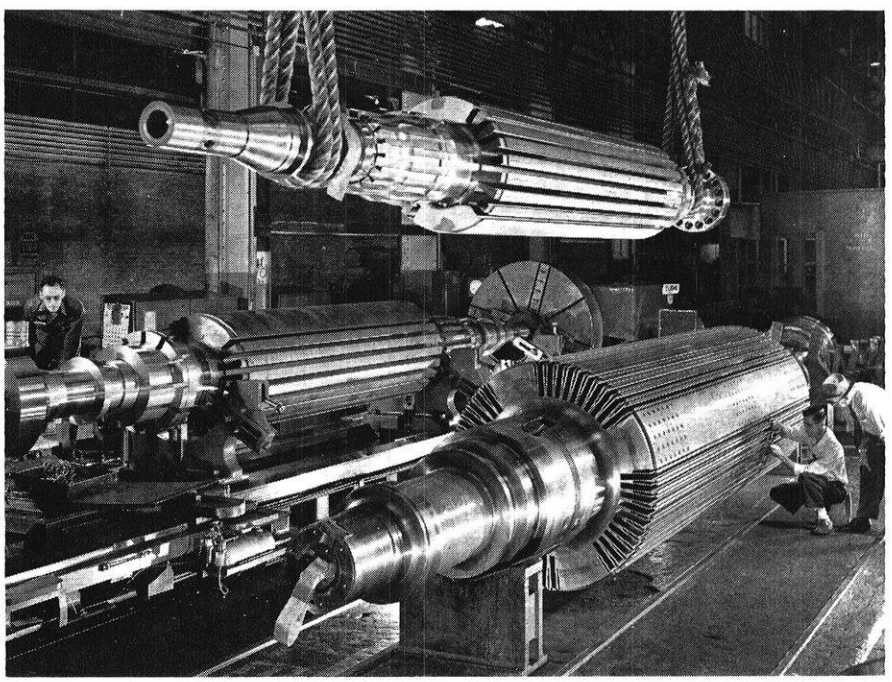
(Continued on page 83)



This rotor for one of two generators in a 300,000-kw steam turbine-generator unit being built for the River Rouge plant of the Detroit Edison Company is being machined at Allis-Chalmers West Allis Works on the largest special design adjustable rail milling machine in the country.

This machine has four 75-hp heads, a maximum overall width of 28 ft., maximum height above floor line of 18 ft., 6 inches, and maximum overall length of 102 ft. The table is 84 inches wide, 56 ft. long and has a carrying capacity of 175 tons.

The machine can be used as a conventional four-head planer type milling machine as well as for special rotor slotting work. It is equipped with a split table arrangement permitting set-up on one portion of the table while the other part is in use. It is fixtured with an index mechanism that operates on the air electric principle.

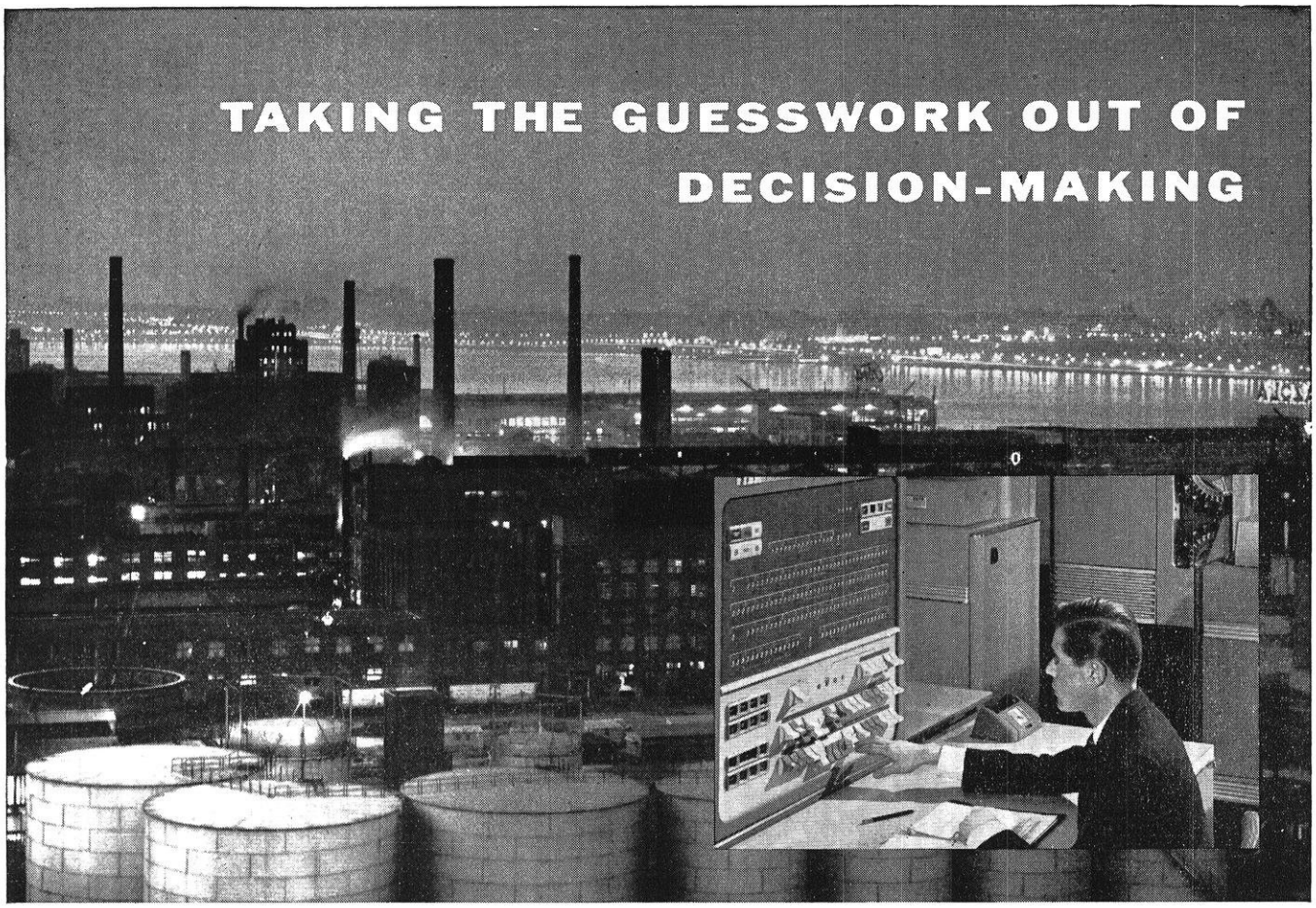


The 76-ton, 4-pole, 1800-rpm rotor (on blocks) and its 35-ton, 2-pole, 3600-rpm partner suspended from a crane are for the world's first 300,000-kilowatt steam turbine-generator unit. This is a 3600/1800-rpm close-coupled, cross-compound unit which Allis-Chalmers is building for The Detroit Edison Company.

Another 3600-rpm rotor is being machined in the lathe. It is for single-shaft, 150,000-kilowatt unit being built for an Indiana utility. Both 3600-rpm rotors are for fully-supercharged, conductor-cooled generators.

In fully-supercharged machines, cool hydrogen gas is pressurized by supercharger-type blowers and driven at high velocity in direct contact with rotor conductor surfaces and through stainless steel tubes inside the stator coils. This cooling method removes heat from these parts so effectively that large capacity generators now require no more space than formerly occupied by conventionally hydrogen-cooled generators of much smaller capacity. Supercharging makes possible turbine-generators of far greater capacity than heretofore without proportionate increase in physical size.

TAKING THE GUESSWORK OUT OF DECISION-MAKING



Have you heard about *linear programming?* It's a new tool of Management Science—a mathematical technique devised to help management make decisions more quickly and accurately than ever before.

Suppose, for example, you are a manager faced with a veritable jungle of figures—schedules, machine loads, cost inventories. A decision based on these must be made. Once you would have had to be satisfied with an educated "guesstimate," or perhaps recourse to trial and error. But now, with linear programming and electronic computation, you can get not merely "an" answer, but the *best possible answer*—and get it fast.

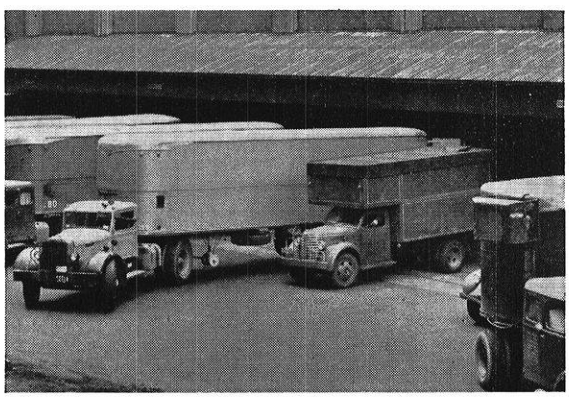
The computer's the key

Key to the success of linear programming is an electronic computer—IBM's 704. Its tremendous calculating speed and data capacity solve complex management problems *often in a matter of minutes.*

If you are preparing for an engineering career, or are majoring in math or physics, perhaps you would enjoy helping IBM create electronic computers such as the 704. The potential of this phase of electronics presents one of the brightest chances today for a rewarding career. Why not ask your Placement Director for a copy of IBM's brochure? Or write direct to our Manager of Engineering Recruitment:

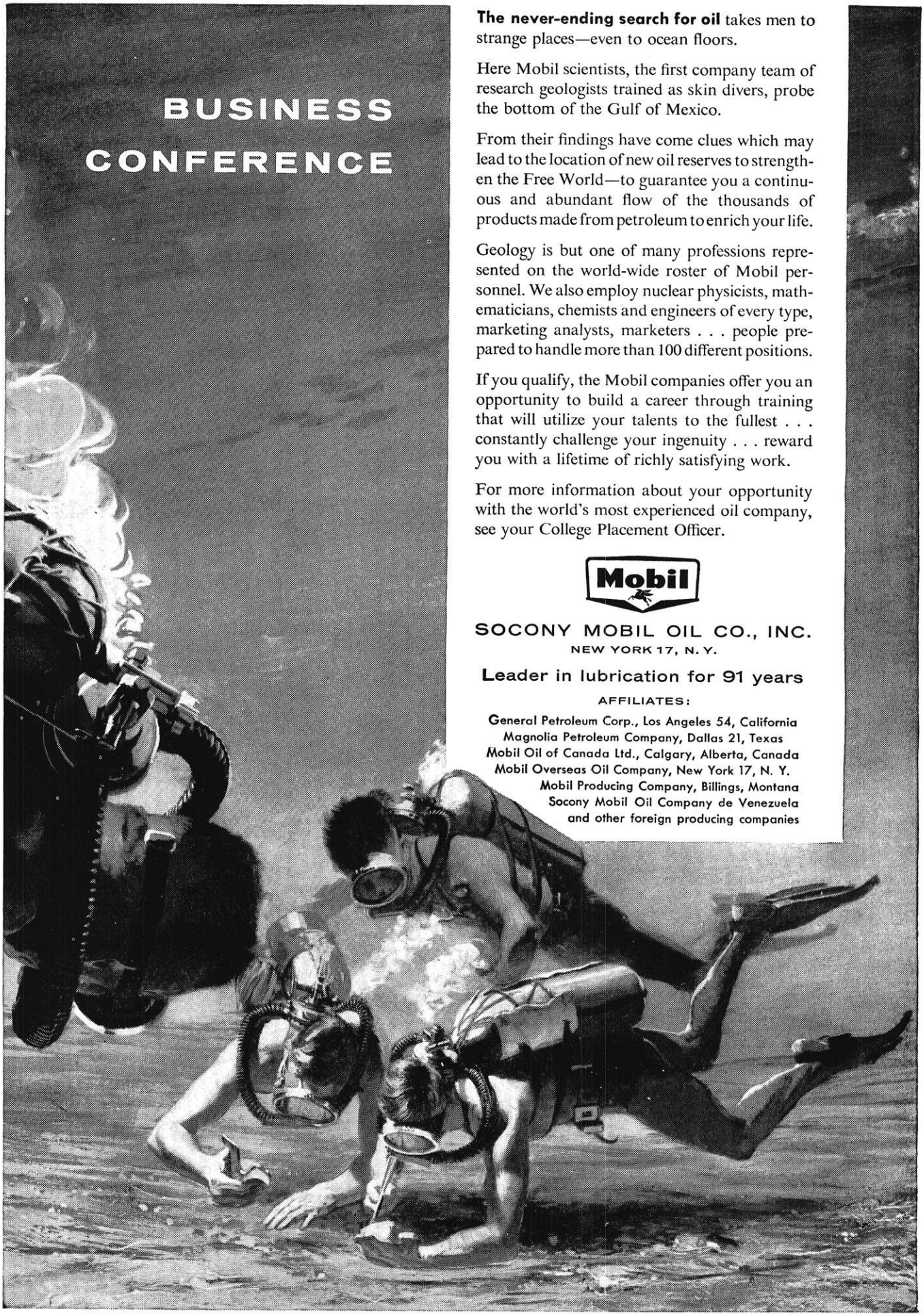
R. A. Whitehorne, Room 3304,
International Business Machines Corporation
590 Madison Avenue, New York 22, N.Y.

IBM INTERNATIONAL BUSINESS MACHINES CORPORATION



Transportation costs cut: Shippers use linear programming and the IBM 704 to map most economical routes. One reports a 50% yearly cost reduction.

More profit per plant: Manufacturers use electronic computation to determine which combination of machines and products means minimized costs, maximized profits.



The never-ending search for oil takes men to strange places—even to ocean floors.

Here Mobil scientists, the first company team of research geologists trained as skin divers, probe the bottom of the Gulf of Mexico.

From their findings have come clues which may lead to the location of new oil reserves to strengthen the Free World—to guarantee you a continuous and abundant flow of the thousands of products made from petroleum to enrich your life.

Geology is but one of many professions represented on the world-wide roster of Mobil personnel. We also employ nuclear physicists, mathematicians, chemists and engineers of every type, marketing analysts, marketers . . . people prepared to handle more than 100 different positions.

If you qualify, the Mobil companies offer you an opportunity to build a career through training that will utilize your talents to the fullest . . . constantly challenge your ingenuity . . . reward you with a lifetime of richly satisfying work.

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and other foreign producing companies

Alumni

(Continued from page 46)

named engineer-in-charge of mechanical design in the Allis–Chalmers steam turbine department. **Clifford Holmes,** '41, is the new engineer-in-charge of steam design, same department.

Lt. Col. Fred F. Seifert, '34, has moved from Redlands, Calif., to Arlington, Virginia.

John E. Brennan, '34, has been appointed a vice president and group executive of Chrysler Corp. to take charge of the 19-plant stamping and general manufacturing group.

Dr. Ernest Krause, '34, president of the Systems Research Corporation, Van Nuys, Calif., has been awarded the Navy's highest civilian award, the Distinguished Civilian Service Award, for his "pioneering efforts in the field of rockets and upper atmosphere research, achievements in the nuclear weapons program, and administrative and organizational capabilities." He is former associate director of research for nucleonics at the Naval Research Laboratory, Washington, District of Columbia.

Dr. Walter F. Grether, '34, has been named chief of operations at the Wright Air Development Center's Aero Medical Laboratory, Wright–Patterson Air Force Base, Ohio.

William S. Kinne, Jr., '34, professor of architecture at the University of Illinois since 1949, has been appointed director of architecture planning of the Kawneer Co., Niles Mich., a major fabricator of aluminum for the architectural, aircraft, and appliance industries.

New general manager of General Electric's low voltage switchgear department in Philadelphia, **Frank E. Stehlik,** '34.

Dr. Donald L. Benedict, '43, director of physical sciences research at Stanford Research Institute, has announced the formation of a department of metallurgy under the division he heads.

James R. Felix, '44, Westfield, N. J., has been named an assistant section head of the correlation section in the process research division of the Esso Research and Engineering Co., Linden, N. J.

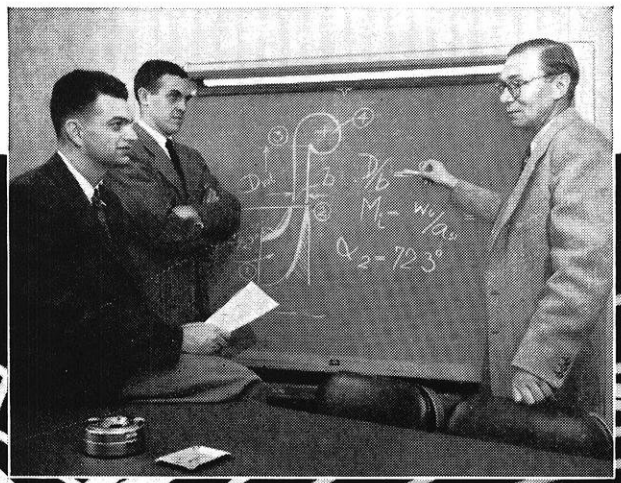
Former research engineer with the Sinclair Research Laboratories, Harvey, Ill., **Warren E. Stewart,** '45, returned to the campus in September to teach chemical engineering. Also new on the College of Engineering faculty is **Jean Van Bladel,** '49, who instructs courses in electrical engineering. An engineer with the Gisholt Machine Co., Madison, **Robert R. Zenk,** '47, is teaching part-time in machine design in mechanical engineering.

A Madison engineer, **Robert William Fleming,** '46, has joined the Bettis Plant, atomic power research laboratory which Westinghouse Electric Corp. operates in Pittsburgh for the Atomic Energy commission. He and his family are living in Pleasant Hills, Pa.

Monsanto Chemical Company's inorganic chemicals division has added to its sales department **John C. Docter,** '47, Lebanon, Ind.

THE END

To the engineer who intends to blaze *new* trails...



Six inch long compressor-turbine assembly in a midget AiResearch air expansion refrigeration unit which operates at 100,000 r.p.m., can drop temperature more than 600° F. in a second.

Great engineering advances are now taking place in America, and The Garrett Corporation is playing a vital part in making them possible.

Reason for our important role is the forward looking approach of our engineers, who develop new solutions for industry as needed. If stimulating assignments and recognition for achievement is what you're looking for, you'll enjoy working with us. And if you like pleasant living, too, our plants are located in the most desirable areas in America. Also, financial assistance and encouragement will help you continue your education in the graduate schools of fine neighboring universities.

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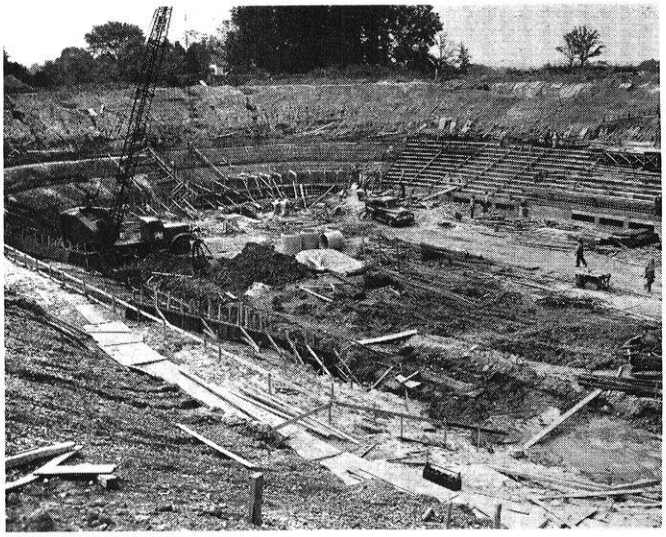

Here is another photo taken during construction of the Student Activity Building on the University of Maryland campus.

Radiant Heating

(Continued from page 31)

ally does the heating. If only relatively low temperatures are required, hot air can be used with radiant heating.

When selecting a boiler for the radiant heating plant, the local conditions would determine what type of fuel would be the most economical. Oil, coal, or gas fuel for heat in a radiant heating system would have the same advantages and disadvantages if the heating system were of the conventional type.

One of the major factors to be considered in the radiant heating plant is the location of the tubes or pipes. As mentioned before, there are only three types of construction. The tubes must be placed either in the floor, walls, or ceiling.

If the tubes are installed in the floor of a building, preventative methods must be taken so that a large percentage of the heat is not radiated down into the ground. This might be desirable if there were a space below the heated floor that required heat. But, if this were not the case, steps must be taken to prevent this loss. There are several types of insulators that are available that could be placed below the coils, to prevent the heat from being radiated down. Also there are reflectors available, that would reflect the radiant heat back up through the floor with little loss.

Coils placed in the walls, present the same problem as those that are placed in the floor. The heat would have a tendency to radiate outside where it would be a complete loss. The methods employed to prevent this loss are the same as those employed to prevent heat loss in the floor installation of radiant heating tubes. A difficulty encountered with wall tubes, would be the obstructions in the wall itself. Doors and windows would have to be bypassed.

The ceiling installation of coils has one large advantage over the other methods mentioned. The heat that escapes through the top of the ceiling will actually be heating the room above. In this connection, a ceiling installation could be considered either a floor installation or a ceiling installation for radiant heating. If it were undesirable to heat the area above the ceiling, the radiant heat loss in the upward direction could be reduced by adequate insulation, as in the floor or wall installation. Ceiling installation is more efficient than floor installation if a thick rug or carpet is on the floor of a building.

When installing the coils, they may be embedded in either concrete or plaster or placed in their proper position without being embedded. If it ever became necessary to remove the coils, it would be impossible for those that were embedded in the concrete or plaster. This problem does not arise often because the tubes are made of a non-corrosive material, and there never would be an occasion to remove corroded piping.

Greater care must be employed in planning radiant heating systems designed with buried tubing than with conventional systems for the obvious reason that after installation it is not possible to make major changes. With conventional systems, it is a relatively simple matter to increase the size of a radiator.

With a radiant system in which the pipes or tubing are buried in the floor or ceiling, it is obvious that few changes can be made, as far as mechanical additions to the systems are concerned; but owing to the fact that the ordinary operating temperature is quite moderate, the output of the radiant system can be increased to some extent, if necessary, by either slightly increasing the water temperature or increasing the rate of flow of the circulating water.

In designing a radiant heating system, the flow of heat through the floors, walls, or ceilings must be considered. This will be illustrated by the following example.

Consider a metallic tube 1 inch in diameter buried in the center of a concrete slab 7 inches thick. Obviously there will be 3 inches of concrete slab above and below the pipe. Assume further, that this slab is horizontal in an enclosed space with an air temperature approximating 65° F., with no air currents, and then assume that water having a temperature of 140° F. starts to flow through the tube. Also assume that the temperature of the slab was at room temperature throughout its volume.

The first effect of the increase in temperature of the pipe due to the circulating water will be the increase in temperature of the concrete directly surrounding the pipe due to the relatively high heat conductivity of metal as compared with concrete. The temperature on the inside of the tube and outside of the tube will be approximately equal and also equal to the temperature of the water circulated; however, with the passage of time, the temperature of the concrete surrounding the tube will gradually increase until, at points on the surface of the slab nearest the pipe the surface temperature of the slab will begin to increase and, up

(Continued on page 72)

CAREERS WITH BECHTEL

PORTER THOMPSON, *Assistant Chief Engineer, Refinery Division*

MECHANICAL ENGINEERING

One of a series of interviews in which Bechtel Corporation executives discuss career opportunities for college men.

QUESTION: *Mr. Thompson, some engineering graduates seem to believe their first jobs might include little more than filing papers. Would that be true at Bechtel?*

THOMPSON: It would not. When the young man joins the Refinery Division, if he is a structural engineer he starts immediately to do structural design work, under proper supervision. An electrical engineer would join our electrical group, working on electrical systems for refineries, doing some design work, taking off materials and working on instrumentation.

QUESTION: *What about mechanical engineers?*

THOMPSON: Mechanical and chemical engineers may either go right into the process department, where they would do calculations, or into the project group where they would do routine designing and write specifications for pumps, exchangers, vessels, piping, instrumentation, insulation, etc.

QUESTION: *There's certainly no sign of "paper shuffling," is there?*

THOMPSON: No. The training period is interesting right from the start. After a few months, we like to send the young engineer out into the field so he can see the end result of what he has been doing.

QUESTION: *What has been your experience as to the length of time required to train a man?*

THOMPSON: That will vary according to the man, so it's impossible to generalize. The young man will have some responsibility right from the start, but it may well be a matter of several years before he can actually take full responsibility for running a job.

QUESTION: *Assuming he handles his first assignments satisfactorily, what would be his first major step upward?*

THOMPSON: After from 6 to 9 months his first responsible assignment might be on a project in connection with handling pumps. On his next project assignment he might have the responsibility for handling pumps and exchangers. He would likely be assigned some other responsibility on each succeeding project. In that way he would get a good grasp of all types of work and eventually be capable of taking overall charge of a project.

QUESTION: *Suppose he is in the structural phase; would there be any difference in his "basic training"?*

THOMPSON: No. He would still have to serve his apprenticeship, moving gradually into more and more complex design work as he gains, a little at a time, the knowledge and experience which qualify him to handle the overall job.

Bechtel Corporation (and its Bechtel foreign subsidiaries) designs, engineers and constructs petroleum refineries, petrochemical and chemical plants; thermal, hydro and nuclear electric generating plants; pipelines for oil and natural gas transmission. Its large and diversified engineering organization offers opportunities for careers in many branches and specialties of engineering —Mechanical...Electrical...Structural ...Chemical...Hydraulic.

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Vice President, Industrial Relations
220 Bush Street, San Francisco 4, Calif.

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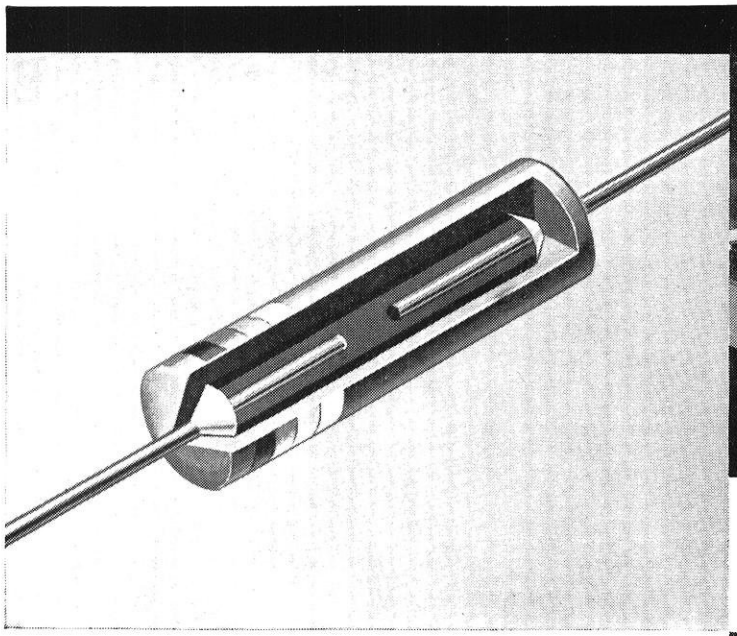
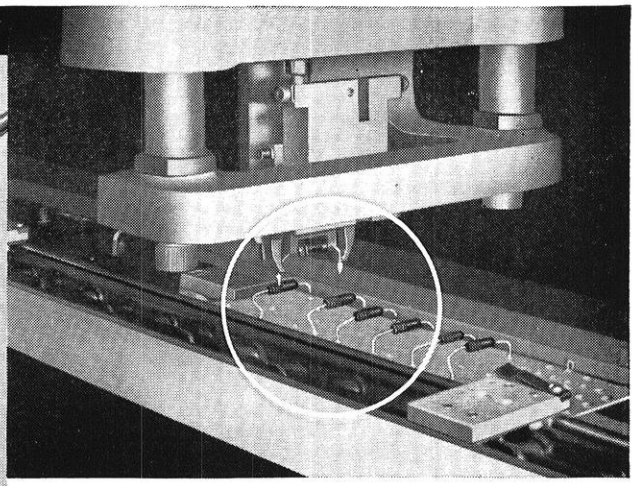
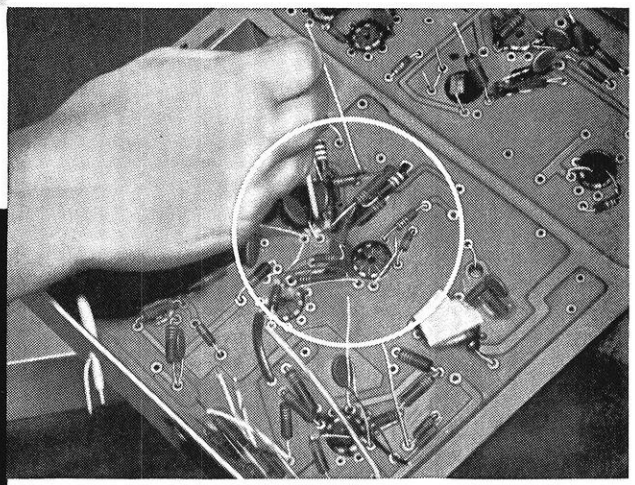


IRC Type BT Resistor leads withstand 5 pounds pull even before resistor is molded. After molding, crimped collar provides a tooth-and-notch effect for still greater strength.



Unique method of anchoring IRC leads keeps them from being twisted or pulled out in automatic bending and inserting operations.



New alloy surface on leads assures superior solderability by any method and under various temperature conditions.

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401 N. Broad St., Philadelphia 8, Pa.

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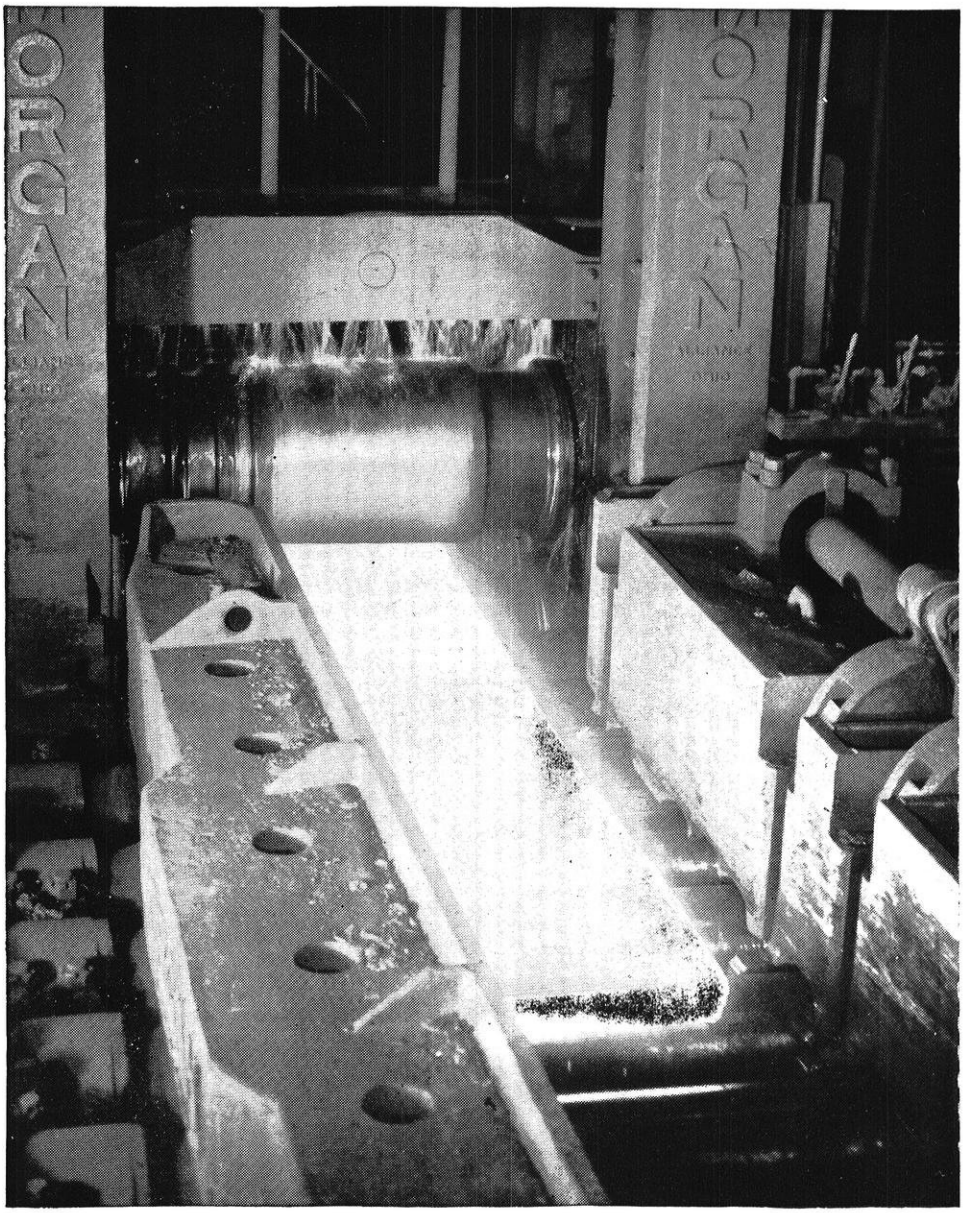
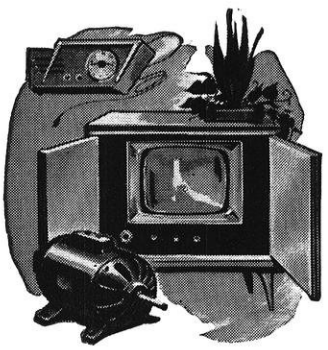
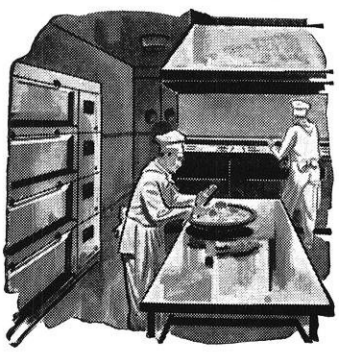
Wherever the Circuit Says — IRC®





SPECIAL ELECTRICAL ALLOYS
and MAGNETIC MATERIALS



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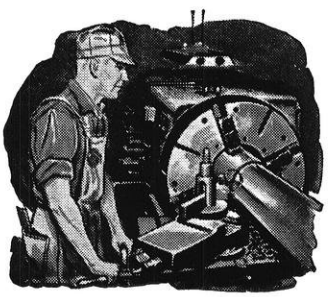
Super High-Temperature Steels



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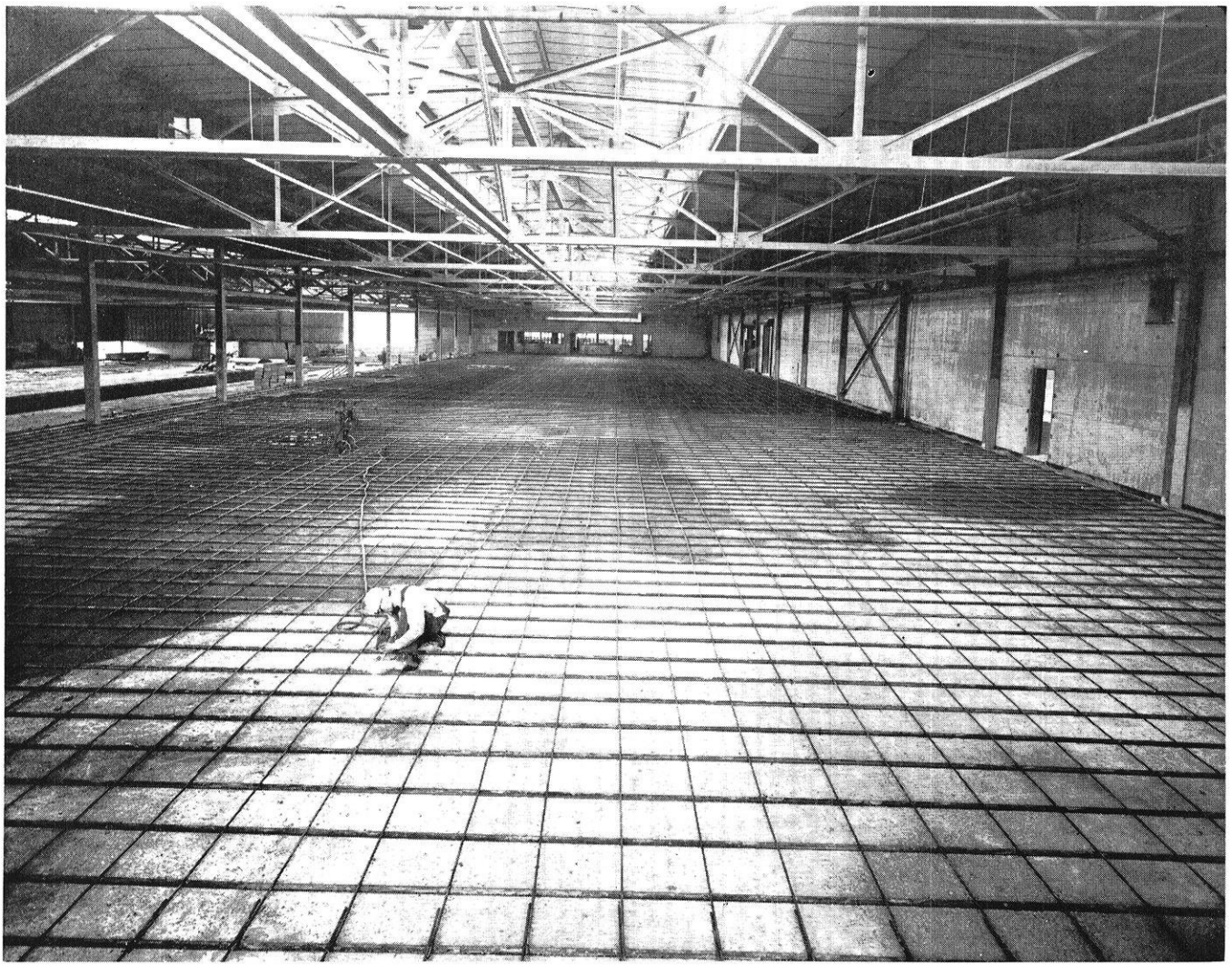

The warehouse for the Pacific Telephone and Telegraph Company, San Leandro, Calif., used more than 16,300 feet of corrosion-resistant wrought iron pipe to radiant heat 22,500 square feet of floor area. A wire mesh was stretched over the pipes to strengthen concrete "topping" slab and help to distribute the heat evenly. Mesh is then covered with 3 inches of concrete.

Radiant Heating

(Continued from page 68)

to this time, the flow of heat in all directions from the tube will be uniform.

Now, as this flow of heat reaches the surface of the slab, conditions will be altered owing to the convection air currents that will be formed as a result of the heated surfaces. On the upper surface of the slab, increase in temperature will be restricted by the convection air currents removing heat. On the under surface of the slab, air currents cannot be so readily formed, consequently, the temperature of the undersurface of the slab will tend to increase at a greater rate than the temperature of the upper surface of the slab, although the heat delivery in BTU will be greater on the upper surface.

It is fairly obvious that by increasing the diameter of the tube buried in concrete floors, such procedure will tend to increase the heat output by reason of increased area of contact between the metal and the surrounding concrete. It is also obvious that if two tubes are used in place of one and spaced a considerable distance apart, say on the order of two feet, twice as much heat will be delivered to the slab as with one tube, but if the distance between the tubes is only three inches apart, then, they are not much more effective than one tube, because the two semidiameters of the tubes facing eath other, are necessarily restricted in their ability to transfer heat to the surrounding area.

Further considering the concrete panel with a tube buried in the center, we see that, if there is additional resistance to heat flow, such as wood flooring or carpeting on the concrete slab, the tendency will be for the temperature on the undersurface to increase and the flow of heat upward to decrease by reason of the resistance to heat flow imposed by the wood and carpet covering. This can be practically compensated for by moving the tubes from their central location to the uppermost location in the concrete slab. If heat transfer in the downward direction is objectionable, insulation should be placed below the pipes to restrict the flow of heat in that direction. **THE END**

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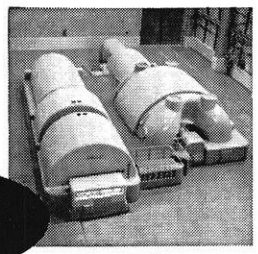
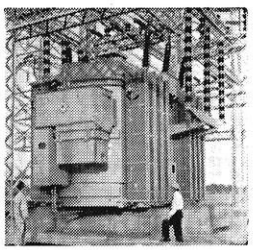
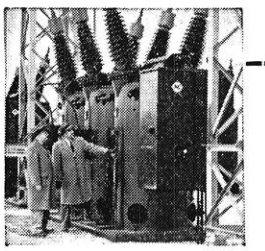


Steam Turbines

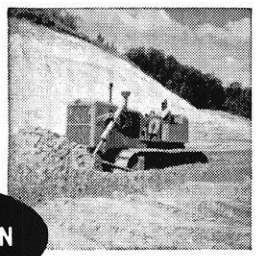


Transformers of all Types

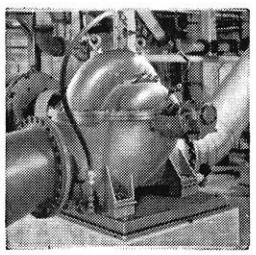


Circuit Breakers

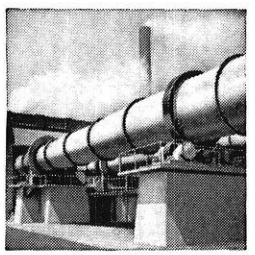
CONSTRUCTION



Road Building Equipment

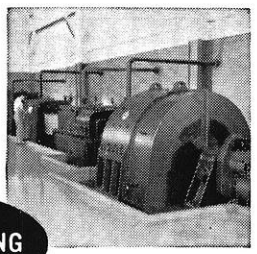


Pumps, Blowers

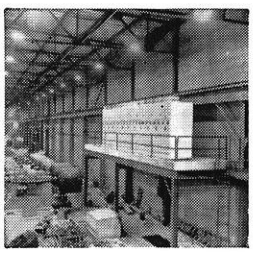


Cement-Making Equipment

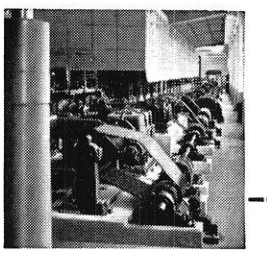
MANUFACTURING



Motors



Control



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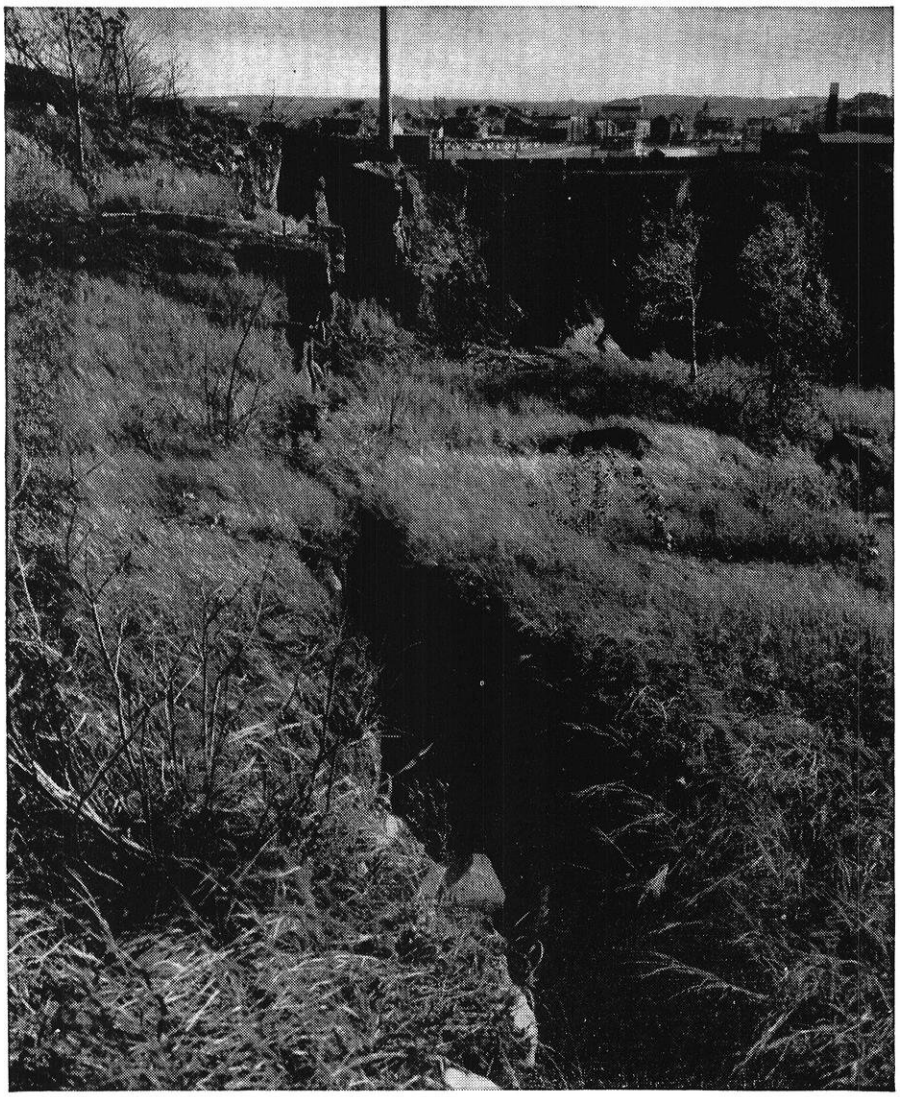
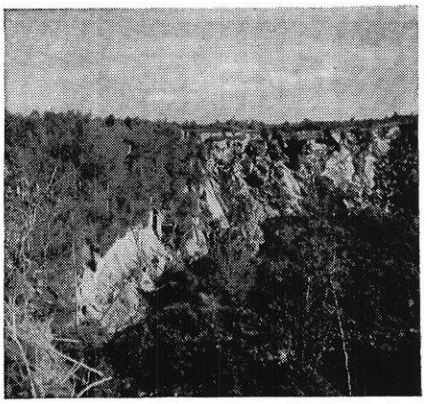


A crack at the earth's surface shows bulk mining is proceeding far underground.



Panel caving is one of two bulk mining methods which account for 70 per cent of the company's total nickel output.

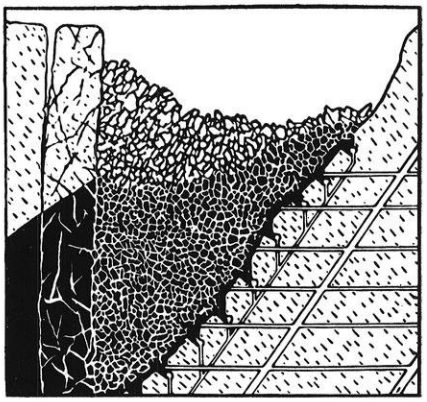


Diagram of panel caving in Creighton mine. The heavy panel of ore and rock sinks, breaking up as it moves down.

Which Mining Method is BEST?

There is no one best method of getting ore out of the ground. Type of ore; type of rock; even the location of the mine must be weighed. Inco uses five underground mining methods at Sudbury:

Square Set *Cut and Fill*
Shrinkage *Blasthole*
Panel Caving

Once only "waste rock"... now a new source of Nickel

How Inco's mine engineers utilize a panel-caving method in order to recover nickel from huge ore deposits that formerly were not practicable to mine

Panel caving is one of the newest mining methods put into use by The International Nickel Company.

The tonnage of ore handled by this method is immense. Sometimes a single block measures 200 by 800 feet. It may weigh as much as 1½ million tons.

As these heavy masses move downward they break into pieces small enough to drop through chutes and into machine crushers deep inside the mine. From crushers the ore goes a quarter mile by conveyor to hoists that lift it to the mine head.

From there, the ore is milled as fine as sand. The concentrate is then pumped to the Inco reduction plant 7½ miles away.

Panel mining; new concentrating machinery; new, continuously improved operating practices; pipeline transport. Add them together and you can see how they make possible production of nickel from ore deposits once only "waste rock."

Inco has prepared a full-color sound film—*Mining for Nickel*—that shows the operations of modern nickel mines. 16mm prints are loaned for showings before technical societies, engineering classes of universities and industrial organizations. For details, write Dept. 130f,

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At the University of California Radiation Laboratory, Berkeley and Livermore, there is an unusual spirit among scientists and engineers — a spirit stimulated by association with pioneers in nuclear research who encourage development of new ideas, techniques, and individual initiative.

Since its founding in 1936, UCRL has contributed an impressive list of achievements to the world's knowledge of the atomic nucleus — from development of the cyclotron and Bevatron, to electromagnetic separation of uranium-235, to the discovery of the antiproton and antineutron.

These accomplishments have, of course, stemmed from an outstanding group of men working with unmatched laboratory facilities. But just as important—and the key, perhaps, to UCRL's successes—has been the spirit with which these men work.

For UCRL is managed and directed by scientists and engineers—men who are liberal with their own knowledge and enthusiastic in the encouragement of their teammates' new ideas and new techniques.

This is the constant and continuing spirit of UCRL. It is to be found in each new and expanded project—whether it involves pure or applied science. It keynotes work on nuclear weapon design, nuclear propulsion, controlled thermonuclear energy (Project Sherwood), and high current accelerators, as well as such problems as the application of radioactive substances to biology and medicine.

The UCRL "spirit" appeals to a particular kind of scientist and engineer — to men of ability and imagination, to men who wish to move forward and challenge the unknown. If you wish additional information, write to the Director of Professional Personnel, University of California Radiation Laboratory, Livermore, California.

Amalgamation

(Continued from page 39)

adept at it that many people have the foregone conclusion that "the engineers will figure it out".

This attitude often leads to acceptance of the answers and their benefits without full realization of the thought, ingenuity, and perseverance that may have gone into the solution. In this way, the engineer's work is woven into the economic fabric with a take-it-for-granted attitude. Modern people are not glad if an engineer's device works well; they are upset if it does not.

Beware the engineer who resents this fact, however. Let him be grateful that his forebears did such a fine job that people now trust the engineer's work. No one flying an airplane today worries about being burnt for practicing witchcraft, nor does the cry "Get a horse!" hound the modern motorist.

We wish, however, as engineers and engineers-to-be, that people would take notice of these fundamental contributions and grant a bit more recognition. In other words, give professional status to the qualified engineer. Since most worthwhile things are maintained by struggle and force, however, at least a mild prodding may be required before this will happen.

A concurrent desire, too, is a paycheck that increases with experience, ability, and work well done. This, by affecting someone's pocketbook, usually requires more than gentle prodding and frequently brings out the contrary streak in some employers. To accomplish these goals, some sort of "battle" seems quite probable. What "knight in shining armor," then, should be chosen to save the engineer from obscurity and the villainous bill collector?

Two "knights" stand out; one being the professional society, shielded by professional spirit and active membership, while the other is an engineers union, made strong by a large membership and a conviction that in numbers there is strength. Both are willing to wield a sword in the same direction, but what happens to those who assume their protection? Are they benefited by the battle, or will they, too, stand vanquished after the clanging and banging has stopped? Or, stated differently, will either of these "knights" do a good job in the long run?

It seems odd that engineers should ever resort to unionism to solve their problems. Going back to our supposed cave-man originator, can you imagine him trying to prove his hunting prowess by collective bargaining? Yet that seems no more difficult to visualize than a group of free-thinking engineers trying to prove their individual worth "en masse". Still, the problem exists and some engineers think that a union is the right approach, although a recent survey shows that 71% of all engineers do not want unions. (Only 17% do).

Most of this antipathy arises from the "mongrelizing" effect of a union. No engineer, having worked many years to attain professional status, wants to be "amalgamated" into a group of technicians, draftsmen, laboratory assistants, and high-grade clerks. Furthermore, the idea of having his decisions and personal relations with management taken over by someone else, does not appeal to him. There is no reason why it should. As a free-thinker, he is paid to exercise his mind, not to put it on a short leash that is lengthened only when work is to be done and never used in his own behalf.

With this in mind, the union organizers have avoided the name "union", when forming their group. Probably the strongest such organization is the "Engineers and Scientists of America," (ESA), which is a union in everything except the name. Their membership runs between 16,000 and 40,000, depending on who is doing the computation. Most of this membership is found in large companies employing several thousand engineers.

ESA is an organization set up to bargain collectively for technical personnel, as well as, to define job categories, etc. Standard union practices generally prevail regarding seniority rights, promotion policies, and wage increases. Note here the conditions under which an engineer works if he joins a union:

1. He is reduced to a "common denominator".
2. His ability may mean less than his seniority.
3. He gives up his right to individual decisons in his dealings with management.
4. He is "on the other side of the fence" from management.
5. The union may help his paycheck, but does little for his professional status.
6. Once a union member, he may find it difficult to quit the union.
7. If he is promoted to management, his union activity is not in his favor.

Many more conditions could be listed here, but this is enough. Need more be said?

Alright then, let us see how a professional organization stacks up. Remember that the search is for a way to enhance the profession and boost the paycheck.

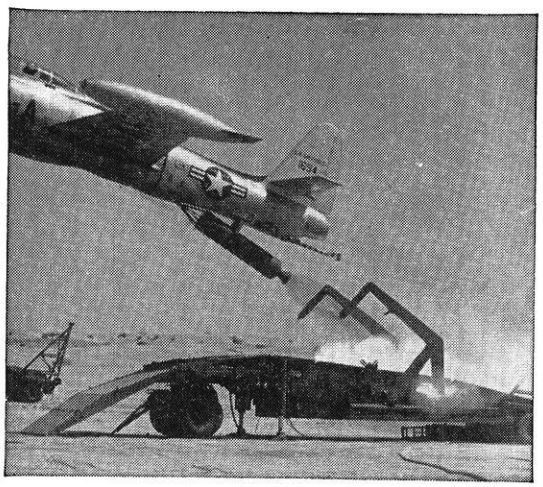
A professional group by its very nature should certainly be able to enhance the profession. The registered professional engineering societies require examinations of various kinds to eliminate applicants without the necessary ability and to protect the public from incompetence. These are not easy tests, thereby making the title "Professional Engineer" a worthwhile goal for any engineer desiring to prove his worth. By continuing this practice and making known the quality of membership, a professional society can do much to further recognition of the engineer.

Do not underestimate the engineer's desire to be active in a professional organization. Of all engineers, 88% would attend professional functions if the "boss" could be persuaded to allow the time off.

This presentation is much simplified, of course, but, at least, the trend that can be followed is clear and remains only for time and initiative to carry it to fulfillment. The next part is not as clear, and that is how to convince employers and management people to pay the engineer in proportion to his value.

(Continued on page 92)

Another page for **YOUR BEARING NOTEBOOK**

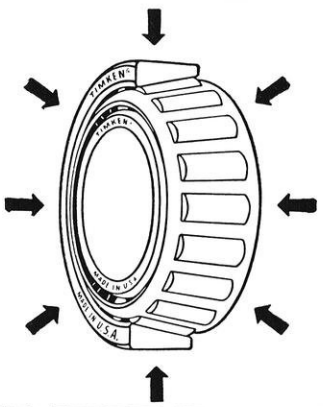


How to keep a portable airport rolling

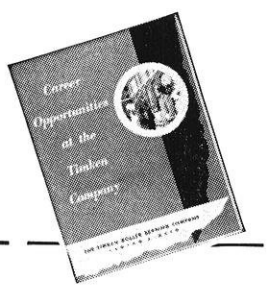
This portable semi-trailer is used to haul and launch jet fighters and missiles. One problem engineers faced in designing it was making sure the wheels and axles could take the heavy radial and thrust loads. That's why they ended up specifying Timken® *tapered roller* bearings.

Tapered design lets Timken® bearings take both radial and thrust loads

Because of their tapered design, Timken bearings can take radial or thrust loads or any combination. And because the load is carried along a full line of contact between rollers and races, Timken bearings have extra load-carrying capacity. And they practically eliminate friction.



Want to learn more about bearings or job opportunities?



Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings.

And for information about the excellent job opportunities at the Timken Company, write for a copy of "Career Opportunities at the Timken Company". The Timken Roller Bearing Company, Canton 6, Ohio.

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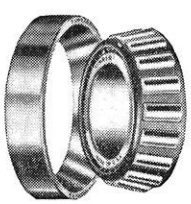
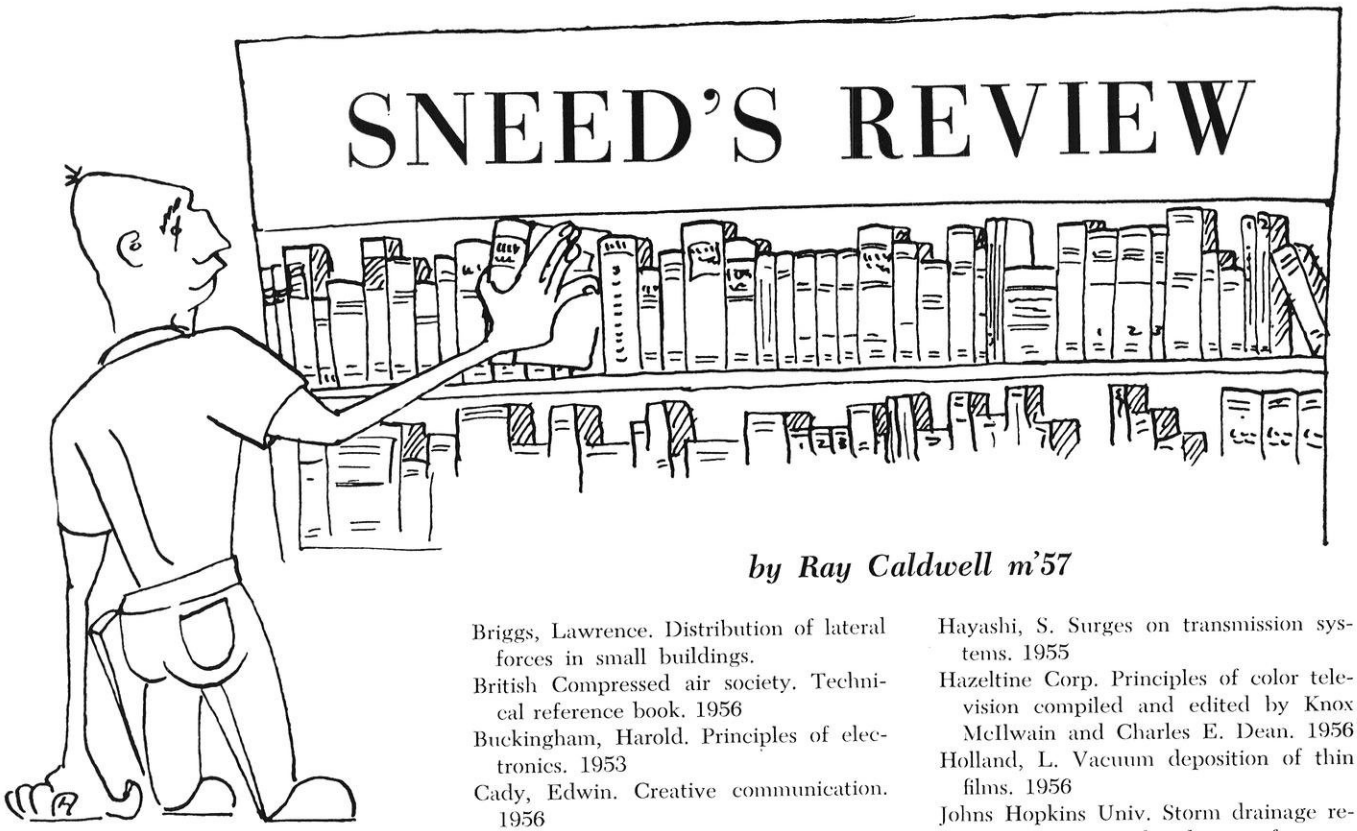


NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭
BEARING TAKES RADIAL ⊕ AND THRUST —◎— LOADS OR ANY COMBINATION ✳

SNEED'S REVIEW



by Ray Caldwell m'57

NEW BOOK LIST

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American Society for Engineering Education. General education in engineering. 1956

American Society for Metals. Theory of alloy phases. 1956

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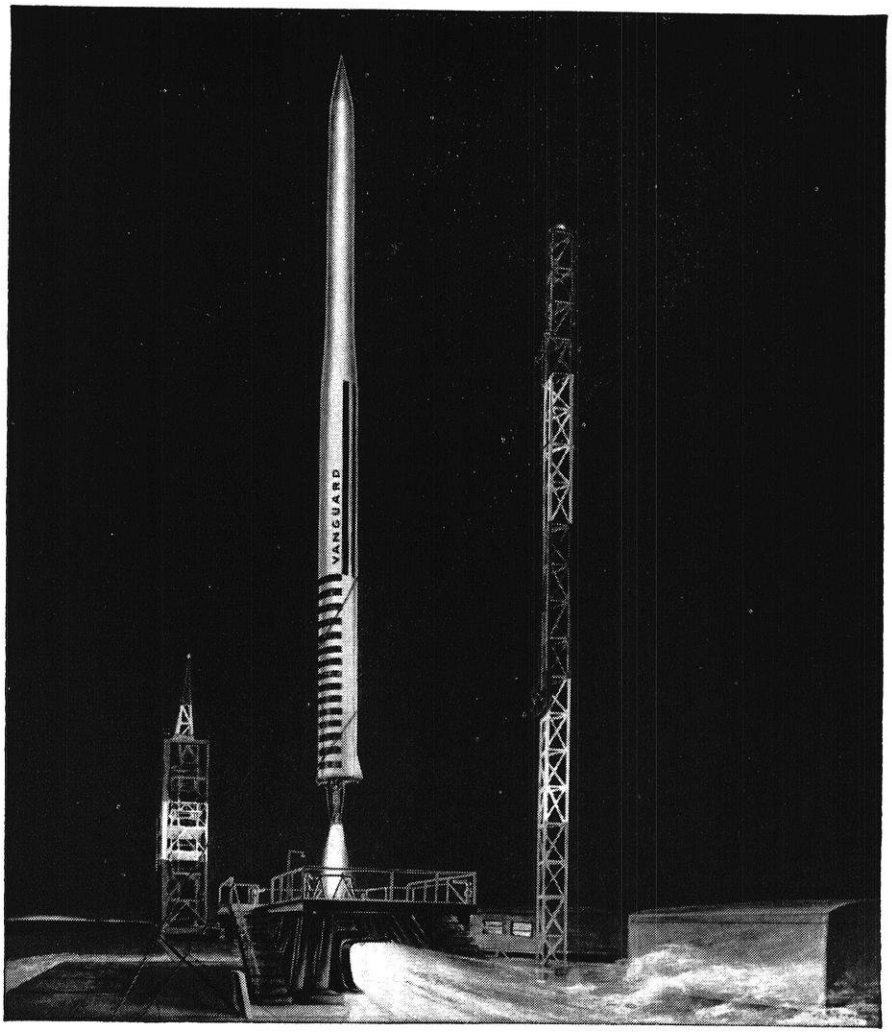

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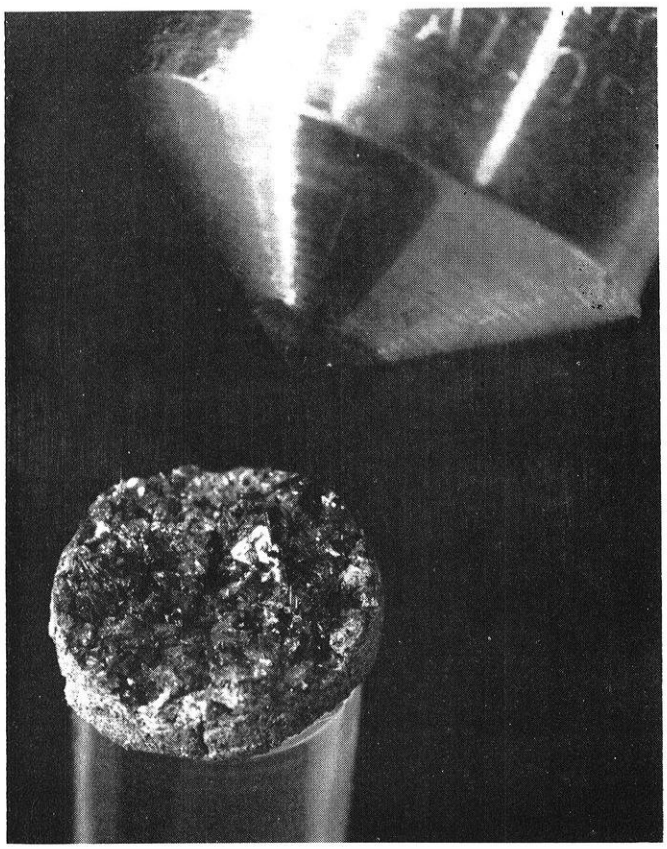


Diamond tool bits such as this find wide use for man-made diamonds.

Diamonds

(Continued from page 27)

diamond to graphite stopped while at the temperature of 3,000° C and the pressure of 15,000 atmospheres the transformation was 100 per cent.

On the basis of this observation Bridgman revised his previous estimate and stated that to obtain diamonds would require greater temperatures and pressures than were obtainable with the equimpent he had available. Before he was able to develop equipment capable of the pressures and temperature he felt necessary, his sponsors decided to discontinue the research project.

Despite Dr. Bridgman's failure to produce diamonds he laid the ground work for G.E.'s success in this line with the equipment and theory he developed. For example, he invented a single stage pressure vessel capable of withstanding 50,000 atmospheres at room temperature. Another of his achievements was in temperature and pressure recording apparatus.

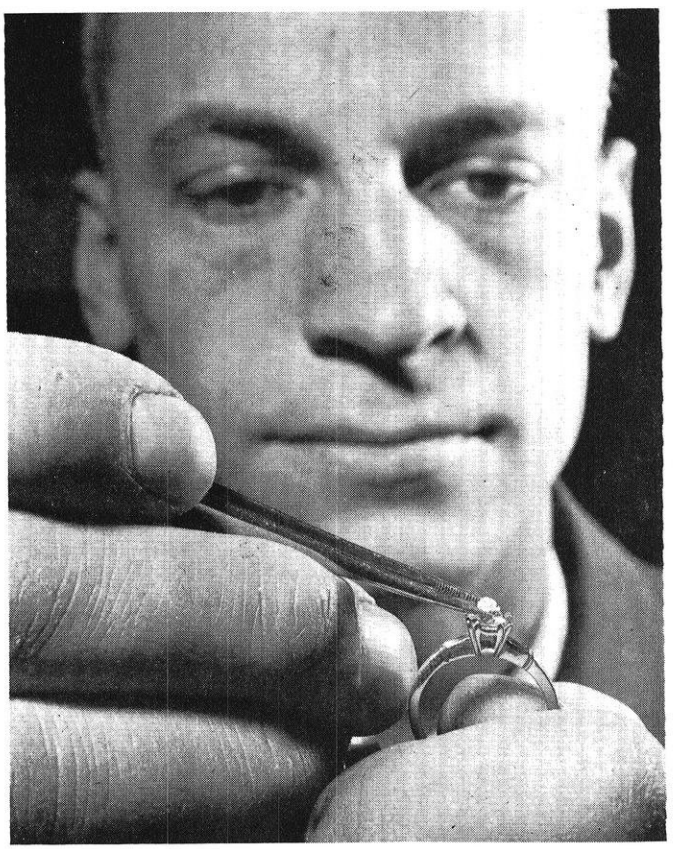
In the basis of the preceding theory and research, General Electric felt that diamond synthesis was worthy of further development by then. Four years later they were able to proudly announce the accomplishment. As a matter of fact, G.E. has developed not only one, but several methods for diamond synthesis and successful experiments have been carried out over 100 times. The research group that achieved this goal consisted of A. J. Nerad, who headed the project, the physists, Dr. R. Wentrof, Dr. F. P. Bundy, Dr. H. T. Hall and Dr. H. M. Strong.

The most successful synthesis was by Dr. Strong when he submitted carbonaceous matter to a pressure equal to 53,000 atmospheres for 16 hours at an undisclosed temperature. He obtained a diamond measuring 1.3 by .4 by .2 millimeters and weighing 0.01 of a carat.

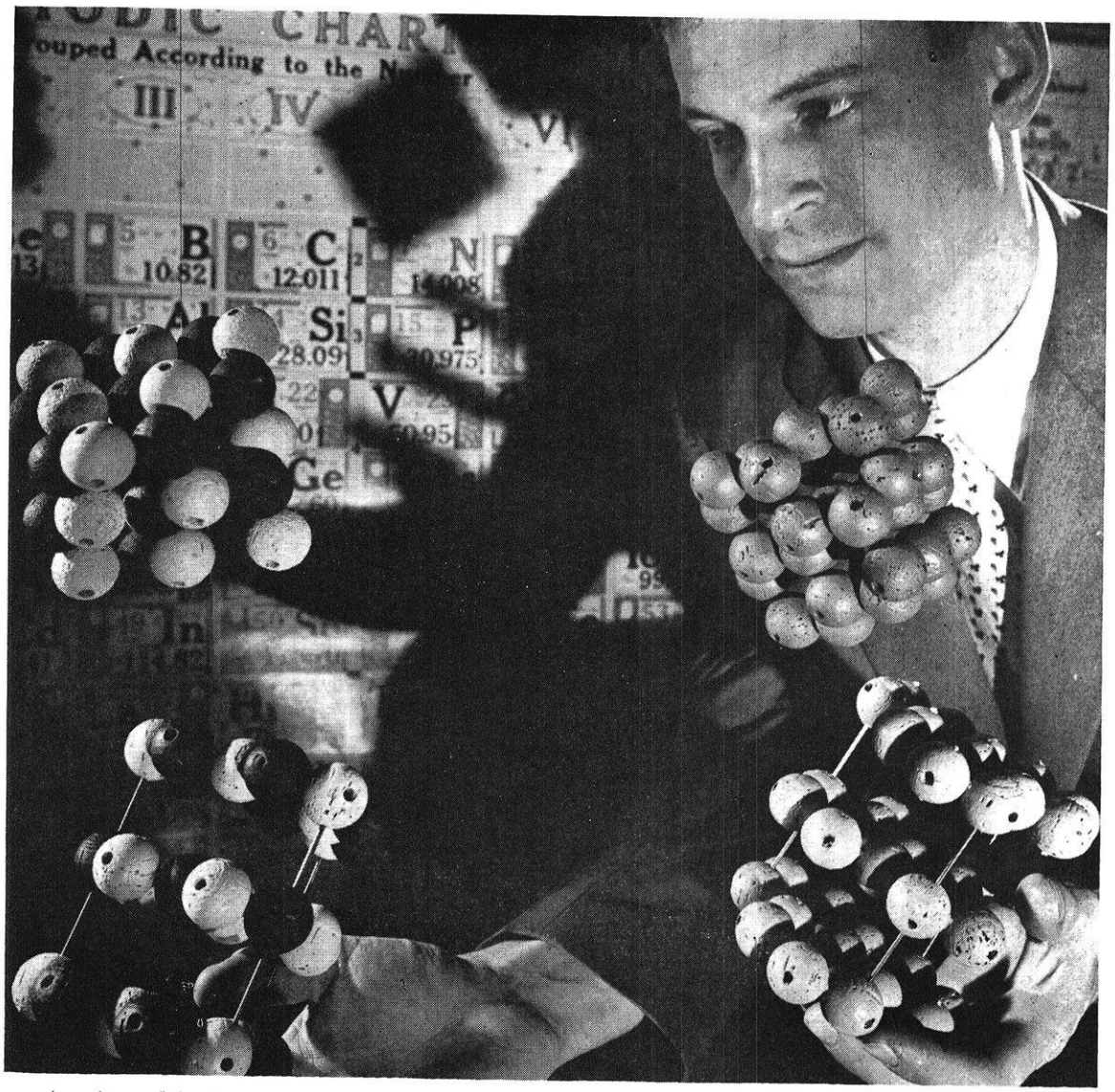
Dr. Hall made perhaps the most important advancement when he developed a "belt" chamber capable of withstanding a pressure equal to 100,000 atmospheres at 5,000° F. Using this chamber he obtained clusters of diamonds weighing up to 0.1 carat in a few seconds.

Other than these few glimpses at particular synthesis attempts, G.E. isn't disclosing their method. It seems that the secret of diamond production that was formerly God's alone is now shared by G.E., but it still is just as well kept. G.E. only says that they work with pressures from 40,000 to 100,000 atmospheres at temperatures between 700 and 2700° C for periods from 2 seconds to 16 hours. Pressure and temperature are determined through the methods developed by Bridgman along with some new ones they've developed. The composition of the carbonaceous matter used by G.E. is undisclosed, the method of heating is described as electrical, and the limiting factor of the system is the pressure vessel.

Despite General Electric's secrecy, there are certain aspects of the requirements for diamond synthesis that can be assumed on the basis of chemical and thermo-



Here a man-made gem is compared to the real article, a diamond ring. As of now, synthetic gems are limited to industrial applications.



Atomic models show similarity between borazon—cubic boron nitride—(top, left) and diamond (top, right) the cubic form of carbon. Borazon has alternating atoms of boron and nitrogen packed together almost as closely as the carbon atoms in diamond.

dynamic theory. The first requirement, that for the graphite to diamond transformation to occur, calls for temperatures and pressures in the diamond stable phase.

Since the thermodynamic limits determined by R. S. Jessup and F. D. Rossini are obviously a function of temperature and pressure, it is desirable to operate at the lowest temperature and pressure possible. In this way it is possible to avoid exceeding the limits of the press and still remain in the region where diamond is more stable. The temperature and pressure can be kept low through the use of catalysts, elementary starting compounds, and tiny diamonds to seed the reaction. With these methods, atomic migration can be increased to the extent that diamond formation will occur as theoretically predicted.

Another factor that might be very important in the synthesis of large diamonds is the element of time.

Now that we've examined the historical and theoretical aspects of diamond synthesis let's look at one more aspect—the future. The real question is, "Where does G.E. go from here?"

At present, they have no intention of trying to sell their synthetic diamonds on the competitive diamond market because of the high cost of production. However, in the case of war or further developments that lead to reduced cost, there is no doubt that G.E.'s synthetic diamonds will see much use. Those produced so far are only of industrial quality, but gems are next in line.

Primarily, the research possible in this new temperature pressure region is one of interest to scientists in their search for new materials with more desirable properties. This region is indicated by the red area on Figure 1.

In the light of the advancement they've already made, Dr. A. J. Nerad feels his group will be able to push on to higher and higher temperatures and pressures that simulate conditions deeper and deeper in the earth. His goal, he has said, is, "to hell by 1960."

THE END

Sneed's Review

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THE END

Science Highlights

(Continued from page 63)

the Du Pont Company under its "Freon" trademark. Three types, all classified technically as "selective solvents", are available in container sizes ranging from 10 to 55 gallons.

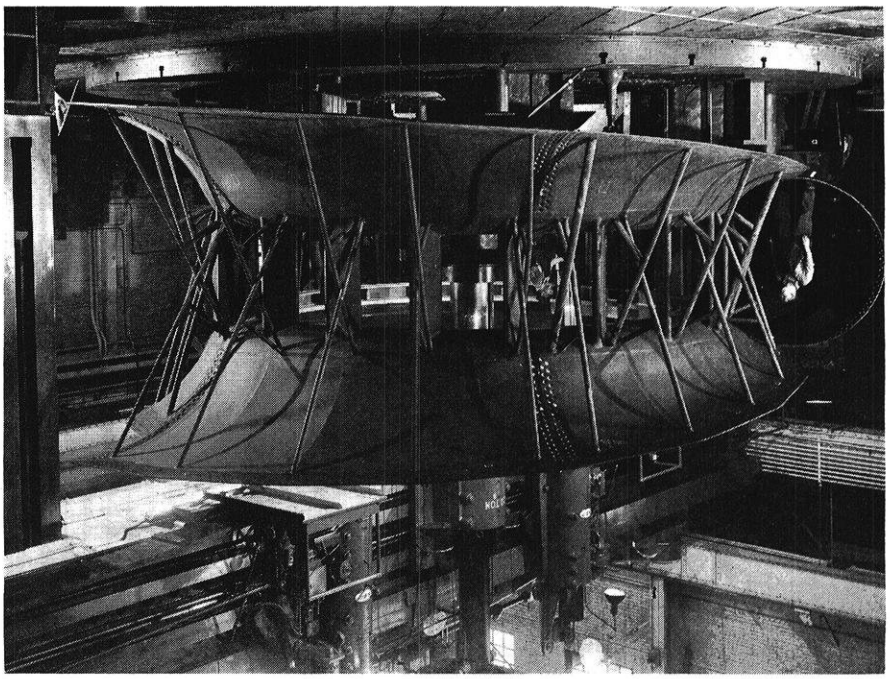
Big advantage of the "Freon" solvents, the company's "Kinetic" Chemicals Division says, rests in their safety, both from a personnel exposure and material standpoint. Because they are nonflammable and nonexplosive, they can be used in open shop areas without danger of fire. In addition, from an inhalation toxicity standpoint, they are rated as the safest of the commonly used nonflammable solvents when used in properly designed equipment which minimizes vapor losses.

Most important use proved to date, the company said, is in cleaning of electrical motors, both new and reconditioned. Biggest problem there in the past has been the tendency of cleaning solvents to attack insulation on the motor wiring, weakening or removing it sufficiently to cause short-circuits when the motor is placed in operation. Three years of tests indicate that the "Freon" solvents will not soften, craze or dissolve any of the commonly used wiring insulation materials.

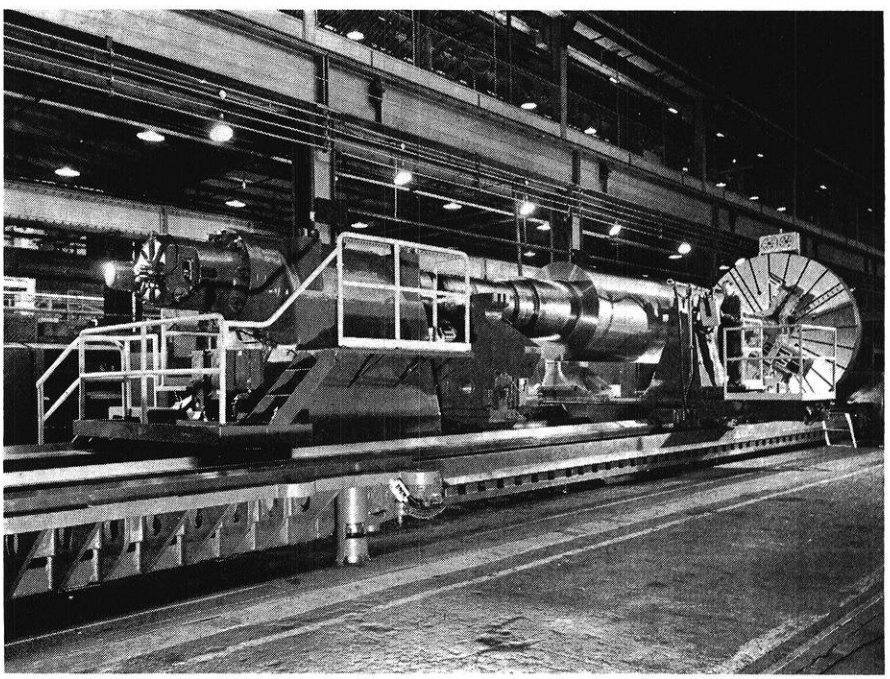
Other important uses developed for the "Freon" solvents, and proved in field applications, include cleaning of electronic instruments, photographic and sound recording films and tapes, oxygen breathing apparatus, and typewriter rollers. The "Freon" solvents also have proved useful as general laboratory equipment cleaners and as safe, efficient heat transfer agents in place of flammable and explosive acetone in low-temperature laboratory chill baths.

Another potential use of the "Freon" solvents is as an additive to other, more dangerous, solvents to decrease the latter's flammability, or change their solvency or boiling point properties for special

(Continued on page 85)



Machining stay ring on 40-ft. boring mill. Unit 6 or F of eight 57,000-h.p., 112-ft. head, 85.7-rpm plate steel scroll case hydraulic turbines for Fort Randall Reservoir Project, Corps of Engineers, U. S. Army.

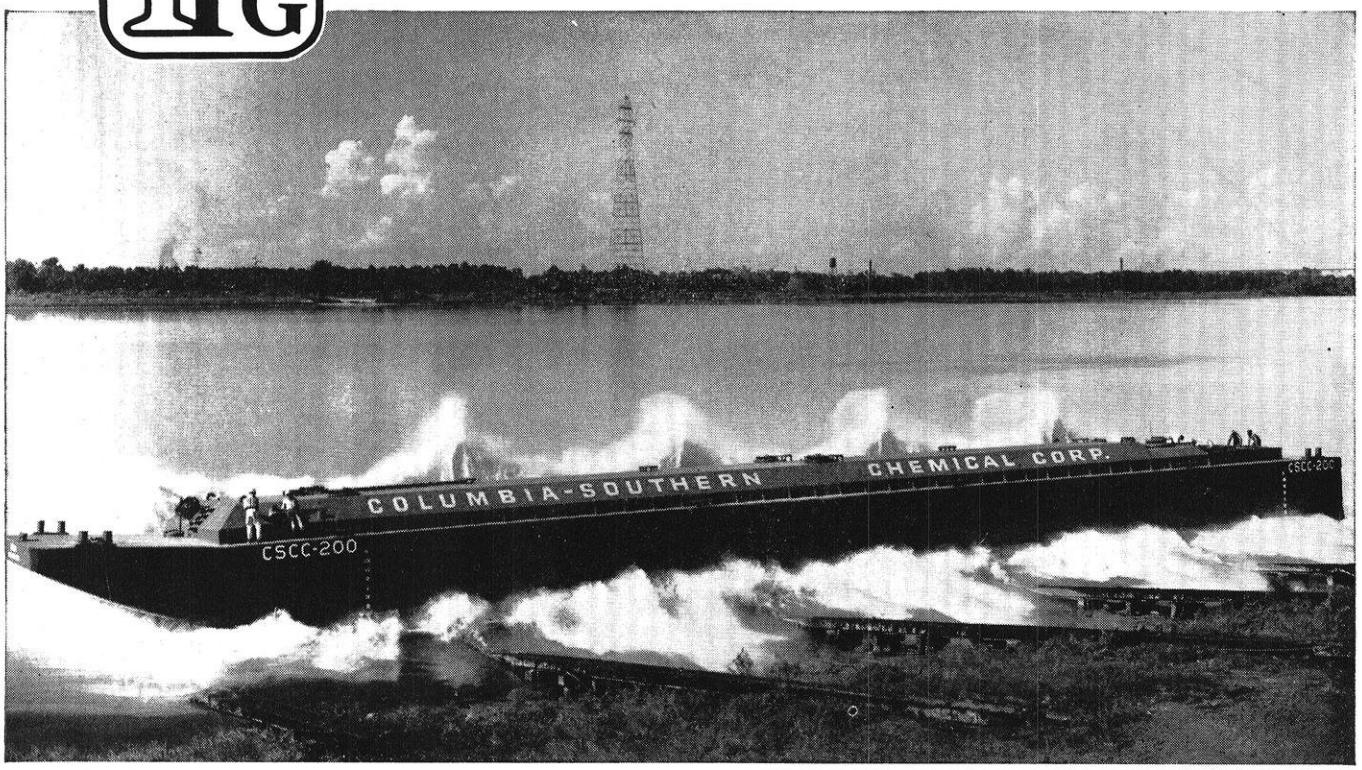


Larger machine tools are being developed to handle the steadily increasing size of power generating equipment now under construction for the electrical industry. Here a 144-inch engine lathe is being used to machine a rotor forging for a 300,000-kw steam turbine-generator unit.

The newly installed lathe is one of the largest ever made and measures 60 feet between centers. Its 200-hp drive motor and the motors used for supporting generator excitation have magnetic amplifier control. The 10-hp carriage armature is controlled electronically. The carriage follows the spindle speed giving a constant feed which is adjustable from 0.003 to 0.75 inches per revolution.

The rotor being turned on the lathe is for the 146,000-kw, 1,800-rpm, 18,000-volt generator on the cross-compound steam turbine-generator unit. The rotor is five feet at its greatest diameter, 35 feet long, and weighs about 200,000 lbs.

PPG ... stands for leadership and expansion in many fields



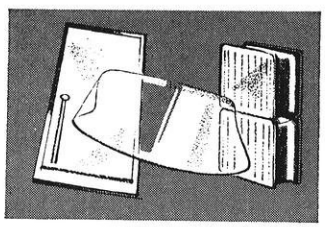
This new Columbia-Southern barge for transporting caustic soda has a 1200-ton capacity, and reflects the latest in design and improvements. Setting the pace in chemical transportation is just one of the many contributions to the chemical industry by Columbia-Southern.

If you are interested in building a successful and creative lifetime with a firmly established, constantly expanding company recognized as a leader in its many fields, you should investigate your career opportunities at Pittsburgh Plate Glass Company.

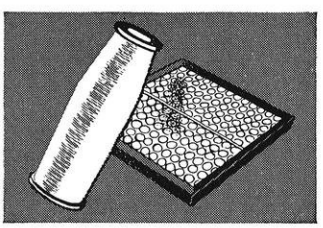
In addition to being a leading name in one of the nation's most essential industries, flat glass, PPG is a "blue-chip" organization in the production of plastics, paints, fiber glass, paint brushes, and chemicals.

Columbia-Southern Chemical Corporation, one of PPG's subsidiaries, is the world's largest merchant producer of chlorine. From Columbia-Southern also come tonnages of vital industrial chemicals: soda ash, caustic soda, calcium chloride, pigments used in rubber compounding, chrome chemicals, and numerous others. Columbia-Southern's position as a leader in the fast-growing chemical industry stems from its reputation for solid business practice and customer service, backed by constant research and development.

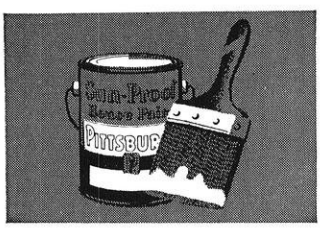
If you are interested in a career with outstanding job opportunities where your talents and initiative are respected and rewarded, by all means look into your career possibilities with the Pittsburgh Plate Glass Company. Write for more information to the Pittsburgh Plate Glass Company, General Personnel Director, One Gateway Center, Pittsburgh 22, Pa.



PPG produces large quantities of glass for automotive, home building, commercial and industrial uses.



Pittsburgh Plate's fiber glass and plastics are being used in many new applications every day.



Colorful Pittsburgh Paints are the overwhelming favorites of Mr. and Mrs. Homeowner the nation over.

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PITTSBURGH PLATE GLASS COMPANY

345 PLANTS, MERCHANDISING BRANCHES, AND SALES OFFICES LOCATED IN 250 CITIES

Science Highlights

(Continued from page 83)

applications. In such cases, it is important that the solvent mixture be formulated carefully so that the flammability of the mixture will be reduced to a safe level under all normal operating conditions.

Three types of the solvents now are available—"Freon" MF, with a boiling point of 75° F.; "Freon" BF, which boils at 199° F., and "Freon" TF, whose boiling point is 118° F. That range, the company explained, makes the "Freon" solvents adaptable to use in many type of mechanical cleaning equipment. Small, portable, and inexpensive cleaning tanks, which would not be suitable from a safety standpoint for use with more toxic or flammable solvents, are now being developed to make the "Freon" solvents easy to use in small-scale cleaning operations.

UNDERSTANDING OF GLASSED STEEL PROCESS EQUIPMENT AIDS ENGINEERING STUDENTS

Normally used in the chemical industry to combat corrosion, glassed steel equipment is also used extensively in other industries such as plastics and synthetic rubber. Some processes do not usually require the corrosion resistance of glass, but here glassed steel is used for other reasons. The type of glass used might differ widely from that used in corrosive chemical services. This difference must be understood by the chemical engineer whose responsibility it is to specify or to use this equipment.

Glassed steel is a laminate fused together chemically and physically by excessive heat. The two components of the laminate are glass and steel. Sometimes the glass is placed on the outside as in the case of agitators, baffles, and thermowells. The universal use of glass in the laboratory is evidence of its resistance to corrosion. As with all things, glass does have certain limitations, the most outstanding of

(Continued on page 91)

Embodying a micrometer device for horizontal measurements, the new Kodak Contour Projector, Model 14–6 features ample table travel to simplify staging. The projector, which will be shown for the first time at the Western Metal Exposition, March 25–29, in Los Angeles, is expected to find wide application in receiving-inspection and tool-room optical gaging.

HOW WOULD YOU LIKE TO WORK WITH GENERAL MOTORS IN THE FIELD OF ELECTRONICS? . . . WITH MEN WHO ARE ENGINEERING AND MANUFACTURING INDUSTRY'S HIGHEST POWERED GERMANIUM TRANSISTORS AND OTHER ELECTRONIC COMPONENTS AND PRODUCTS?

. . . men who have the ability to solve problems that stand in the way of progress . . . men who give a qualified college graduate a running start on success. They're Delco Radio men—and our most prized asset. You can work with them—become one of them. They have perfected the new high-powered germanium transistors, the beginning of an expanded program of research, development, and production at Delco Radio. This revolutionary transistor is already filling a vital need, and its potential use is incalculable! To keep this program moving and to develop equally big, new ideas in the field of electronics, Delco Radio needs men like yourself—graduates with degrees (BS, MS and PhD) in electrical engineering, mechanical engineering, metallurgy, physical chemistry, physics, and production engineering. If you are interested in permanent work in the field of semiconductor devices, applications, production, and related engineering jobs, contact us today. You'll find Delco Radio's policies regarding salaries, promotions, and benefits as advanced as the transistor itself.

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W.S.P.E.

(Continued from page 56)

tain engineers by the device of an evidence clause and

WHEREAS: it is the considered opinion of the Board of Directors of W.S.P.E. that registration by reason of eminence is not in accord with the purposes of the Ideal Registration Law nor does it contribute to the professional status of engineers: and

WHEREAS: other recognized professional groups, in the amendment of their practice laws, eliminated "eminence" as a measure of professional ability;

Now, therefore, be it resolved, that the W.S.P.E. by its Board of Directors, at a regular meeting, hereby request the N.S.P.E. to take appropriate action to strike the eminence clause from the proposed Ideal Registration Law prior to the promulgation of such as the national policy of professional engineers.

By the Board of Directors W.S.P.E. on Jan. 24, 1957.

The resolution was drafted by Glen Coates and Harold Trester. It was then transmitted to Paul Robbins (N.S.P.E.) requesting that N.S.P.E. remove the eminence clause from its proposed Ideal Registration Law.

ENGINEER SHORTAGE

The product development and plant expansion programs of Wisconsin industries are being held up due to a shortage of engineers.

Mr. Frederick said that despite the increase in the number of graduating engineers, the need is increasing because of automation and keener competition in product development.

The Wisconsin State Employment Service has more than 500 openings unfilled at the professional placement service.

Information about these openings can be obtained from the district office of the Wisconsin State Employment Service, 448 State Street, Madison, Wisconsin.

THE END

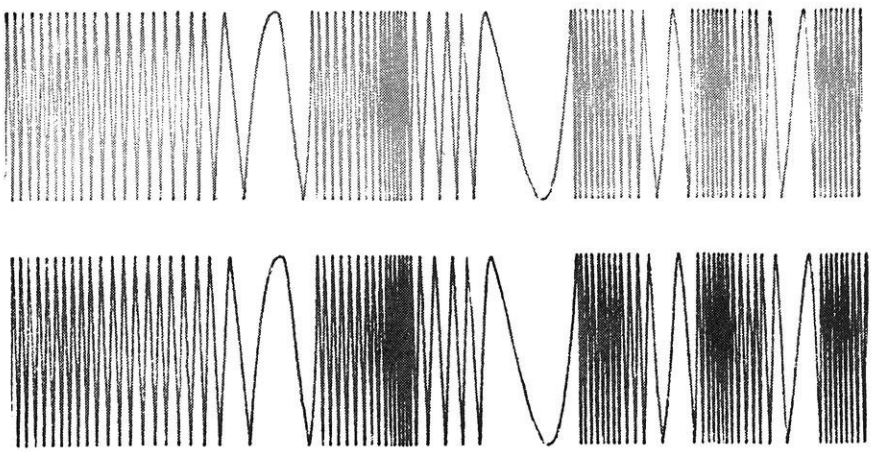
FYI

FOR YOUR INFORMATION

Allied Chemical

DIVISIONS Barrett, General Chemical, National Aniline, Nitrogen, Semet-Solvay, Solvay Process, International

- *ball-point inks*
- *odor control*
- *biological grade chemicals*



Ball-point inks

If you drew a continuous, unbroken line with a ball-point pen until its ink supply was exhausted, the line would be two to three miles long. Enough to write 50,000 to 70,000 words, compared with the 2,500 to 4,000 words you get from the same amount of fountain pen ink.

Because you would be exhausted long before your ink supply, a mechanical scriber—which produces those mysterious zig-zag lines above—is used to test hundreds of ball-point ink formulations.

The amazing number of words coming from a ball-point pen has enabled ball-points to roll past both fountain pens and mechanical pencils to become the most commonly used writing instruments today.

This would not be so if the ball-point pen remained unchanged, still staining, skipping, smearing, drying up. A better mechanical tool was needed to start with.

Once accomplished, the ink became the most important element, and synthetic organic chemists turned to the key element—the colorant—which is half of the entire ink formulation.

Early ball-point inks were made with the same dyes used for years in fluid inks. But ball-points have different ink requirements: good flow properties, lubricity, solubility, storage stability and—most important—an exceptionally high concentration of dye. Tinctorial value must be twenty times that of a fluid ink.

From research has come a special line of NATIONAL dyes, tailor-made for ball-point inks. Research on both pen and ink has enabled the ball-point to supplant in 15 years the pointed pen, in use for 13 centuries.

Odor control

Odor control presents an ingenious twist on the old question of whether there is any sound when a tree falls in a deserted forest.

We have always had odor-causing sites. But today, with industry expanding and our suburban communities moving further into the country, these odors become a serious problem. Some sources of this problem are sewage plants, landfill garbage, drainage ditches, storm sewers and market area streets.

SOLVAY OZENE (emulsifiable orthodichlorobenzene) is becoming widely used in industrial odor control situations, for dripping into sewage or spraying on garbage and other odor sources.

OZENE works on odors these ways: its own odor serves as a masking agent; it slows down the production of bacteria which cause sulfide odors; it prevents the growth of fungi which speed the decomposition of waste materials.

A dark-colored liquid, OZENE mixes readily with water and can be substantially diluted for economical use.

Biological grade chemicals

Preparing balanced salt solutions for the growth of cultures is typical of the stringent needs of biochemists for extremely high-purity chemicals, products which have been purified even beyond the universally recognized American Chemical Society quality standards for analytical reagents.

Three such "reagent plus" compounds have been added to BAKER & ADAMSON'S line of 1,000 laboratory reagents. These initial chemicals—sodium bicarbonate, sodium chloride and potassium chloride—show very minute trace impurities, materially lower than in similar chemicals produced to A. C. S. specifications.

They are the first in a proposed line of biological grade chemicals made especially for such important scientific applications.

Creative Research

These examples of product development work are illustrative of some of Allied Chemical's research activities and opportunities. Allied divisions offer rewarding careers in many different areas of chemical research and development.

ALLIED CHEMICAL
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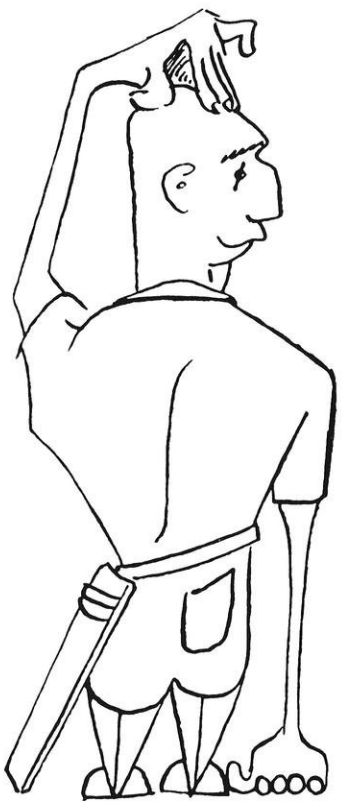
So You Think You're SMART!



by Sneedly bs '61

Ah April. The beards and green beer is but a memory now. Everyday the grass looks greener and the hill students look leaner. Most of them are over their sniffles now and some have even stopped wearing their rubbers. But we must leave their world of fantasy and return to the important things.

* * *

First of all, how many of you were able to determine the two locations in the world where it is possible to walk one mile south, one mile east, and one mile north and arrive at the place from which you started? Sneedly hopes that you did not neglect the North Pole, which is one solution. The other is from any point 2.19 miles north of the South Pole. It will be found that after walking a mile toward the Pole, traveling a mile east will lead you in a circle, the circumference of which is one mile. All that is left is to retrace steps by walking a mile north to the origin.

* * *

Pete P. Robbins was right. That fence around the earth at the equator that was 10 feet too long wouldn't hold rabbits for long, since it would be about 19 inches off the ground. Use $C = 2\pi\gamma$ as the formula for the true radius and circumference of the earth. Let $C + E = 2\pi(\gamma + d)$ be the formula applying to "Wild Bills" fence, when set up. By the second equation: $\frac{C}{2\pi} + \frac{E}{2\pi} = \gamma + d$. By the first: $\frac{C}{2\pi} = \gamma$. Dropping equals from both sides leaves $\frac{E}{2\pi} = d$. Therefore if $E = 10$ feet, $d = \frac{10}{2\pi}$ or 1.59 feet or about 19 inches.

* * *

A metal bar weighing 40 pounds is to be cut into four pieces so that, equipped with a balance scale, any object weighing an integral number of pounds between one and forty can be weighed. What are the weights of the four pieces into which the bar must be cut?

* * *

Two tourists, traveling on foot, set out from the same place in the same place in the same direction, A walks at a uniform rate of 18 miles a day and after 9 days he turns back and goes as far as B has traveled in those nine days. A then turns once more and overtakes B exactly 22½ days from the time they first set out. What is B's rate of speed, assuming it to be uniform?

* * *

Williams, who was born in the last century, suddenly realized on his birthday in 1944 that his age in years was twice the sum of the four digits of the year in which he was born. Also, his son's age in years when celebrating his birthday in 1944 was the sum of the four digits of the year of his birth. How old was Williams in 1944 and how old was his son?

* * *

Send your answers to the above problems, or some teasers of your own, to Sneedly at *The Wisconsin Engineer.*

Science Highlights

(Continued from page 85)

which are fragility and thermal shock susceptibility. When the process of applying glass to steel was perfected, the chemist truly had a container with the corrosion resistance of glass plus the working strength and protection of steel.

Because of the myriad number of attributes that makes glassed steel such excellent process equipment, it is much easier to discuss limitations of glass rather than to cover all the satisfactory conditions. Borosilicate glasses of which glasses applied to steel are typical can be regarded as having three definite chemical limitations. Briefly they are: hydrofluoric acid, strong alkalis, and steam or hot water under pressure. The first one is self explanatory. Hydrofluoric acid is a known solvent for sand and silicates and hence the fluoride industry is given a wide berth by suppliers of glass or glassed steel equipment. Most chemists are aware of the fact that strong alkalis severely etch glass. The concentration limits of alkalis are in the region of pH 12 at 212° F. The temperature is the most important single factor in corrosion resistance. Many times, by lowering the temperature even a few degrees, higher concentrations of alkalis can be safely handled in glassed steel equipment.

The inability of glass to resist steam is not widely recognized. This may be due to the fact that chemical glasses were developed to be acid resisting and not much attention was given to either alkaline or water resistance properties. Other materials of construction were generally available which were satisfactory for other than acid conditions.

TINY NEW POWER SOURCE

The General Electric Company announced that it is in pilot production here on a tiny new power source, only 1/35 the size of a common flashlight battery, but with 60 times the voltage of such a battery.

Designed for highly-specialized uses requiring small size, long life, and high voltage output, the new cylindrical, one-inch-long battery has a projected life of over 20 years.

The company believes it can be a new power source in such equipment as remote fire and radiation warning devices, deep well survey equipment, and electronic instruments.

The new battery produces 95 volts. It weighs less than one-fifth ounce and is less than one-third inch in diameter.

According to engineers of the Specialty Electronic Components Department, the battery's long life and other unusual features result from its solid, dry internal construction.

It contains 127 hair-thin discs, of silver and copper compounds and carbon, stacked tightly within the case.

Present price of the battery is $12.50, but the company believes mass production could eventually lower this to about one dollar.

"THINKS"

A new 8 million dollar testing device which "thinks" faster than a guided missile will be put into operation by the USAF at Holloman Air Force Base in 1958.

Known as a "real time" closed loop analysis system, it is intended to allow a single flight test to give results which now require several tests to obtain. It was explained that the new technique will reduce the data from the first few minutes of a missile's flight and compare it with the estimated performance of the missile. On the basis of this comparison, it will be possible to select new settings and variables and transmit new instructions to the missile still in flight.

By using two high speed "Univac" computers and careful planning before flight, it will be possible to do in half a second what is usually done between flights.

THE END

Amalgamation

(Continued from page 76)

A recent survey shows the average engineer to be worth a bit less, salary-wise, than the hourly paid production worker, and a bit more than the lawyer (as expected), although the lawyer overtakes the engineer, salary-wise, and passes him by seven or eight years after graduation (not as expected). This is partially due to the take-the-engineer-for-granted attitude mentioned earlier, and as long as the engineer does not object strongly to this fate, these conditions are not likely to change. Employers having an eye to profits are not apt to increase salaries without good reason.

Changing pay may be a tough problem, since the engineer cannot use existing, successful methods. The doctor, a recognized professional man, changes his pay by setting his fees in proportion to his ability. The union man, who is not a professional, works for a wage or salary and lets the union raise his pay. The engineer, who is a professional man, cannot raise his fees, since he usually works for a salary, nor can he let a union fight his battles because he is no longer a professional man if he does. It looks like quite a situation, does it not?

There is a salvation, however, and one that does not seem impossible. A figure mentioned earlier was that 71% of all engineers opposed unions. Suppose all of these were registered professional engineers. Then, of the 500,000 engineers in the country, over 350,000 would be in the organization. This is, indeed, an impressive bargaining body and one that need not sacrifice professional status to gain its power.

Currently there are about 200,000 registered engineers in the country and the figure is still climbing, although weakened by the 300,000 engineers not registered. Perhaps, a "wake-up" campaign is needed to avoid losing the battle by default. A unified front is essential and even the lawyers have a very solid Bar Association to which all practicing lawyers belong. The unions often cite this as proof of the need for a union, but fail to point out that the Bar Association is a truly professional group.

Much could be done concerning favorable legislation and ordinary, outright pressure, if all engineers were professional men, as they now claim to be. In this, the unions are right; a solid membership is the key to bargaining success. No single individual can do all for himself in the increasingly competitive world of today, unless Fortune smiles at him all the time, a condition usually noticeable by its absence.

In short, a professional society of engineers can do what is required for prestige and eventually for paycheck, provided it gains support from most engineers. Membershipwise it is gaining on the unions because it offers more in the way of professional benefits. It still leaves the engineer to bargain for his own paycheck, but places him in a better position to do so.

THE END

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STA  TIC

The aviation instructor, having delivered a lecture on parachute work, concluded:

"And if it doesn't open—well, men, that's known as jumping to a conclusion."

* * *

The E.E.'s Lament

Through the smoke and ozone fumes
The student slowly rises,
His hair is singed, his face is black,
His partner he despises.
He shakes his head and says to him
With words so softly spoken,
"The last thing that you said to me
'I'm sure the switch is open'."

* * *

Then there was the fellow who had a hobby of collecting rocks and putting them in his bathroom. He had rocks in his head.

* * *

A big buck Indian had just ordered a ham sandwich at a drug counter and was peering between the slices of bread when he turned to the waiter—"Ugh, you slice 'em ham?"

The waiter replied, "Yes, I sliced the ham."

"Ugh," grunted the Indian, "You damn near miss 'em."

* * *

Two lunatics were playing a little game.

"What have I got here?" asked one, with his hands cupped.

"Three Navy Patrol bombers," said the other.

The first one looked carefully into his hands, "Nope."

"The Empire State Building?"

"Nope."

"The Philadelphia Symphony Orchestra?"

The first one looked into his hands again and said slyly, "Who's conducting?"

An Engineer is a person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude infinite strings of incomprehensible formulae calculated with misromatic precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of doubtful ability and questionable mentality for the avowed purpose of annoying and confounding a hopelessly chimerical group of fanatics referred to all too frequently as Engineers.

(Editor's note: Engineers have no use for English; so supply your own punctuation.)

* * *

After watching a drunk try to unlock the door to his house without success, a policeman went over and asked if he might handle the key for him.

"No thanksh," the inebriated chap answered. "I gotta pretty good hold on thish key. You try and grab the housh."

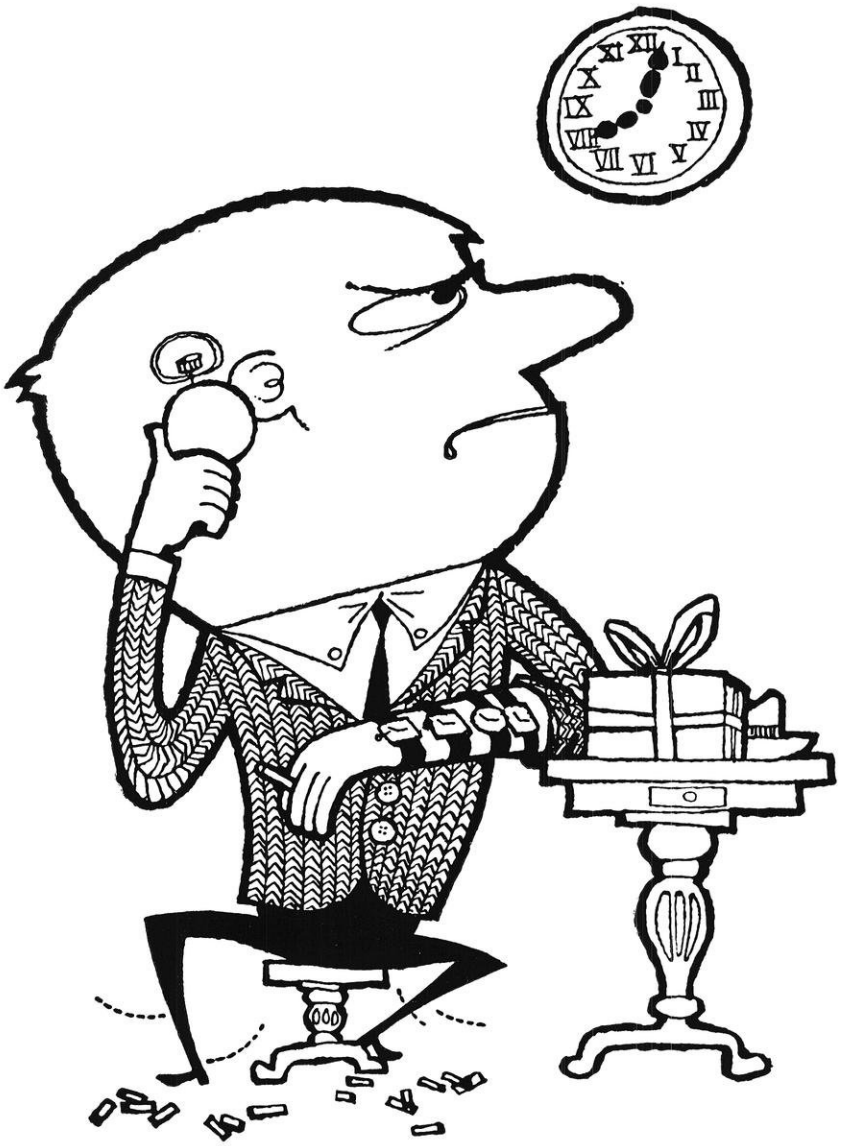
* * *

"Now children," said the kindergarten teacher, "we'll draw what we'd like to be when we grow up."

At the end of twenty minutes everyone handed in a picture except little Butch McGurk. His paper was blank.

"Why Butch," remonstrated the teacher, "isn't there anything you want to be when you grow up?"

"Sure teacher," replied little Butch, "I'd like to be married, but I don't know how to draw it."



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Or write: Engineering Personnel Office, Dept. COL, North American Aviation, Columbus 16, Ohio.

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So again we see photography at work helping to improve operations—doing it for commercial aviation just as it does for manufacturing and distribution.

Photography works in many ways for all kinds of business, large and small. It is saving time, saving money, bettering methods.

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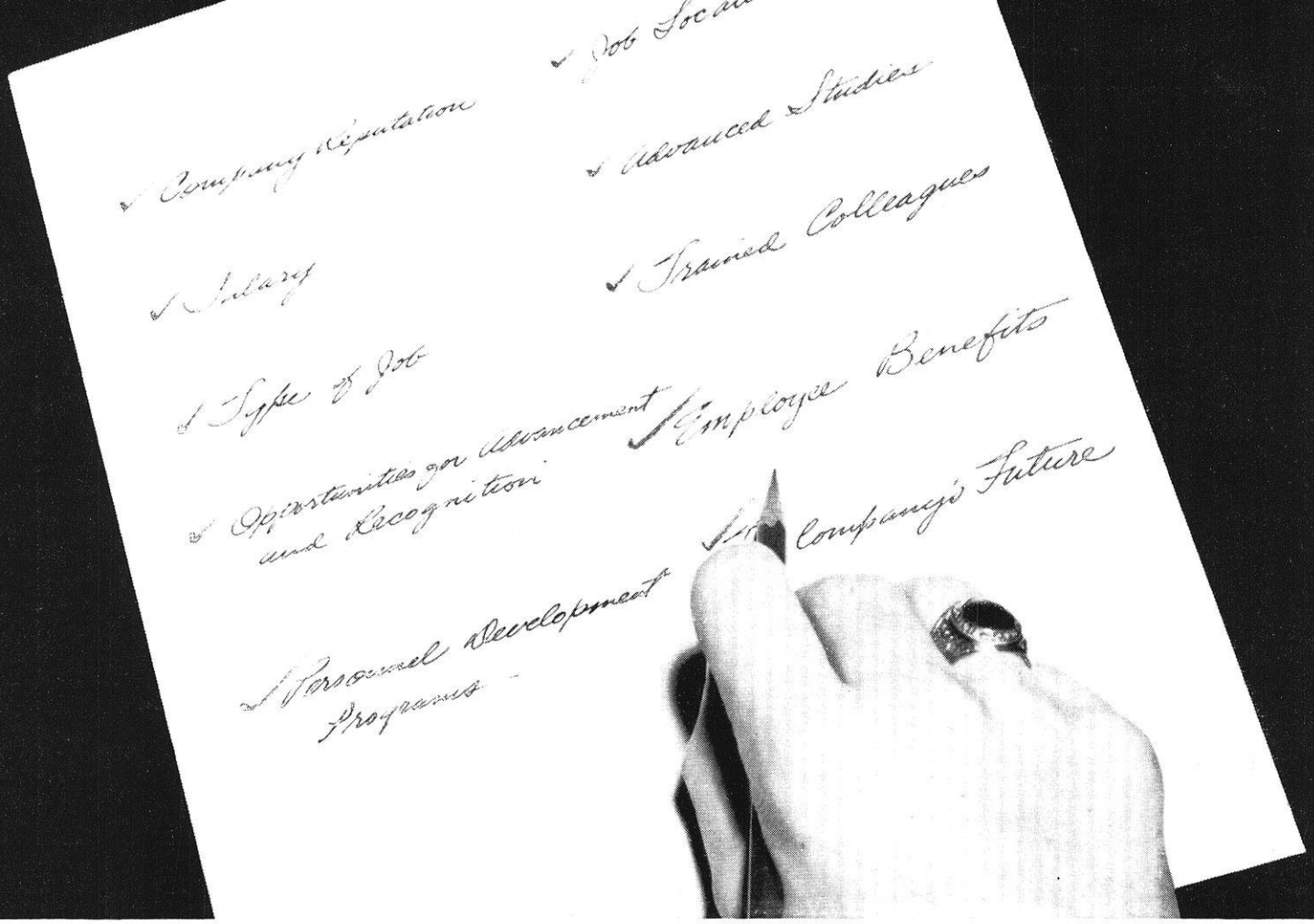

How General Electric stacks up on your job check list

● **COMPANY REPUTATION**—As an engineer, the names of Thomas Edison and Charles Steinmetz should be known to you. These men, who so greatly influenced the industrial surge of our country since the 19th century, are symbolic of General Electric's past and present technological leadership.

● **SALARY**—General Electric's salary program is planned with a long-range view for your career; a well-considered starting salary and merit increases based on your contributions. Through regular counseling by your supervisor you know just "how you are progressing".

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● **TYPE OF JOB**—Based on your personal preferences and abilities, you will work in various marketing, manufacturing or engineering fields. Your technical or managerial experiences may be in any of nearly 100 product departments where you contribute to the engineering, manufacturing or marketing of some of the more than 200,000 G-E products.

● **PERSONNEL DEVELOPMENT PROGRAMS**—General Electric, a pioneer in industrial training programs, hastens your professional development through classroom and on-the-job assignments as a part of the Company's marketing, manufacturing and engineering programs. Specific position placement is also available if your interests are already formulated.

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● **ADVANCED STUDIES**—General Electric offers to technical graduates the Tuition Refund Program and Honors Program for Graduate Study wherein you may take graduate courses at nearby universities. In addition, G.E. sponsors graduate-level Company courses where top professional men teach in their respective fields.

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