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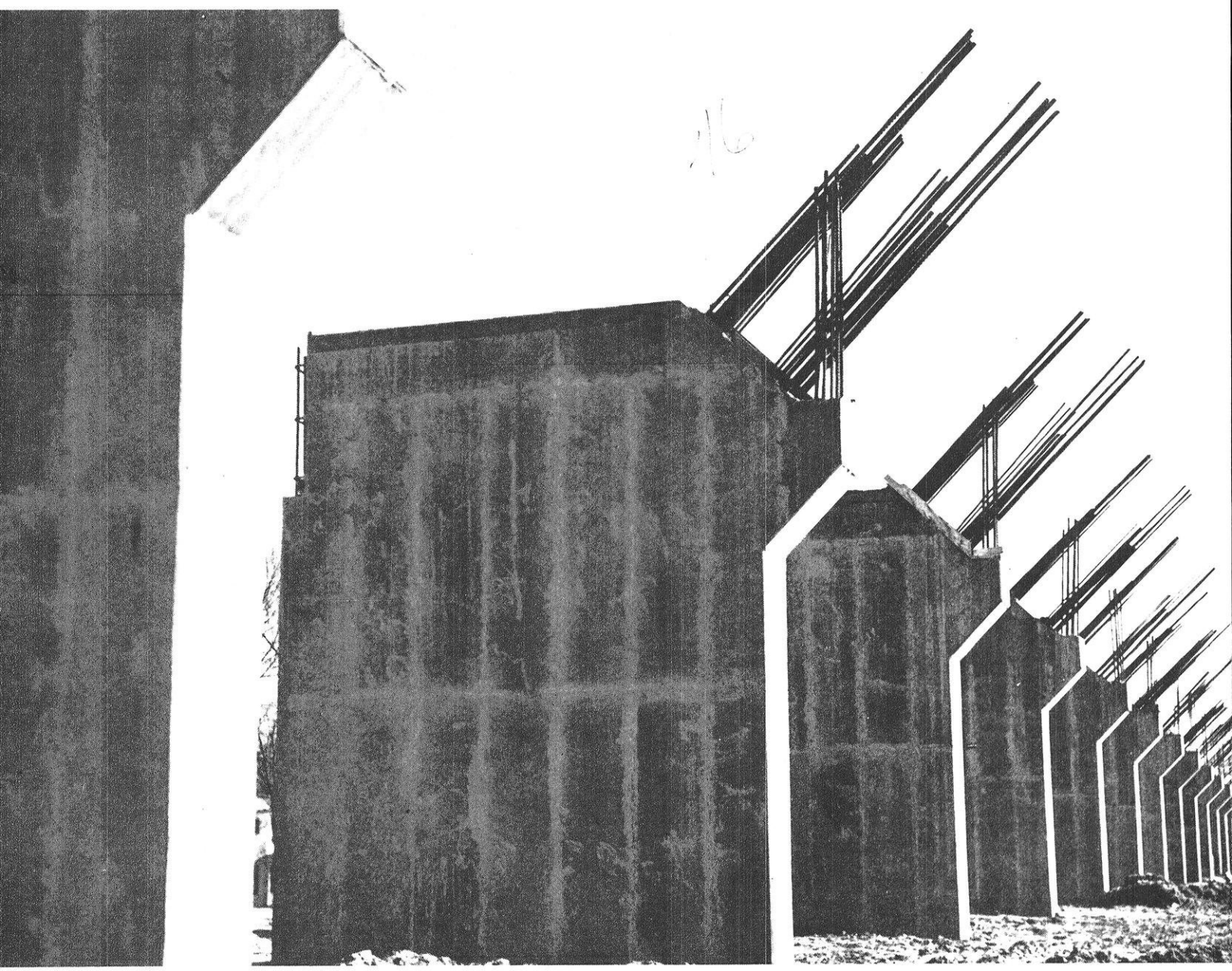
The Wisconsin engineer

APRIL, 1955 25¢



in this issue

John F. Holt, class of '47

speaks from experience when he says . . .

"Expanding research and product development at U. S. Steel mean more opportunities for qualified engineers"

SINCE 1952, John F. Holt has been Assistant Superintendent of the Coke and Coal Chemicals Department at United States Steel's new Fairless Works in Morrisville, Pa. He started working at U.S. Steel—as a trainee—in 1947. That's a lot of progress in just five years. For in his present position, John is responsible for both the quality and the quantity of all coal chemicals produced at the Fairless Works – about 3,500,000 gallons of light oils per year. 190 hourly employees and 25 supervisory personnel report to him.

But John's case of rapid advancement is not unusual. U.S. Steel has always placed great emphasis upon its management training programs and has provided the kind of training that enables ambitious young engineers to take over responsible positions within a comparatively short time.

As one example, John feels that the opportunities in his own department are very promising at this time. He says, "Many important new concepts of modernization and expansion in such fields as the carbonization of coal and synthetic products are coming up every day pointing the way to extensive future developments. Well-trained engineers will be in a position to lead the way into these new areas of industry."

If *you* are interested in a challenging and rewarding career with United States Steel and feel that you can qualify, you can obtain further information from your college placement director. Or we will gladly send you our informative booklet, "Paths of Opportunity," upon request. Just write to United States Steel Corporation, Personnel Division, Room 1622, 525 William Penn Place, Pittsburgh 30, Pa.

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They're having a **GRADUATION CONFABULATION**

It's not much more than a hop, skip and jump to Commencement. And engineering seniors are getting together for long talks on what they're going to do after graduation.

Frankly, we wish we could be present at such sessions. We'd register a few enthusiastic opinions of our own—on the subject of career opportunities at General Motors.

For a starter, we'd point out that young engineers have an admirable chance to follow their natural bent in a company like GM—which manufactures products ranging from cars and locomotives and earth-movers all the way to household electrical appliances.

On top of that, GM's extensive decentralization into 121 plants gives our young engineers an unusually fine opportunity to work in locations of their choice. Besides, this policy provides the chance to learn and win recognition while working with a close-knit engineering team.

And for the record, we'd like to make mention of GM's incomparable resources and facilities. While each of GM's 35 manufacturing divisions has its own, they can all draw on vast central research facilities.

But most important, remember that GM thrives on engineering achievements – constantly seeks to produce more and better things for more people. Hence, there's a really stimulating creative climate that's ideal for men with enthusiasm and imagination.

So if you'd like to toss your mortarboard in the ring, why not ask your Placement Office to arrange an interview with our College Representative. Meanwhile, write us for the informative booklet, *"The College Graduate and General Motors."*

GM Positions Now Available in These Fields:

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Personnel Staff, Detroit 2, Michigan

IBM news

FOR ENGINEERING STUDENTS

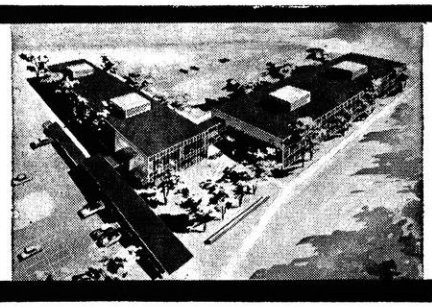
"IBM's a great place to work," says engineer now in his 8th year with the company

"Every year with IBM is more challenging than the last," says Max E. Femmer, Development Engineer at Poughkeepsie. "It was a tremendous satisfaction in 1952 to help develop IBM's outstanding 701 Electronic Computer. Today, our projects and our work are even more interesting. Both my wife and I think IBM is a wonderful company."
Mr. Femmer is Technical Administrator of the entire Electronic Data Processing Machine Development Program.

IBM Introduces 12 New Products in Year

The 12 new products introduced in the past 12 months dramatize IBM's continuing diversification.

Ranging from the versatile "Cardatype"—a major step forward in the simplification of office work—to the gigantic NORC, the most powerful electronic digital computer ever built, IBM's products serve *all* industries plus government and education.



IBM building 5 new labs

By early next year, 1500 members of IBM's engineering staff will be working in five new buildings now under construction (two sketched above). They will be built at Poughkeepsie, N. Y., and at Glendale, N. Y. overlooking the Endicott Valley.

Ability is quickly recognized —and rewarded

At IBM, lack of years is no handicap. Frequently, the soundest creative thinking comes from young minds. For example, average age of the engineering team that developed the 701, first of IBM's great electronic computers, was *28 years.*

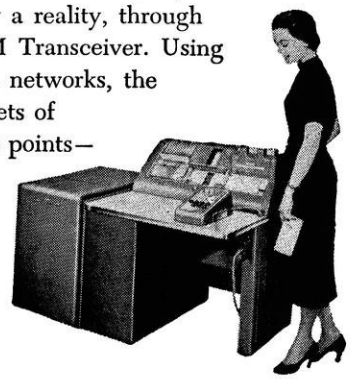
WHAT A YOUNG ENGINEER SHOULD KNOW ABOUT IBM

IBM is a company on the move! New ideas, new expansion create exciting opportunities.

- IBM has a 41-year record of steady growth. Sales have doubled on an average of every 5 years during the past 25.
- IBM serves all industries, plus government and education—diversified, non-seasonal markets free of the fluctuations of war and peace . . . your best assurance of stability and growth.
- Salaries are excellent—with advancement based on merit. Benefits include company-paid hospitalization, life insurance and retirement plans.

NEW IBM MACHINE AUTOMATICALLY TRANSMITS DATA OVER TELEPHONE CIRCUITS

Instantaneous and accurate transmission of engineering and research data between widely separated computer centers is now a reality, through development of the IBM Transceiver. Using telephone and telegraph networks, the Transceiver duplicates sets of punched cards at remote points—can be used to link plants or branches thousands of miles apart.



FOR INFORMATION ON IBM CAREER OPPORTUNITIES

Ask at your College Placement Office for a copy of IBM's new booklet "Opportunities Unlimited" or write, giving details of your education and experience to:

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Looking ahead with Detroit Edison

Important new addition to the engineering facilities of Detroit Edison is this huge System Analog and Network Computer, bringing new speed, accuracy and convenience to solving the problems of providing better power systems, both for today and for tomorrow.

Designed and built by Detroit Edison engineers, this unique four-ton machine reproduces in miniature the company's power system, and can be varied to simulate other power systems as well. The effect of any combination of generators, transformers, lines, cables and other equipment, and of any variations in components within the system, can be determined in a fraction of the time required by conventional methods.

The System Analog and Network Computer, along with other advanced electronic equipment, such as the digital computer, serves Detroit Edison engineers in a variety of fields, including research, system operation, and production, planning, project and design engineering. . . . Such advanced facilities, combined with the steadily rising demands for electrical power in Detroit and Southeastern Michigan, enable Detroit Edison to offer young engineers an outstanding opportunity and challenge to build for their own futures.

For the full story of career opportunities at Detroit Edison, simply call or write for a free copy of this new booklet, "Detroit Edison Engineering."

THE DETROIT EDISON COMPANY

2000 Second Avenue

Detroit 26, Michigan

Volume 59 APRIL, 1955 Number 7

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WISCONSIN ENGINEER

The Student Engineer's Magazine

FOUNDED 1896

Articles

Departments

Cover

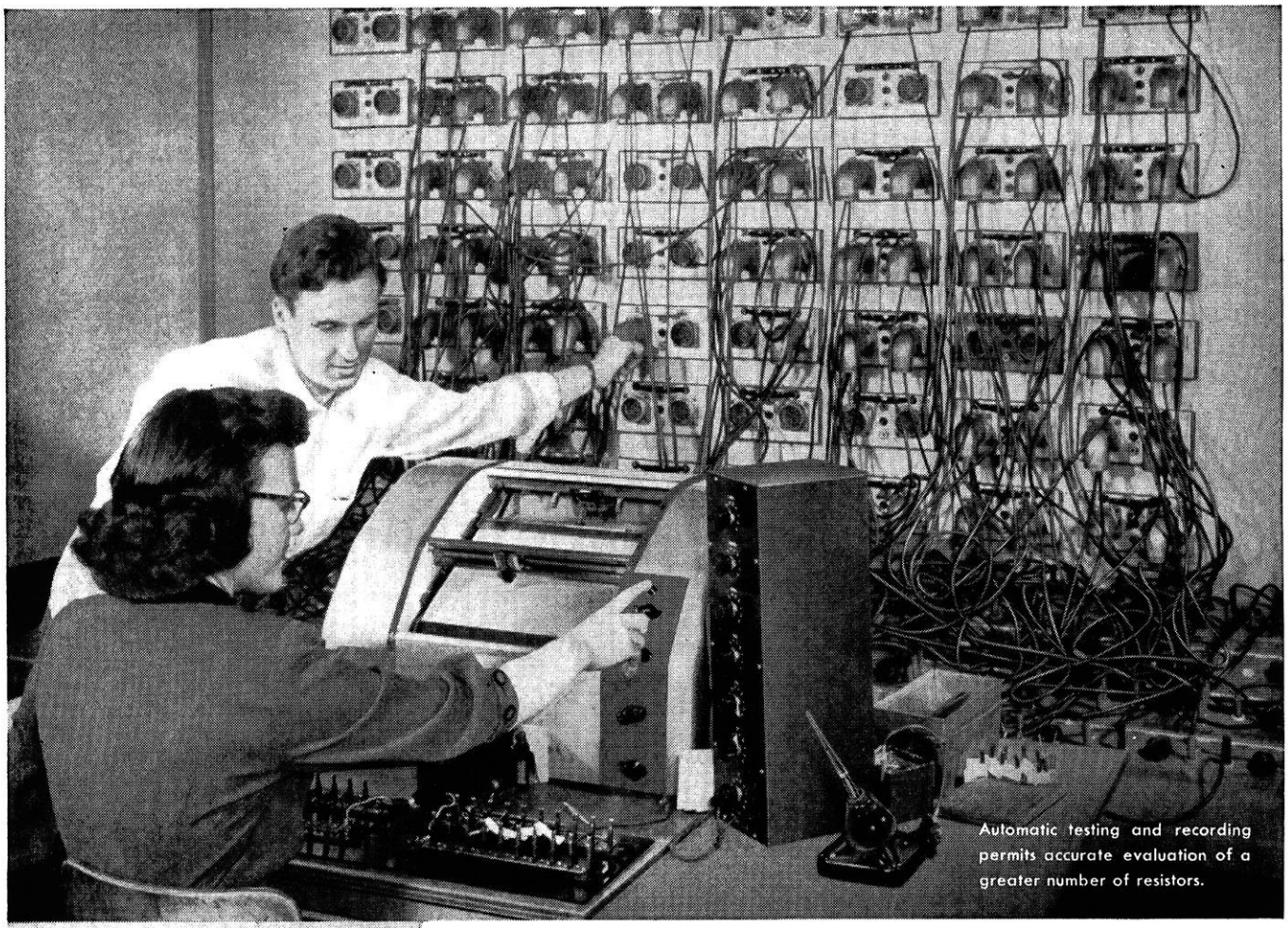
Shown on the cover is one row of reinforced concrete bases for the long roof arches which will soon curve above the University of Wisconsin Athletic Practice Building. The building, now under construction, will be 400 feet long and 190 feet wide. The graceful arches will support a thin concrete shell roof reinforced with steel mesh. The arches provide a building which is completely free of interior supports.—Dave Dauterman Photo.

Frontispiece

Headed for the Mesabi Range in Minnesota and a multimillion dollar taconite project, this bottom shell for one of the world's largest gyratory crushers is shown leaving the Allis-Chalmers plant in Milwaukee.

Weight of this single piece casting is 251,500 pounds, while that of the assembled crusher will be 1,250,000 pounds. When in operation later this year, the crusher will reduce any chunk of taconite that will enter its 5-ft opening down to 10 inches or smaller at a rate of 3,500 tons per hour.

Two 60-ton cranes operating in tandem through a 130-ton equalizer bar were needed to load the shell to a depressed center railway flat car.—Photo Courtesy Allis-Chalmers.



Automatic testing and recording permits accurate evaluation of a greater number of resistors.

BASIC REQUIREMENTS

JAN and MIL Specifications are basic guideposts for electronic advancement, whether used as engineering reference points or as procurement standards. IRC's dual emphasis on mass production and exacting testing assures highest performance standards at lowest possible cost.

SPECIFIC EXAMPLES

Type BT Insulated Composition Resistors
MIL-R-11A Specification

IRC Power Wire Wound Resistors
MIL-R-26B Specification

Type BW Low Wattage Wire Wounds
JAN-R-184 Specification

Sealed Precision Voltmeter Multipliers
JAN-R-29 Specification

ONLY IRC MAKES SO MANY JAN AND MIL TYPE RESISTORS

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56 different IRC resistors is today's figure—all equivalent to JAN or MIL specifications. Manufacturers of military equipment who must meet these specifications depend on IRC for all their resistor requirements. Offering the widest line of resistors in the industry—138 different types in all—IRC is the logical source of JAN and MIL type units.

IRC

Wherever the Circuit Says

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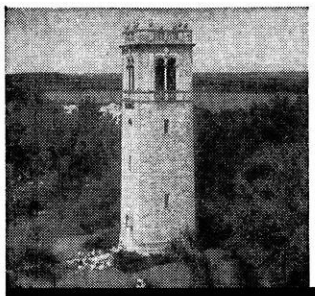
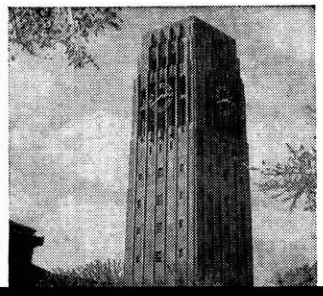
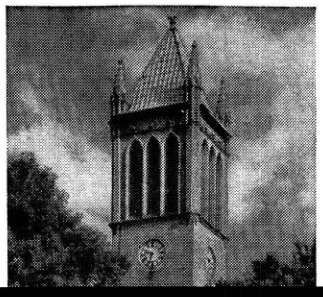
In Canada: International Resistance Co., Toronto, Licensee



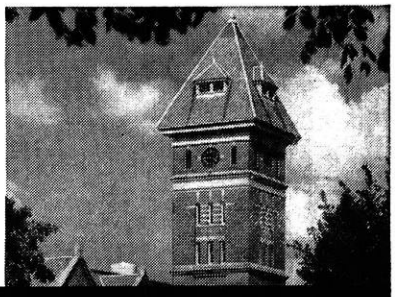
WISCONSIN



MICHIGAN



IOWA STATE



PURDUE

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PENN STATE

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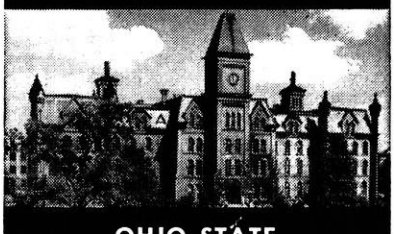
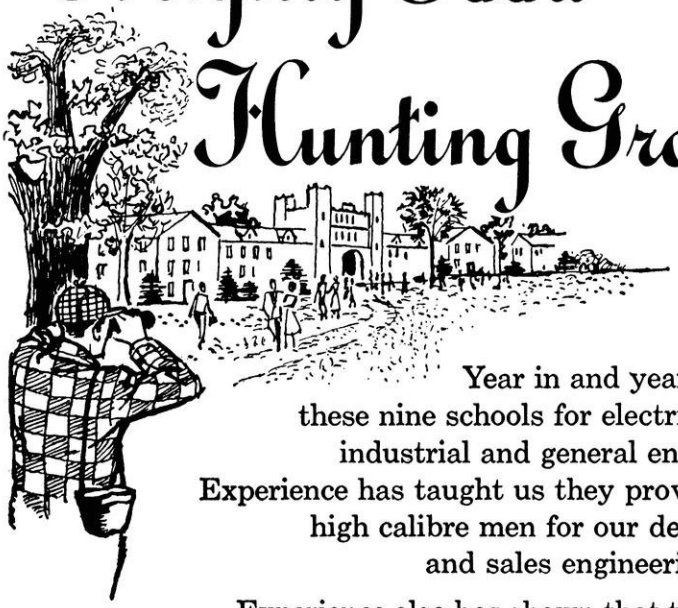


OHIO STATE

these are Mighty Good Hunting Grounds!



Year in and year out, we look to these nine schools for electrical, mechanical, industrial and general engineering talent. Experience has taught us they provide consistently high calibre men for our design, production and sales engineering assignments.

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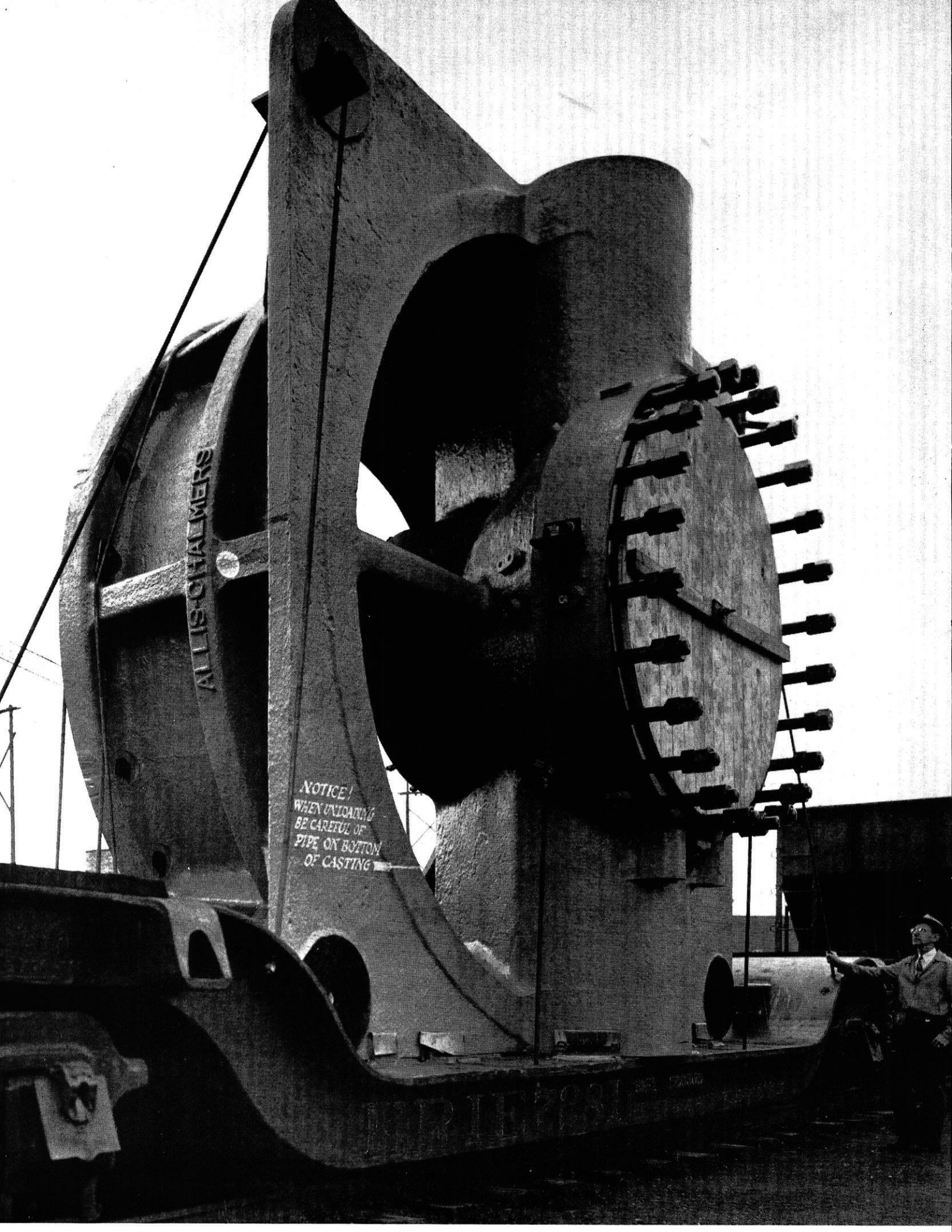
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WHEN UNLOADING
BE CAREFUL OF
PIPE ON BOTTOM
OF CASTING

editorial

Now is the Time . . .

It sure would be nice to have a few clocks in the ME building. Student ME's in thermo lab always know the time—there are two clocks in that room. The Electrical Engineering building is loaded with clocks; there's no excuse for being late for class there! But the Mechanical Engineering building?—no Sir. For some reason the place has none. Sure would be nice to have a few, though.

The Boundaries of the Campus are the Boundaries of the Lake . . .

Did you ever walk to a class on the engineering campus from the Memorial Library? Many students walk that far, and farther, every day. It's about a mile walk for many of them. Then notice the plans laid out for future University expansion. Where will the new buildings be placed—farther west! The Madison Campus is already over twice as long as it is wide, but the plans contemplate more westward expansion. Pretty soon a 25 minute break between classes will be needed.

True, the Campus would be kept near the lake under this plan. It's also true that, were it expanded to the south, the Milwaukee Road right-of-way and heavily traveled University Avenue would cause even more pedestrian crossing difficulties. Another, and perhaps the biggest, reason for not expanding to the south is this: the University now owns land to the west, but has been unable so far to get the Regents' ok to purchase land south of University Ave. It seems that there has been opposition from a Madison faction which doesn't want this area, between University, Regent, Randall, and Park Streets, taken off the city's tax rolls.

Many feel, however, that the problems stated here can be solved and that the Campus can still be enlarged in the logical direction—to the south. If adopted, this plan would keep between-class time to a minimum and would tend to hold down student use of autos. The Campus would become one impressive area instead of a long, strung out line of buildings.

The solution is yet to be found, but many do hope that it lies to the south.

Time to Reclothe . . .

The "Levi" Factory must be doing a booming business these days. More and more you see them on the engineering campus. They really don't give the neat, business-like appearance all engineers want to have. Some apparently feel it's the thing to wear, but this feeling isn't shared by very many; you can bet your last dollar on that. Actually 'tans' are no more expensive, but they add a lot to a person's appearance.

Here's to a better-looking bunch of engineers who leave their Levi's at home!

K. A. G.

LEONARDO DA VINCI'S PEDESTRIAN IDEA

Each time the wheels turned, a bean dropped to a container below the axle. Then Leonardo counted the beans and multiplied by the wheel circumference to learn how far he'd walked.

Even New Departure ball bearings couldn't do much for Leonardo's simple pedometer. But if Leonardo were designing one of today's complex instruments, he'd call on New Departure for ball bearings. That's because New Departures bring about such advantages as low starting torque and even lower running friction, precise location of moving parts at all speeds, compact design, long life with almost no upkeep. Besides, New Departure's research and manufacturing facilities are unmatched.

No wonder engineers everywhere call on New Departure for the finest in instrument ball bearings.

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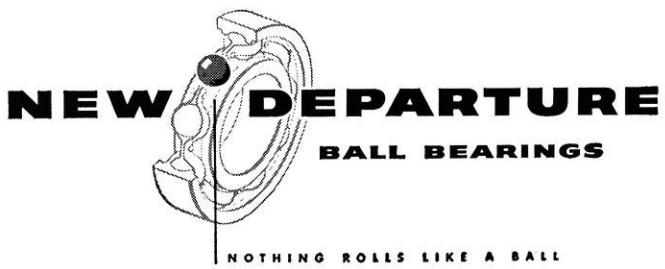


Automatic gram-centimeter torque tester measures starting torque characteristics of New Departure instrument ball bearings. Like many of the ultra-precise devices used in bearing manufacture, this torque tester was largely developed by New Departure.

MISSILE SYSTEMS

Research and Development

Physicists and engineers at Lockheed Missile Systems Division are engaged in a group effort covering virtually every field of science.

Missile Systems Division scientists and engineers discuss a new missile systems concept in light of tactical requirements. Left to right: Dr. H. H. Hall, nuclear physicist; I. H. Culver, systems development division engineer; Dr. R. J. Havens, research scientist; W. M. Hawkins, chief engineer; Dr. Ernst H. Krause, nuclear physicist and director of research laboratories; S. W. Burriss, experimental operations division engineer; Ralph H. Miner, staff engineering division engineer; and Dr. Eric Durand, nuclear physicist.

Continuing developments are creating new positions for those capable of significant contributions to the technology of guided missiles.

Lockheed

MISSILE SYSTEMS DIVISION

research and engineering staff

LOCKHEED AIRCRAFT CORPORATION • VAN NUYS, CALIFORNIA

THE BIG WIND

WIND TUNNELS ARE PLAYING A NEW AND LARGER ROLE IN THIS ERA OF SUPERSONIC SPEEDS

by Stephen K. Carter, m'56

The problems created by the increase in speed of airplanes to the sonic and supersonic ranges have led to a great increase in the number, locations, sizes, air speeds, operating conditions, and functions of wind tunnels. Wind tunnels save time and expense by the reduction of flight testing, which is costly in time and money and also in pilot's lives.

Use of Models

Wind tunnels are primarily used in tests of scale models, since a model, under such conditions as to produce the same Reynolds and Mach numbers as its full scale counterpart, will have forces, moments and flow patterns that can be directly scaled. In most cases models are adequate for high quality research, and if they are not means can be devised to make them work. Increased pressure can be used to build the Reynolds number. Also gases with properties different from those of air reduce the speed of sound. For example, the substitution of Freon 12 for air increases the Mach and Reynolds numbers by factors of 2.5 and 3.6 respectively.

The Eiffel or open-circuit type wind tunnel is generally a venturi-shaped contraction cone, with no provision for guided return of the air to the test section. Except for a few special purposes this type is not used.

The common Prandtl, Gottingen, or return-flow type tunnel provides a continuous path for the air. This type usually provides a single rectangular or circular return channel for the air. There are also a few double- and annular return tunnels in operation.

Further identification may be made by the cross-sectional form of the test section, commonly called the jet. It may be rectangular, octagonal, circular, elliptical or a modification of any of these forms. Also the jet may be completely walled in, called a closed jet, or it may be a completely open space, called an open-jet, with air flowing freely from the entrance cone to the exit cone.

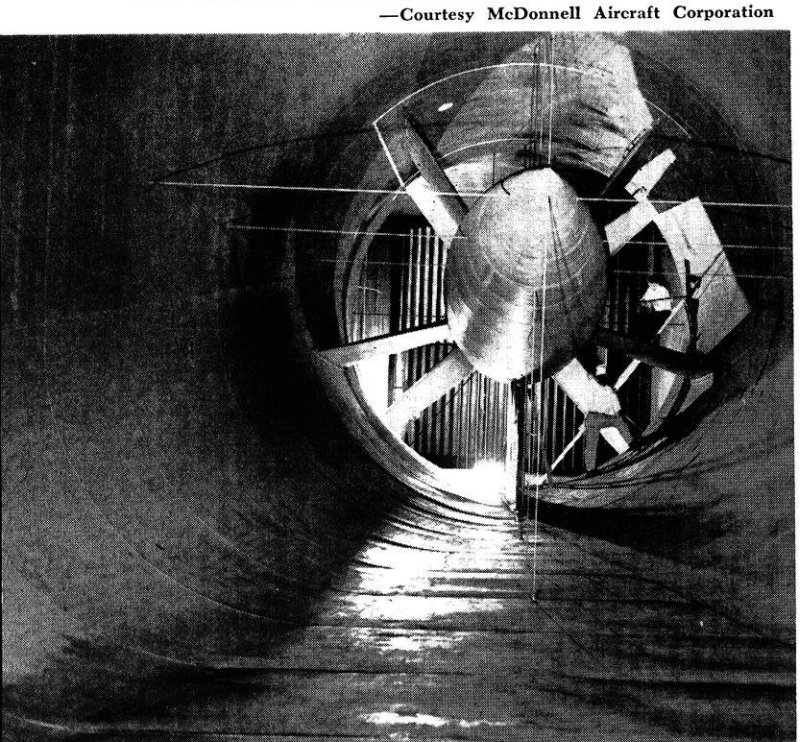
The induction trans- or supersonic-type tunnel resembles the Prandtl wind tunnel except that downstream from the test section it employs an annular slot which emits high pressure air or steam into the stream. The use of dry steam has proved most successful due to the tremendous pressures that modern boilers can produce.

Supersonic tunnels are of two main types, intermittent and continuous. The intermittent tunnels consist of the "Blowdown" type, where high pressure air is stored in pressure tanks and then exhausted through the jet, and the "Suckdown" or indraft type, where pressure vessels are evacuated and then the intake is directed through the jet. Naturally a combination of the two systems brings even higher Mach numbers due to the increased pressure differential.

The continuous types are basically the same as the subsonic tunnels. The main difference is a decrease in the jet static pressure to well below atmospheric pressure.

Fig. I.—A view of the motor nacelle in the McDonnel wind tunnel. Also visible are the fan blades and the anti-twist vanes. Note the size of the men inspecting the braces.

—Courtesy McDonnell Aircraft Corporation



Design of Supersonic Tunnels

The main design changes between the sub- and supersonic tunnels are: the need for a contracting-expanding nozzle, since sonic velocity can occur only at a minimum section in the duct; and avoiding condensation due to the great drop in temperature (90° F at Mach 1.0; 230° F at Mach 2.0) caused by expansion through the nozzle. This can be done either by permitting tunnel temperatures to rise or by drying the tunnel air.

The difficulties increase many fold when the Mach number reaches the hypersonic range (greater than Mach 5.0). The greatest problem is that caused by the temperature and pressure change with the Mach number, which results in liquification of unheated air. Also the power requirements become enormous in the hypersonic range.

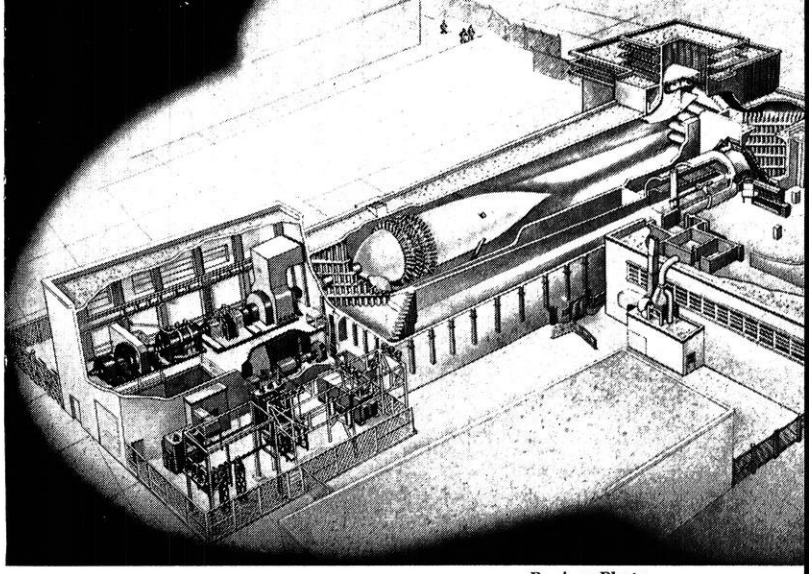
Location of Testing Facilities

There are about 200 wind tunnels in the United States today. These are evenly divided between subsonic, and trans- and supersonic. About 30 of these tunnels are located at 17 universities for classroom instruction and research. The test sections ran as large as 8 by 12 ft. in the subsonic range and Mach numbers range as high as 10 +.

Privately Owned Tunnels. Most aircraft and engine manufacturers have at least one tunnel. These tunnels range in size from 4.5 by 5 in. to 8 by 12 ft. The outstanding example of a privately owned test facility is the Edmund T. Allen Memorial Aeronautical laboratory of the Boeing Airplane Company, Seattle, Washington (see Fig. II). The original tunnel was powered by an 18,000 hp motor and developed speeds up to 700 mph. Recent addition of a 36,000 hp motor provides a total of 54,000 hp, and speeds up to Mach 1.2 have been attained. The tunnel is a semi-closed system with a jet size of 8 by 12 ft. This is the largest privately owned test facility in the world.

In one case five aircraft companies: Douglas, Lockheed, North American, McDonnel, and Convair, have formed the Southern California Co-operative Wind Tunnel operated by the California Institute of Technology. This tunnel is a Prandtl type with a jet size of 8 by 12½ ft. and velocities up to Mach 1.2.

NACA. The outstanding factor in the wind tunnel business is the National Advisory Committee for Aeronautics (NACA). The NACA operates three wind tunnel centers: Langley Aeronautical Laboratory, Langley, Virginia; Ames Aeronactical Laboratory at Moffet Field, San Francisco; and the Lewis Flight Propulsion Laboratory, near Cleveland.



—Boeing Photo

Fig. II.—This cutaway view shows details of the modified Boeing wind tunnel. The two-stage fan describes a 24-foot circle, forcing air past the 18-foot-diameter nacelle, around two turns and into the test section.

Langley's buildings house 20 tunnels, mostly special purpose like the 5 ft Free-Flight Tunnel. The largest is a 60 by 30 ft full scale tunnel with speeds up to 120 mph. Four transonic and five supersonic tunnels, with speeds up to Mach 10, are in operation or under construction.

The Ames Laboratory is equipped with nine high-speed tunnels. The largest is a full scale tunnel with a 40 by 80 ft. elliptical jet. Speeds up to 250 mph have been attained, very high for so large a tunnel. In addition to several smaller tunnels, Ames has four large tunnels with drives totaling 422,000 hp.

The Lewis Flight Propulsion Laboratory is principally for engine research. The laboratory is equipped

(Continued on page 58)

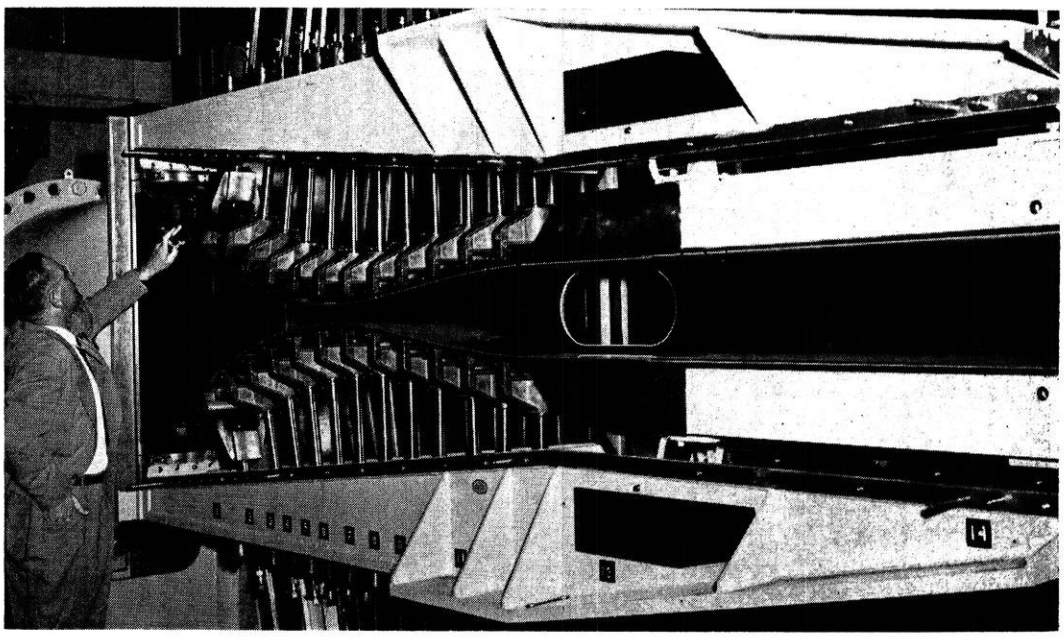


Fig. III—Tunnel E-1, a supersonic model tunnel of the Gas Dynamics Facility, has been operating for more than a year. Speeds up to 3,500 mph have been attained in the 12 by 12 inch test section.

—USAF Photo

PETROCHEMICALS

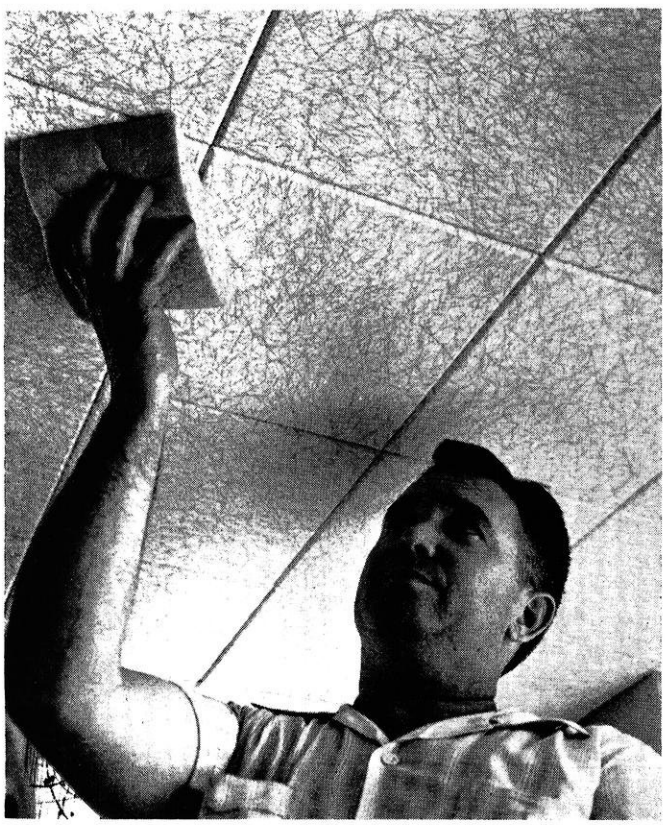
ONCE WASTED, THE BYPRODUCTS OF GASOLINE REFINING NOW ACCOUNT FOR 25% OF U. S. CHEMICAL PRODUCTION

by Leland R. Briggs, Ch'56

It was in the year 1855 that crude oil was first discovered in America. It was found in a pool near Titusville, Pennsylvania. In the same year a group of men, interested in the commercial possibilities of this petroleum, visited Benjamin Sillman, Jr., a professor at Yale College. They requested and received the first scientific analysis of petroleum. As a result of his analysis, Professor Sillman made the following statement: " . . my experiments prove that nearly the whole of the raw product may be manufactured without waste."

In the years following the discovery, many uses were developed for the low boiling, lighter fractions of petroleum. One of the most important uses was as a fuel for the newly developed internal combustion engine. Heavier, more viscous fractions were used as lubricants and the by-products were discarded. It was from these discarded and forgotten by-products that the petrochemical industry arose.

"Mylar" polyester film, one of the newest products of Du Pont research, has an unusual combination of physical, electrical, chemical and thermal properties which make it suitable for a wide variety of industrial uses. Among these is covering for acoustical tile. Acoustical tile made with "Mylar" is easily washed with soap and water and the color remains brilliant for years.



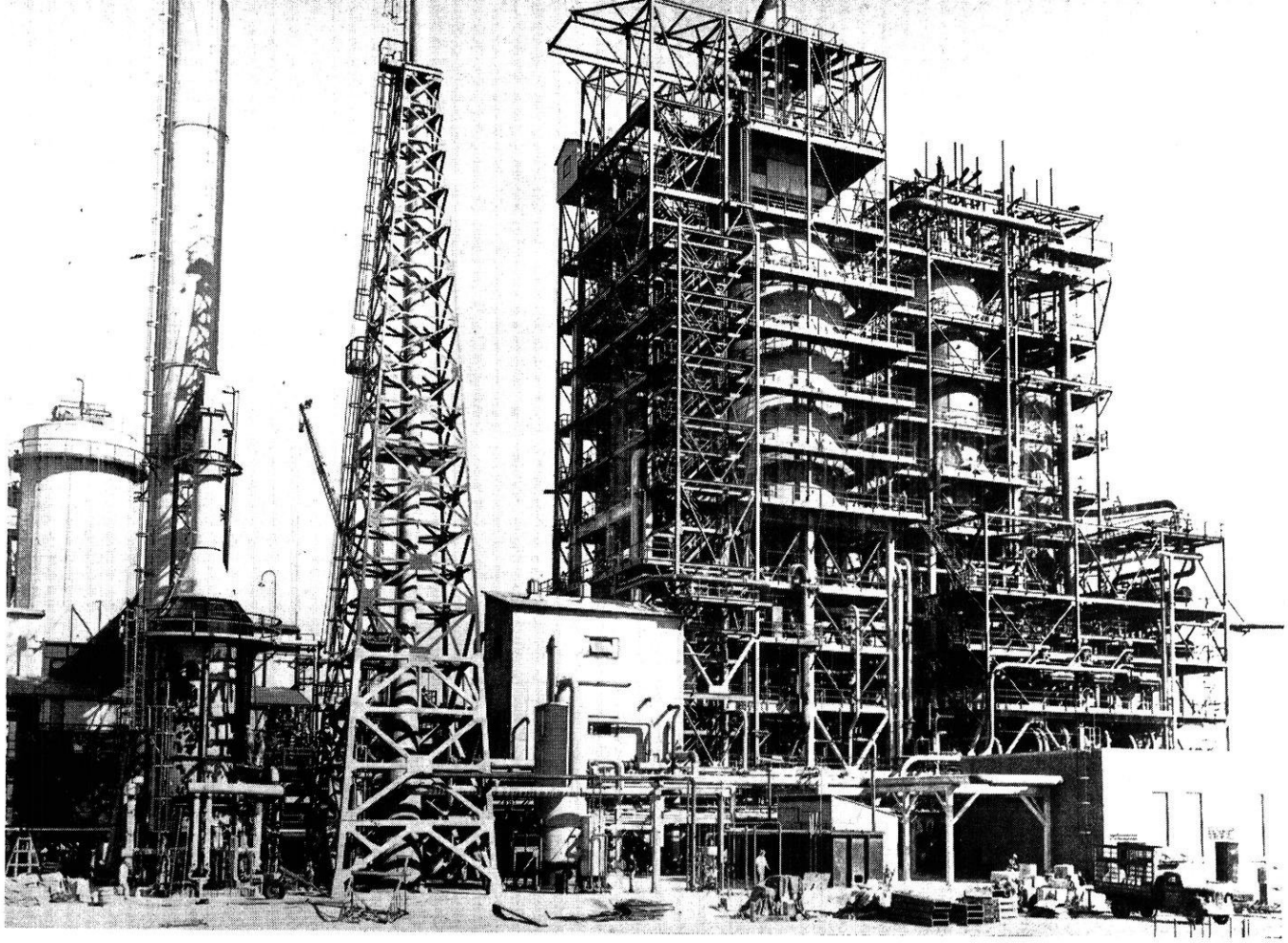
It was not long until the economy minded engineers and executives of the firms utilizing petroleum as a raw material became interested in the possibilities of recovery of materials from the discarded wastes. In the years following 1900, men from these firms and others began to experiment with these wastes. In 1912 scientists were working with naphthenic acids extracted from crude oil to determine their properties, amounts available, and uses. Even as late as 1925, however, a complete list of chemicals actually manufactured from petroleum amounted to only four products, three chlorinated hydrocarbons and iso-propyl alcohol.

Although the petrochemical industry arose from petroleum by-products, it has developed itself to the point where the whole crude oil is now used in the manufacture of some products. The industry is altering our national habits and is bringing undreamed of potentialities to the chemist and businessman. To give some idea of the extent of the petrochemical industry today, of its past, and its future, the following data has been tabulated.

Date	Pounds Petrochemicals Produced
1925[1]	150,000
1942[1]	2,000,000
1952[2]	16,000,000
1962 (EST.)[2]	64,000,000

In 1925 less than 0.1% of all organic chemicals were petroleum derivatives. In 1946, 28% of all organic chemicals were derived from petroleum. In 1952, 25% of all chemicals, both organic and inorganic, made in the United States were petrochemicals. In 1952 scientists and chemists knew some 500,000 compounds which could be made from petroleum and were discovering more everyday. All this information is best summed up by this statement: "Perhaps the most important industrial development of the past several decades, petrochemistry is setting the pace in the fast advancing age of chemistry."

The production of petrochemicals today is divided into several processes, no one of which is completely independent of the others, but is instead, integrated with them to give furnished products of high quality, purity, and usefulness. Hydrocarbons in petroleum vary greatly in composition from methane (CH_4) to high molecular weight compounds. Many petroleums are



Fluid Catalytic Cracking Unit at Standard Oil of Indiana's Whiting Refinery. Some of the products of the petroleum refining done here are used to make petrochemicals.

paraffinic. That is the carbon atoms are connected in chains. Others are naphthenic and aromatic in character. In these, the ends of the carbon chains are connected together to form rings. Rings containing five or six carbon atoms seem to be the most stable. By the use of thermal and catalytic cracking, alkylation, hydrogenation, dehydrogenation, polymerization, oxidation, and halogenation, hydrocarbons and substituted hydrocarbons of almost any structure can be produced.

One of the most important processes for a company engaged in the production of petrochemicals is cracking. There are two types of cracking, thermal and catalytic. Cracking can be defined as the fragmentation or splitting of hydrocarbons by the use of temperature or catalyst to form new, lower molecular weight compounds. This process makes possible the production of thousands of new compounds which would otherwise not be available for use.

One process for thermal cracking of hydrocarbons is the Wulff process. In this process the crude petroleum is diluted with steam. The plant is operated at pressures below atmospheric so that the partial pressure of each reactant is low. The reactants are heated to 2100° F. If the proper petroleum is used, the end product in this reaction is acetylene. This then has become an important process since previously acetylene could only be made in an electric furnace using calcium carbide as a starter.

The thermal cracking of ethane and propane to produce ethylene is another important process. Ethylene was previously only available in limited quantities since it was principally recovered from refinery gas steams. Now it is becoming increasingly important due to its availability.

In catalytic cracking high temperature is still important, but in order to speed a reaction a catalyst is added to the process. Many catalysts can be added to the process and each one does a specific thing to a specific reaction. Catalysts can cause swifter reactions, more complete reactions, or more selective reactions.

Alkylation is another process which is important in the petrochemical industry. Much importance was attached to it during the Second World War because the products obtained were used in aviation gasoline. Alkylation is usually the reaction of iso-butane or other saturated hydrocarbons with unsaturated alkenes or aromatic ring structures to produce branched hydrocarbons having properties which make them suitable for base stocks for blending aviation gasolines.

Alkylation can be carried out at either high temperature and pressure or low temperature and pressure using a variety of catalysts. Sulfuric acid (H_2SO_4), hydroflouric acid (HF) and aluminum chloride ($AlCl_3$) are the most common catalysts.

The alkylation of isobutane and ethylene under the influence of high temperature and pressure gives neo-

Du Pont's new "Mylar" polyester film emerges in a continuous sheet at the end of the manufacturing at the Circleville, Ohio, plant. It is then wound on large mill rolls, which are later slit in widths from 1/2 inch to 54 inches. The film is carried on overhead conveyors to the shipping room.

hexane, better known to the public as victane. Victane was one of the main components of British aviation gasoline during the Second World War. The reaction of iso-butane and propylene using aluminum chloride as a catalyst produces iso-heptanes. Iso-heptanes are used in ordinary motor fuels. The hydrocarbons produced by alkylation in these examples are longer chained and branched. In general it will be found that this is the case.

Alkylation of naphthalene with olefins of high molecular weights, produced in the cracking of paraffin waxes, gives a lubricating oil pour point depressant and improver. Uses such as the ones previously mentioned caused the production of alkylates to rise as high as 150,000 barrels per day during the Second World War.

Hydrogenation and dehydrogenation are important processes to the petrochemical concern. One process is exactly the reverse of the other. Hydrogenation is of use in altering hydrocarbon structures. Direct hydrogenation of olefins produces the corresponding paraffins. It also gives partially or completely hydrogenated ring structures if aromatics are used as starting materials. Many times a catalyst such as nickel or palladium is used in the hydrogenation to induce the reaction to go faster.

Destructive hydrogenation is used to increase the yield of low boiling hydrocarbons from crude oil and to alter the composition of heavier portions. This is useful since better gasoline is made from lower boiling, more combustible fractions of the crude oil.

Many important petrochemicals are produced by dehydrogenation. Dehydrogenation is exactly what it says. It is the removal of hydrogen from molecules in order to produce new molecules having entirely different properties. This process can be induced in several ways but is generally done in the presence of a catalyst. Dehydrogenation of butane and normal butylene gives butadiene, the all important chemical in the manufacture of GR–S rubber. Styrene, the other chemical important in the manufacture of GR–S rubber is made by the dehydrogenation of ethylbenzene. In that reaction iron oxide is used as a catalyst.

Fractions of petroleum containing cyclohexane and methylcyclohexane are dehydrogenated to produce the important petrochemicals benzene and toluene respectively. Ketones such as acetone are produced by passing alcohols over a copper-zinc catalyst at a high temperature.

Polymerization, the forming of long chain molecules with high molecular weights, is another important process in the petrochemical industry. In polymerization relatively low molecular weight compounds are reacted with themselves or with other compounds. Many of these reactions are catalytically controlled. Some of the most important catalysts are phosphoric acid (H_3PO_4), and aluminum chloride ($AlCl_3$). The products obtained have a variety of properties. The outstanding ones are high viscosity of liquid products and toughness of solid products.

Extensive polymerization of iso-butylene yields products which are either very viscous liquids or solids. Copolymerization of iso-butylene with a small amount

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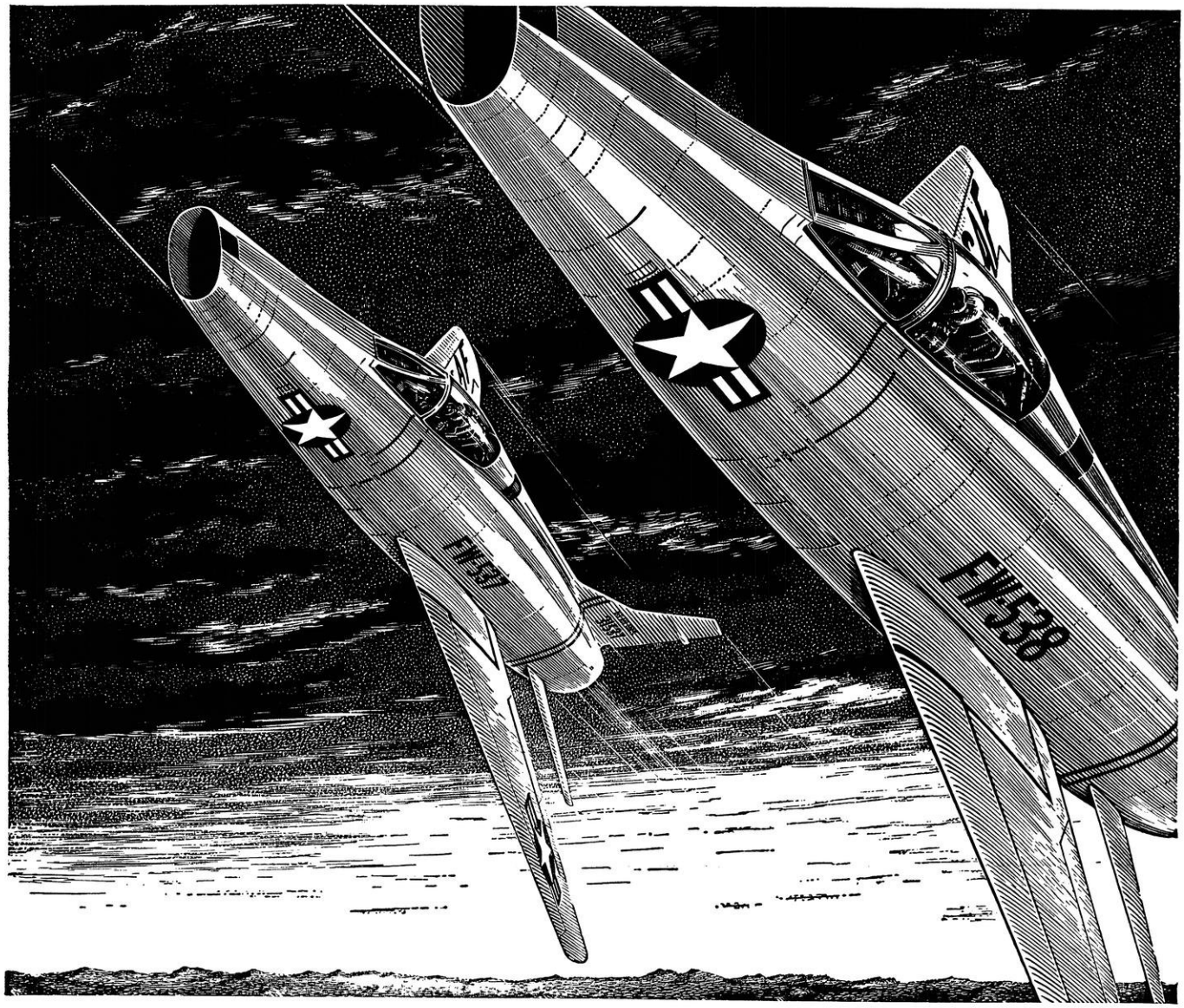

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ENGINEERING AHEAD FOR A BETTER TOMORROW

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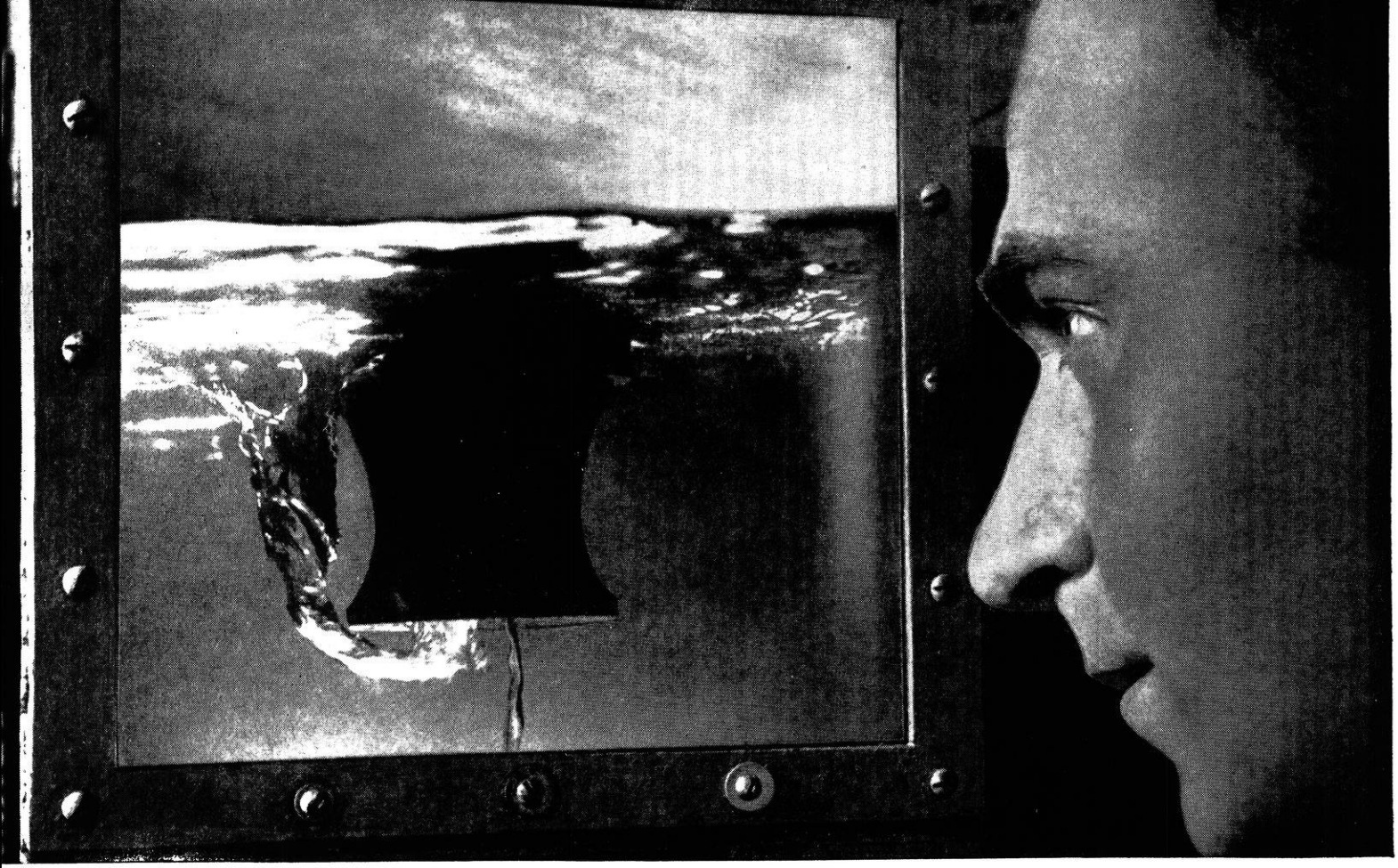

A WHIRLPOOL SPIRALS into the inlet of a model pump. This unique picture shows how air, a common cause of pumping trouble, was carried into the pump in . . .

The Case of the Baffled Whirlpool

Some time ago, the report reached us that two Worthington vertical turbine pumps installed by one of our customers weren't working right. They delivered plenty of water, but vibrated badly and burned out bearings.

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A whirlpool immediately formed between the water surface and the pump inlet. Air, trapped in the whirlpool and carried into the pump, was the villain in the case.

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What's an Engineer Worth?

by Emeritus Dean M. O. Withey

Morton O. Withey, Emeritus Dean of the U. W. College of Engineering, came to Wisconsin in 1905 with degrees of BS and CE from Darthmouth. He was Dean of the College of Engineering from 1946 to 1952, prior to which he was Chairman of the Mechanics Department. He has written several texts on strength of materials, drawing on his vast knowledge gained in 27 years as head of the University's materials testing laboratory.

Withey is an active member of ASTM, ASEE, ACI, NSPE, and WSPE, and has had numerous positions and honors in these organizations. He is interested in camping and golf, and is a member of the Madison Rotary Club.

This report is confined to a brief review of the engineering salaries which have come to the attention of the W.S.P.E. committee on Fees and Classification. The information is herewith transmitted to the membership of the society and certain recommendations are made which it is hoped will be beneficial to both the profession and the public.

Offers to Graduating Engineering Students

Last year attention was called to salaries being offered to inexperienced graduating students, and comparisons were also made between the salary scales of beginning engineers and those given to persons of experience. It was pointed out that whereas the beginners were being paid a reasonable wage, the scales for engineers with five to twenty years of experience were for the most part entirely too low.

In this connection information from the University of Wisconsin's placement officer, Professor Henry G. Goehring, indicates the following starting salaries are presently being offered by interviewers to graduating senior engineers.

TABLE I

Number of Firms	Location	Monthly Salaries Offered in Dollars Range	Average
76	Out of State	331 to 415	367
12	In State	335 to 390	353

Students with a Master's degree in engineering are being offered from $35 to $50 per month more than those with a Bachelor's degree. Those engineering students who are receiving a Ph.D. degree are being offered on the average $550 to $575 per month.

So anxious are companies to obtain options on the services of engineering graduates that about ninety per cent of the companies are offering positions without regard to the military status of the student despite the fact that about 80 per cent of the graduates face a military experience in the near future. Of the men who return from service, nearly 80 per cent are going back to companies with which they were previously associated.

Salaries in State and Federal Services

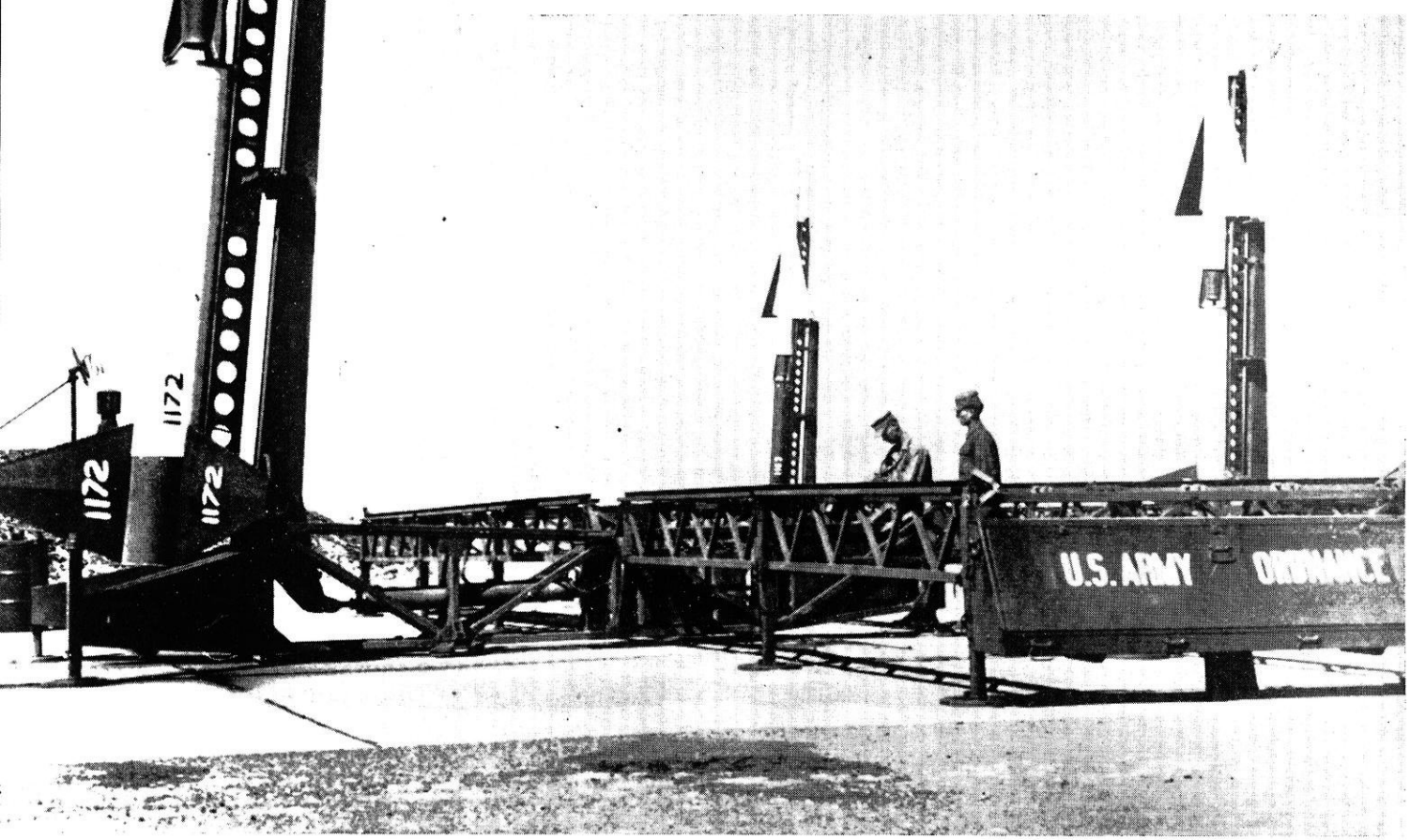
The Wisconsin Highway Commission has made no overall changes in its salary scales since last year; but Mr. Astell, who has recently retired from the position of personnel officer, reports that whereas the initial salary offered at the Engineer I level is only $337 per month, including bonus, the Commission has provided some fringe benefits which make the positions in the lower brackets more attractive. These benefits are more rapid promotions, pay for overtime, reasonable travel allowance, and a sound training program for beginners. Mr. Astell stated that there isn't much wrong with the beginners' salaries in that department. On the other hand, he pointed out that these beginners are discouraged from continuing in the highway service by the evidence of inadequate financial compensation which is presently being given to experienced personnel within the organization. His data show that Wisconsin pays lower salaries in most of the upper grades than is paid for like services in adjoining states. Consequently he stated that salaries for the position of chief engineer ($875 per month), for departmental heads Grade VI ($687–827 per month), for Grade V ($637–757 per month), and for Grade IV ($542–637 per month) should all be increased.

(Continued on page 50)

What Guides the GUIDED MISSILES

THE STORY OF THE CONTROL OF FANTASTICALLY COMPLEX WEAPONS WHICH GUARD OUR SKYS

by Dick Groth, e'55



—Western Electric Photo

The Nike, the first supersonic anti-aircraft missile that can track and destroy an enemy target regardless of weather or evasive action. The liquid-fueled missiles are 20 feet long and one foot in diameter. A booster rocket, which compromises the lower portion of the missile as it stands in firing position, detaches when the missile is in flight powered by its own rocket engine. Though a valuable defense weapon, the Nike's high cost and short (15 miles) range limit its use.

One June 13, 1944, the Nazi regime unveiled an age of new warfare techniques with the launching of the Vergeltungswaffe #1—Revenge Weapon #1. It screamed into London apparently uncontrolled and loose, but in reality it was closely subjected to the wishes of its German creators. It was the first war-molded guided missile.

Since then guided missile research the world over has led to missiles that can sense the heat of a man's body from a distance of a quarter mile; that can track a plane flying at supersonic speeds at 30,000 feet of altitude and bring it to earth; that can fly, unmanned by humans, a distance of 2500 miles and strike a predetermined area with a radius of accuracy of a few miles. NATO forces in Western Europe are now bolstered with the U. S. Air Force B–61 Matador, a pilotless aircraft designed for long range use. Nests of Nike supersonic anti-aircraft rockets encircle Washington, D. C. and New York City waiting to welcome enemy bombers. It is no longer true that we have only the push-button of the often talked of push-button warfare.

What quality is common to each of these devices? How are they alike? Their similarity involves the manner in which they find their objectives. A signal, or command, from some control center is transmitted to the missile, and the missile interprets the command and reacts. Generally, the missile will return a signal, indicating its reaction, to the control center. The accomplishment of these functions, plus less fundamental activities such as prevention of signal transmission interference, is the object of today's guidance systems.

Missile control is accomplished by one, or a combination, of three basic guidance systems: preset, command, or homing guidance. Preset guidance is the simplest control method; it relies almost entirely on preflight settings of controls and gyroscopes.

Since the common denominator of all missile control systems in use today is the gyroscope, it will be profitable to examine its principles and properties. It is actually a rotating wheel, universally mounted; that is, mounted so that it is free to rotate about any axis. It's free to rotate about its 'spinning' axis, the wheel's axle. It's also free to rotate about the vertical axis, which is in the plane of the wheel, and intersects the spinning axis at right angles. And finally, the wheel is free to rotate about the horizontal axis, which axis intersects the vertical axis at right angles at the intersection with the spinning axis. The vertical and spinning axes are always at right angles, but the spinning axis may make any angle with the horizontal axis.

The most vital and fundamental property of the gyroscope is its stabilizing property. It results from the fact that the angular momentum of the gyroscope can be increased almost without limit by increasing the

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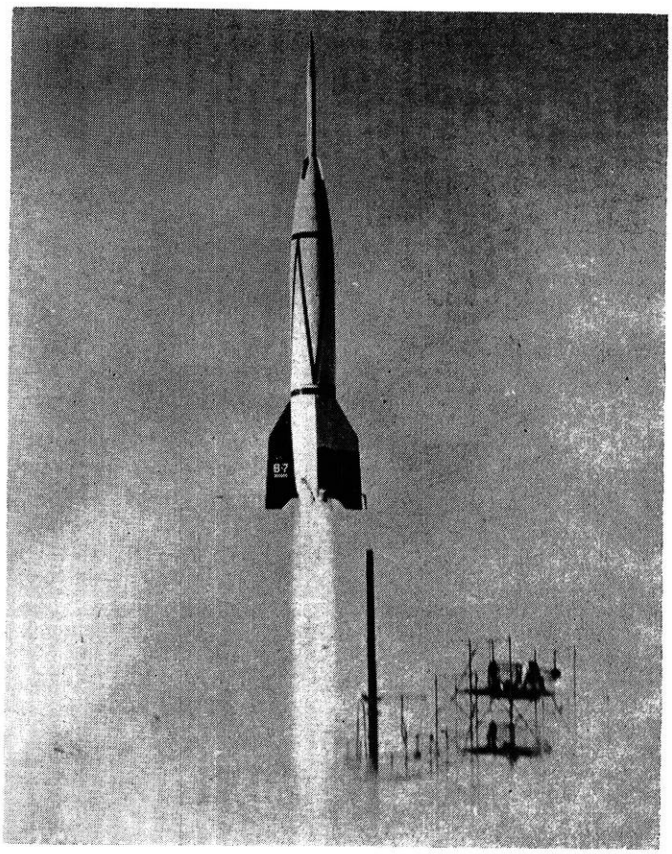
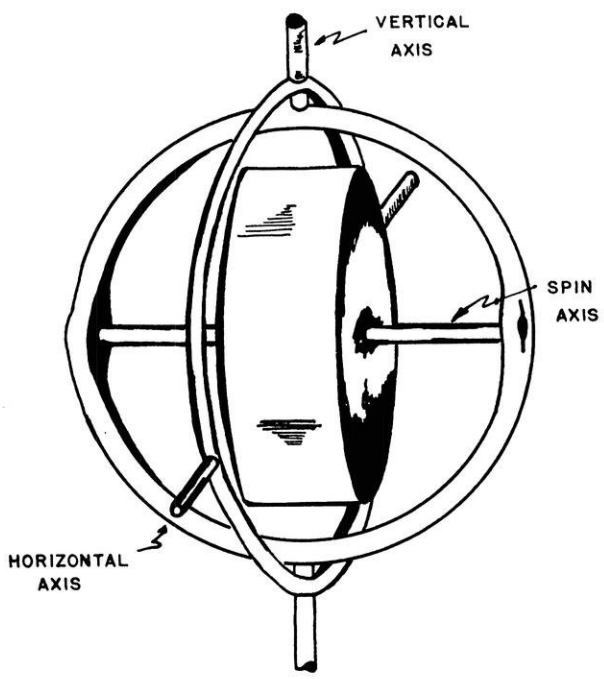


—General Electric Photo

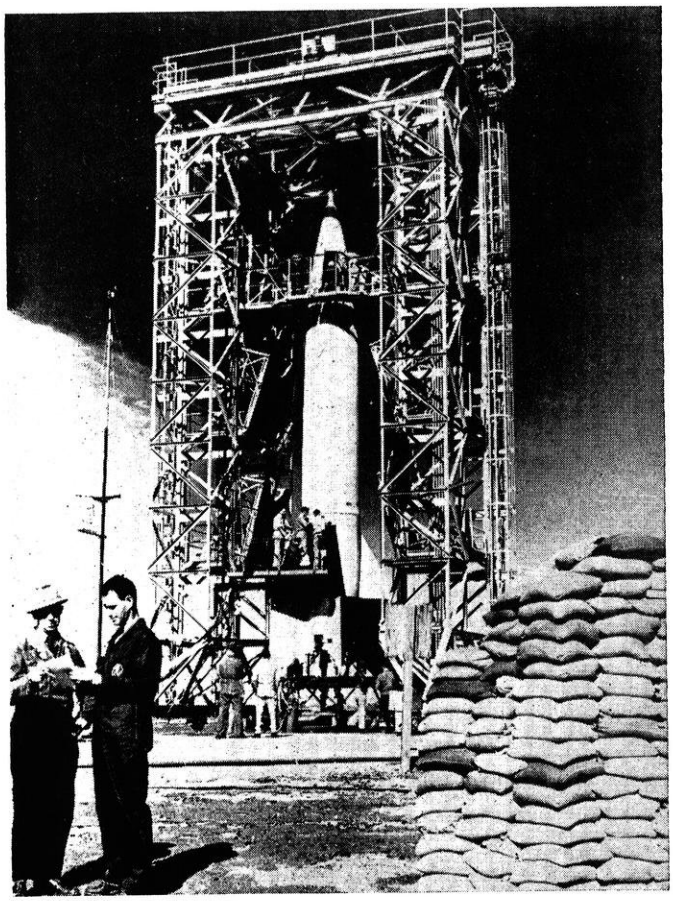
Army Ordnance's two-stage Bumper rocket zooms skyward from the long-range Proving Ground at Cocoa, Florida, on the first leg of its flight. When the basic vehicle, a V-2, reaches the end of its first burning period, the smaller Wac Corporal missile will be separated from the nose for its own high-powered flight. An Ordnance Bumper similar to this test vehicle attained a speed of 5,000 miles an hour and a height of 250 miles at their White Sands Proving Ground, the greatest velocity and highest altitude ever attained by a man-made object.



GYROSCOPE

mass, diameter, and/or spin of the wheel, thereby endowing it with a very large gyroscopic inertia. When installed in an aircraft one of the axes, usually the horizontal, is restricted by being the axis of mounting within the body of the aircraft. The flywheel of the gyro, given a large value of angular inertia, will hold steadily to its position in space with its spinning axis constant, regardless of the position of the aircraft. The theory of the gyroscope is simply Newton's first law of motion applied to rotating bodies. This steadfastness of the gyro is utilized by electronically coupling the space constant axes with the moving body of the aircraft so that any relative movement between the two may be detected, amplified, and used to activate servomechanisms to correct the ship's movement or perform any desired operation.

What happens when it's desirable to turn the aircraft without alerting the error-sensing devices? It's possible to turn the axes, except for the one stationary axis, relative to their original space positions by a simple method called precessing. Precessing means that an external couple is applied to one of the axes; it causes angular momentum about this axis. Newton's second law of motion states that the resultant of any addition of components of angular momentum is the vector sum of the two. On the gyro the externally caused couple gives a component of angular momentum which, when added to the large existing component caused by the spinning flywheel of the gyro, results in a third component of angular momentum. The gyro flywheel will now spin on a new space axis which is not the axis of either of the former components of angular momentum. It can be brought to any new position, depending on the magnitude and length of time that the external couple is applied. Thus the aircraft can be made to turn in space by the application of a small couple, or torque, which may be controlled electronically from nearly any distance.



Guided-missile engineers of "Project Hermes" have regularly exchanged technical information with German and other Army Ordnance V-2 specialists at White Sands Proving Ground, N. M. On-the-spot discussions (as shown above) considerably increased American rocket know-how and provided a solid foundation for advanced missile development. In the background, a crew of technicians are shown preparing the V-2 test vehicle for firing. General Electric coordinated tests, modification and firing of V-2 rockets for the U. S. Army Ordnance Corps.

The guidance system incorporated in the German V–2 provides an excellent example of pre-set guidance. Three gyroscopes control missile position relative to vertical, horizontal, and lateral axes. That is, the spinning axes of the gyros coincide with each of the three axes of the V–2. The gyros are initially oriented at given altitudes and are either held constant in that position or are precessed about an axis at a constant rate by electric motors or wind velocity. Any error signal relative to gyro position is noted, amplified, and relayed to servo-systems which control tabs on the four rocket fins. These four fins constitute the only movable control surfaces on the missile.

The only gyro precessed is that which controls the pitch of the V–2; this pitch control, in turn, controls the missile direction. It causes the rocket to nose over in the direction of the flight path which it must follow.

Fuel governs the distance that the V–2 will travel in its flight toward its target. At the proper predetermined instant the fuel supply is cut, and from that time on the missile is an unpropelled body whose path is determined by the gyro-activated control fins.

A look at the time sequence of events following missile launching of a typical World War II German V–2 provides an interesting picture of a preset guidance system in action:

A. As the missile leaves the launching table ground cables activate the time sequence.

B. The gyroscopes are activated and within four seconds inclination of the missile starts.

C. In 40 seconds the warhead is armed.

D. In 42 seconds the missile is 6.2 miles in the air traveling at a speed of Mach 2.

E. Fifty-two seconds after launching the pitch gryo stops precessing; altitude, 10 miles; speed, Mach 3.

F. In 60 seconds the missile has gained 14.6 miles of altitude; speed, Mach 4.

G. Combustion is cut off when a predetermined velocity is reached—usually this is about 3300 mph.

H. In 175 seconds the V–2 reaches the peak of its trajectory, an altitude of 50 miles.

I. Three hundred twenty seconds after launching the missile strikes its objective, a maximum distance of 250 miles from the launching site.

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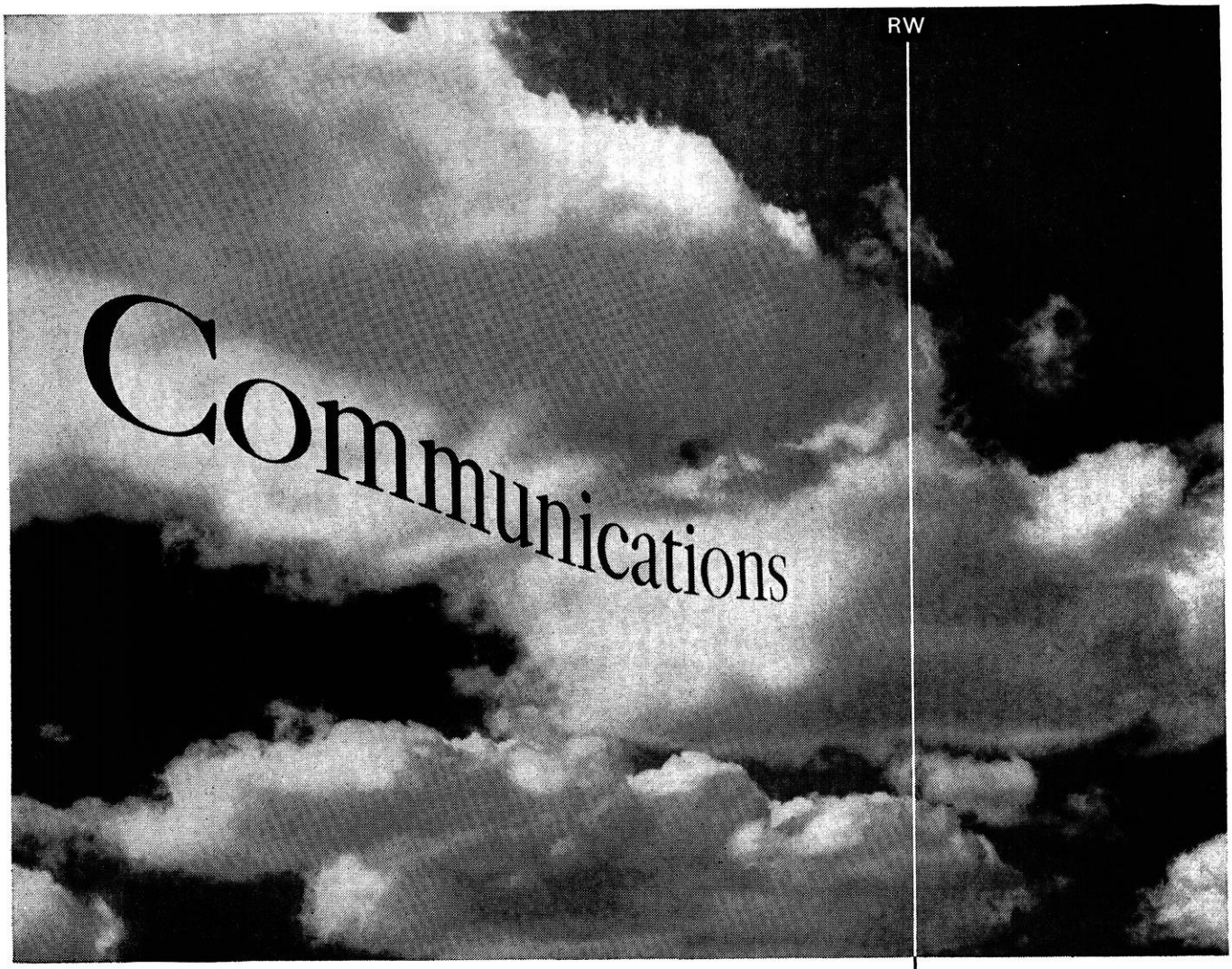

Vital link between thought and action paces all military and industrial activity

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ICE BOATING

by Bjorn J. Thompson, m'57

WHAT ARE THE ENGINEERING PRINCIPLES BEHIND THE FOUR TYPES OF ICE BOATS NOW IN COMMON USE?

Scene from the starting line of the 1951 International Skeeter Association Regatta.

There are many ideas pertaining to the beginning of ice boating, but there is a particularly romantic story which is most popular among ice boaters. It seems that one day in the pre-American Revolution era, a young lady and her beau went skating. While the lady glided gracefully across the ice, her skirt, which was very long and full, was lifted over her head by a sudden gust of wind. Much to her embarrassment she had great difficulty in getting her skirt down again, and the wind swept her across the ice. In despair she finally had to sit down.

This experience proved extremely embarrassing to the young lady, but it gave her beau an exciting idea. According to the story he sat up all night with needle, thread, palm, canvas and battens and in the morning appeared upon the ice looking like a huge bat, darting swiftly, to the amazement of all.

The authenticity of this tale is questionable since it has been passed along from person to person and has undoubtedly changed in the process. The first actual records of ice boating known are a set of plans for an iceboat that were drawn in 1768. The plans showed a conventional sloop-rigged sailboat hull with a cross plank fastened underneath. The plank had a runner at each end with a third runner fastened to the bottom of the rudder to provide for steering. This arrangement made it quite easy for the owner to convert back to water sailing, merely by removing the cross plank and steering runner, and then plugging up the holes in the boat. Iceboats of this sort are still in use today in the Netherlands, where a man is satisfied to take a slow, family sail on the local canals. This type of boat had a definite influence on the development of its American counterpart, the "Scooter", which is discussed later. The first authentic iceboat was built in 1790 by Oliver Booth at Poughkeepsie, New York, on the Hudson River. A rectangular box made up the body of this iceboat. Runners were placed at each side forward and the steering runner with a tiller[1] was placed aft.

Until 1856, the trend in iceboats followed this cumbersome lumberbox type of boat. That was the year in which the skeleton-type of hull appeared. A desired increase in speed called for a design with less weight and less wind resistance. The skeleton-type hull fulfilled these requirements and has been used ever since, modified only in design while remaining functionally the same.

The year 1938 brought about what was believed to be the ultimate in iceboat design when the Meyer Brothers of Wisconsin built the first high speed front steerer. This boat was designed to overcome shortcomings inherent in the stern steerer, the most noticeable of which was called flickering. Flickering is the loss of

[1] Tiller—a handle by which the steering runner is turned.

control of an iceboat at high speed when the boat is hiking.[2]

A better understanding of flickering is possible if we break the force of the wind into its components at the center of effort of the sail. First assume that the sail can not be perpendicular to the wind; if it were, the boat would not move. Second, when the wind is not perpendicular to the sail, it may be resolved into a force Y that is perpendicular to the sail and a force X that is parallel to it. (See Fig. 1 a).

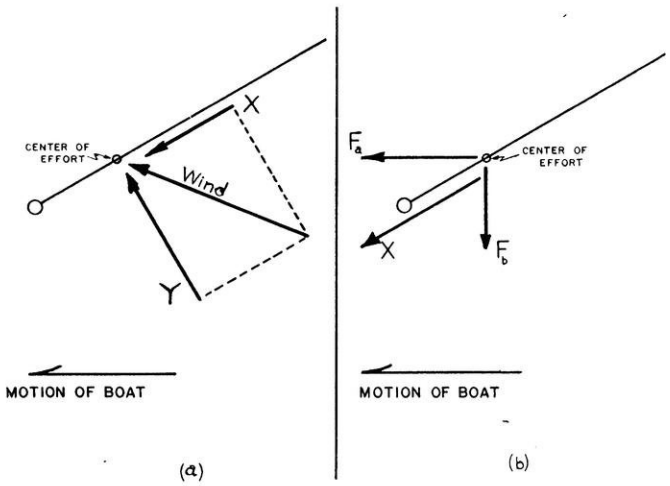


Fig. 1.

If the force X is broken into its component forces, F_b is perpendicular to the motion of the boat and F_a parallel to the motion of the boat, thus it is clear that F_a is the force that pushes the boat. (See Fig. 1_b). Any increase in the force of the wind would also bring about an increase in the Force F_a. It is seen from Fig. 2, that if F_a increases to such a degree that the moment of F_a xY exceeds the moment of Weight xX, the boat will have a counterclockwise moment about point P.

In other words, there will be a tendency for the steering runner to lift off the ice and the boat will go out of control.

Since flickering takes place when the aft end of a stern steering iceboat lifts off the ice, someone conceived the idea of putting the steering runner in front. This brought about the type of boat which is called a "skeeter."

It is seen from Fig. 2 that, as the force of the wind increases, the prow of the boat is pressed harder against the ice with the result that the steering runner is pressed harder against the ice, thus providing even greater control and eliminating flickering.

The differences between the "skeeter" and the stern steerer are most noticeable when the boats are in a hike. When an iceboat hikes, the force of gravity is constantly trying to get the boat down on the ice. In a "skeeter", this force has to work against the wind since the sail tips forward when the boat hikes and must tip back into the wind when it unhikes. The action of the sail moving into the wind creates the same effect that an increase in the force of the wind would—namely an increase in speed. In a stern steerer, a hike, to some extent, causes the sail to move into the wind. Therefore when the boat unhikes, the sail falls away from the wind with the result that the boat slows down.

Another characteristic of each type boat is the relative ease of hiking. By comparing the "skeeter" and stern steerer to a three legged stool, one may determine which type of boat hikes (or tips) the easiest. If a

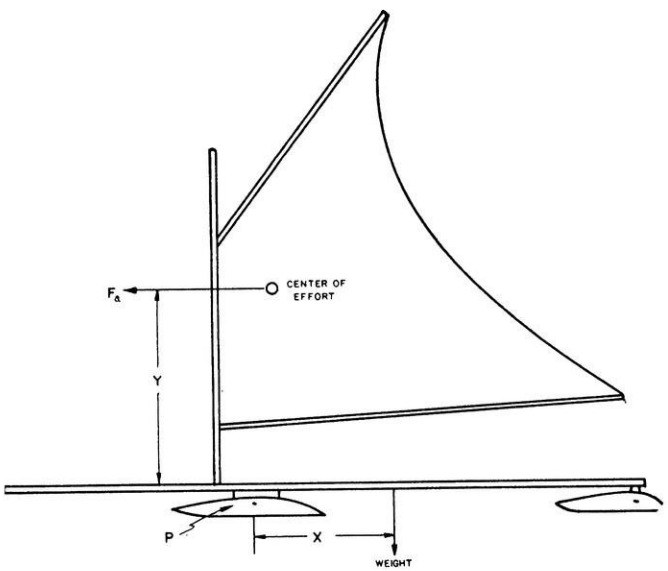


Fig. 2.

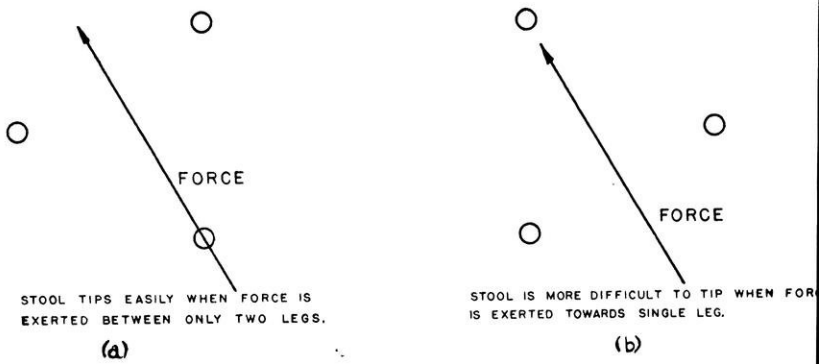


Fig. 3.

force is exerted between two legs, the stool tips easily, whereas a force exerted toward any single leg will have to be greater to cause the stool to tip. (See Fig. 3). The "skeeter" compares with part (a) of Fig. 3, and the stern steerer compares with part (b) of Fig. 3.

The subject of tipping (or hiking) brings up one of the hazards of iceboating, that is capsizing. Since the front steerer tips the easiest, it is logical and correct to assume that it is the most hazardous. Omitting the fact

[2] Hiking—a term used to describe the raising of the windward runner of an iceboat, brought about by the pressure of the wind on the sail. The action is similar to the leaning of a sailboat in a stiff breeze.

that it tips the easiest, the "skeeter" would be considered most hazardous anyway due to the fact that when it capsizes it is traveling at a high rate of speed. Also, when the "skeeter" capsizes, the mast leans forward and breaks unless it is extremely strong or stayed excessively.

This failure of the mast is unsafe for the operator because as the mast collapses, he may be pitched out on his neck and pinned to the ice by the iceboat.

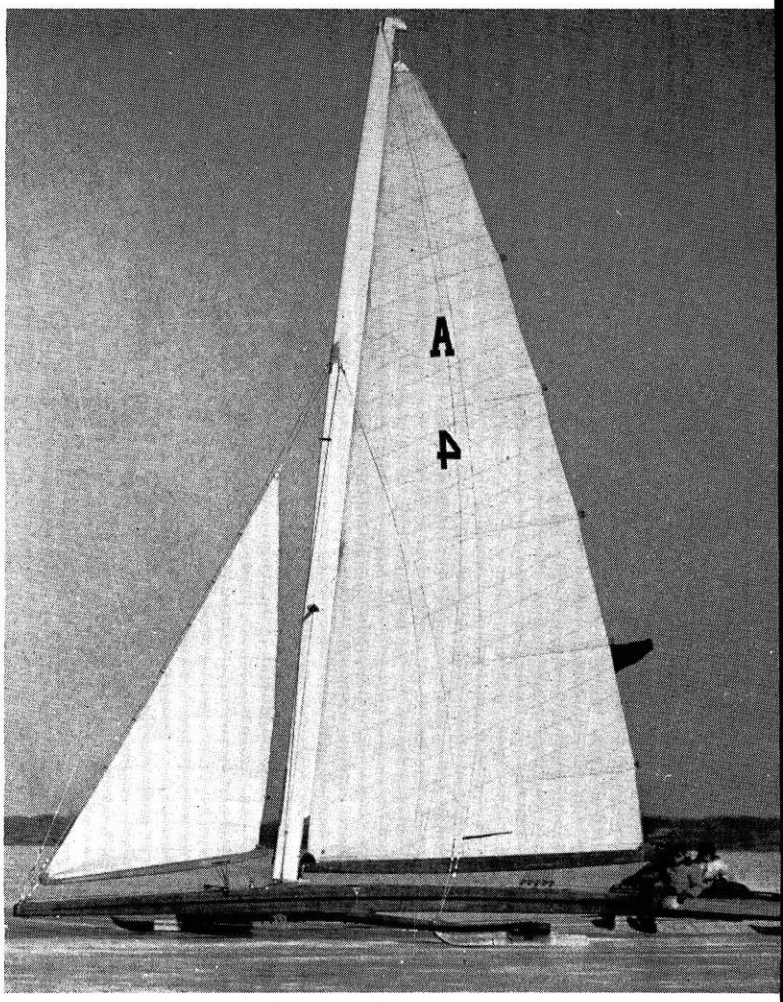
The stern steerer iceboat goes almost to the opposite extreme in that when it capsizes, it is almost stationary. The reason for this is that the more that a stern steerer tips, the more wind is spilled from the sail. When capsizing occurs, a point is reached where the wind gets under the sail and creates a parachute effect which eases the boat over. Instead of being catapulted, it is then possible for the operator to climb out safely.

The problems that are inherent to the stern steerer and front steerer iceboats have almost been eliminated in the recent development of the four runner iceboat. This arrangement seems to be a compromise between the two previously mentioned iceboats since flickering has been eliminated and the danger of capsizing lessened. When the four runner boat hikes, it does so on a line that is parallel to the centerline of the boat, thus eliminating any change in forces at the center of effort of the sail.

The staying of the mast, which was sometimes a problem in the three runner iceboats, has been simplified a great deal in the four runner boat by the ability to use four stays instead of three. This increase of staying strength permits the use of lighter weight masts with the result that the overall weight of the boat is reduced.

A problem in the four runner boat which presents greater difficulties than in the other types of iceboats is the method of steering. The problem is to get the runners properly aligned in the first place and then to keep them so under the strain of high speed operation. One arrangement that has been the most successful is the use of two Model T Ford front axles, one fore and one aft. These axles are then connected so that when the front one turns left, the back one turns right, and vice versa. This type of steering allows good control and a short turning radius, and though it is a relatively new and untried idea, it may help to increase the popularity of the four runner iceboat.

One other type of iceboat that has gained considerable popularity is the "scooter". This boat, as mentioned earlier, is similar to the Dutch ice sailing sailboat in the fact that it can be sailed on the ice as well as on the water. Shaped like a flat duckboat, the "scooter" has two long steel runners fastened on its bottom and is sloop-rigged. The interesting feature about this boat is that there are no means of steering other than by trimming the sails. This lack of steering mechanisms makes it a great deal easier to go from the ice to the water and back again, since nothing has to be removed. The "scooter" is ideal where the operator of an iceboat is liable to take a plunge due to not seeing open water ahead.



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A brief summary of the types of iceboats discussed here will show that:

(1) The four runner iceboat is the safest, but least developed.

(2) The front steerer is the fastest.

(3) The stern steerer is the cheapest and easiest to build.

(4) The "scooter" is the most practical where open water threatens dunkings.

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2. Stone, H. L., *Ice Boating,* New York: The Macmillan Company, 1922.

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Lay That Slide Rule Down!

FUN WITH SQUARES, OR BOPPERS AGHAST

by Prof. Paul J. Grogan

This is the second in a series of excerpts from Professor Grogan's "Slide Rule" paper.

There is hardly anything more commonplace in our way of life than the infinite succession of integers, 1, 2, 3, . . . , 11, 12, 13, . . . , 21, 22, 23, ... Yet, our Western civilization did not have this arithmetical notation in general use until about the time of Columbus. Our most intelligent forefathers of seven life spans often labored tediously and all but vainly in solving problems easily mastered by a sixth-grade student of today.

We all understand how the integers follow endlessly, each a single unit greater in absolute value than its predecessor. We often do not understand, however, how easily the natural order of the simple integers may be made to do marvelous things for us if we handle them properly. For instance, by leaving out all even-integers, we may establish the equally infinite sequence, 1, 3, 5, 7, . . . , 2n–1, ... Then by making a summation of the terms in the series, Table I below, we arrive at the squares of the integers. Along the first line of the table appear the first ten integers. The second line represents the first ten odd numbers. The third line values are found by performing a running addition of the odd numbers from the line above. These terms, uniquely enough, also represent the squares of the corresponding integers from the first row.

TABLE I

SQUARES OF INTEGERS FROM 1 TO 10 BY ADDITIVE PROCESSES

n	1	2	3	4	5	6	7	8	9	10
2n−1	1	3	5	7	9	11	13	15	17	19
WW₀2n−1=n²	1	4	9	16	25	36	49	64	81	100
WW₁										

Therein lies the germ of an idea which suggests the origin of the calculus. Should we inquire, how does the function $y = x^2$ vary when $x = 5$? By inspection of line three above, we see that y increases 9 units between 4 and 5, and increases 11 units between 5 and 6. Or, we may assume that y is changing an average 10 units per unit change of x. Expressed in calculus, $y = x^2$, $dy/dx = 2x$; for $x = 5$, $dy/dx = 10$. Further inspection of Table I along line two shows that the "second difference" between the successive squares is simply 2, and it holds for the entire range of x. Expressed in calculus, $d^2y/dx^2 = 2$, a constant for all x.

How may the foregoing be put to work for us? We have merely chanced upon an *identity*, a mathematical tool which holds for the general case and may be applied therefore to any particular case. Probably the most familiar identity in the experience of engineers is the example from trigonometry.

$$(\sin^2 x + \cos^2 x) = 1.$$

There are many more which are equally well known and useful. The one suggested in Table I may be established in many ways. The simplest method likely being

$$(x + 1)^2 = x^2 + 2x + 1.$$

Thus we may proceed from 10^2 to 11^2 by the simple expedient of adding $(2x + 1)$, or 21, to 100. We recognize the square of 11 at once as being 121.

If we rewrite the identity used previously to read,

$$(x + 1)^2 = x^2 + x + (x + 1),$$

we may use the new form in more difficult assignments. The following is a demonstration of the prowess of this variation:

$$91^2 = 90^2 + 90 + 91 = 8{,}100 + 181 = 8{,}281.$$

Similarly, we may use another identity,

$$(x - 1)^2 = x^2 - x - (x - 1).$$

Solving for 99^2 with the new relationship,

$$99^2 = 100^2 - 100 - 99 = 10{,}000 - 199 = 9{,}801.$$

There are endless variations:

$$(x + 2)^2 = x^2 + 4x + 4$$
$$102^2 = (100 + 2)^2 = 10{,}000 + 400 + 4 = 10{,}404$$

And,
$$(x - 2)^2 = x^2 - 4x + 4$$
$$98^2 = (100 - 2)^2 = 10{,}000 - 400 + 4 = 9{,}604.$$

Repeated application of a select few of the foregoing, and similar relationships, will develop new skills.

Another very useful identity deserves mentioning at this time.

$$(x + \frac{1}{2})^2 = x^2 + x + \frac{1}{4} = x(x + 1) + \frac{1}{4}.$$

Thus,
$$1.5^2 = (1)(2) + \frac{1}{4} = 2.25$$

And,
$$7.5^2 = (7)(8) + \frac{1}{4} = 56.25$$

If we but imagine the immediately preceding example as applying to 75^2, then the answer will be just 100 times greater than the value obtained for 7.5^2.

Therefore,
$$75^2 = (7)(8)100 + 25 = 5{,}625$$
$$95^2 = (9)(10)100 + 25 = 9{,}025$$
$$205^2 = (20)(21)100 + 25 = 42{,}025.$$

Proceeding in another vein, if we investigate the successive squares of integers in the range from 20 to 30 some additional interesting properties are discovered. We realize already that the square of 25 is 49 units greater than the square of 24, and the square of 26 is 51 units greater than the square of 25. Hence, the square of 26 is 100 units greater than the square of 24.

Prof. Grogan was appointed Chairman of the U. W. Extension Division's Engineering Department in 1951, and also acts as Director of Engineering Institutes. A Purdue graduate in Mechanical Engineering, he has also attended Pennsylvania State College, University of Michigan, and the University of Wisconsin, where he received his master's degree.

He has taught at Notre Dame, where he directed the Internal Combustion Engine Laboratory, and in the U. W. College of Engineering, Industrial experience includes furnace and economizer design and power plant erection, as well as promotional and sales work. During World War II, Grogan saw service as engineering officer aboard the USS Panay and as repair officer on a floating drydock.

As a hobby, Prof. Grogan likes to devise mathematicl shortcuts, slide rule methods and unusual approaches to engineering problems. He is a member of ASME, WSPE, American Society for Engineering Education, Engineers' Society of Milwaukee, U. S. Naval Institute, Wisconsin Council of Safety, Madison-Dane County Safety Council, and the Technical Club of Madison.

In Table II below, these various squares appear and their relationships to one another are indicated.

TABLE II

PROPERTIES OF SQUARES OF INTEGERS FROM 20 TO 30

n−5	n−4	n−3	n−2	n−1	n	n+1	n+2	n+3	n+4	n+5
20	21	22	23	24	25	26	27	28	29	30
400		+			500			=		900
	441		+		400		=		841	
		484		+	300	=		784		
			529	+	200		729			
				576	+ 100	= 676				
					625					

Thus the integers which are equally far removed from 25 have squares which differ by even hundreds. Furthermore, the number of hundreds difference corresponds to the number of units the integers are removed from 25. Now, assuming all the squares up to 25 are known, one may find the square of any other integer from 26 through 75 by using an identity which we write as follows:

$$x^2 = (100)(x - 25) + (50 - x)^2$$

Hence, $38^2 = (100)(38 - 25) + (50 - 38)^2$
$= (100)(13) + (12)^2 = 1{,}300 + 144$
$= 1{,}444$

And, $69^2 = (100)(69 - 25)^2 + (50 - 69)^2$
$= (100)(44) + (-19)^2$
$= 4{,}400 + 361 = 4{,}761.$

A similar, but less wieldly, identity may be written with 50 occupying the "pivot position" held by 25 in the example above:

$$x^2 = 200(x - 50) + (100 - x)^2$$

The range of application lies between 50 and 150, providing the first fifty squares are at hand. The existence of the identity may be established by expanding the right-hand side.

$$x^2 = 200x - 10{,}000 + 10{,}000 - 200x + x^2$$

A more advantageous method for finding squares of larger numbers is presented below:

$$(2x)^2 = 4(x)^2$$
$$(3x)^2 = 9(x)^2$$

Where a number is divisible by two or three, the square of the smaller number may be determined and multiplied by four or by nine, whichever is applicable. Multiplication by nine is most easily done by multiplying by ten first, and then subtracting the number from ten times itself.

Applying the previous method,

$$(144)^2 = 4(72)^2 = 9(48)^2$$

where either 48 or 72 may be squared by an earlier device. We may readily visualize,

$$48^2 = (48 - 25)100 + (50 - 48)^2$$
$$= (23)100 + 4 = 2{,}304$$

And, $9(48)^2 = 23{,}040 - 2{,}304 = 20{,}736.$

The question might arise, "Why so much fuss about the squares of numbers?" But in defense, call on more and more identities, and use the squares of numbers to produce many other useful products. For example,

$$(x + 1)(x - 1) = x^2 - 1$$

And, $17 \times 19 = 18^2 - 1 = 323$

Or, $1.7 \times 19 = \dfrac{18^2 - 1}{10} = 32.3$

Again, $(x + 2)(x - 2) = x^2 - 4$

And, $17 \times 21 = 19^2 - 4 = 357$

Be the master of the method, rather than letting the method be the master of you. Keep it flexible and fit it to each circumstance by calling upon the most useful application. After a time you will catch yourself using these methods to check answers obtained by conventional means.

A given identity may be useful in one sense one time and in the opposite sense the next. The last appearing examples are specific applications of the more general identity,

$$(a + b)(a - b) = (a^2 - b^2)$$

where we have been using b as a small integer. Writing the identity in the opposite sense,

$$(a^2 - b^2) = (a + b)(a - b),$$

find the crank-end area of a 16-inch piston which has a 4-inch rod.

$$A = \pi \frac{(16 + 4)(16 - 4)}{4} = \frac{\pi}{4}(20)(12) = 60\,\pi \text{ sq. in.}$$

Or, find the net cross sectional area of a pipe with a 12-inch outside diameter and a 10-inch inside diameter.

$$A = \pi \frac{(12 + 10)(12 - 10)}{4} = \pi \frac{(22)(2)}{4} = 11\,\pi \text{ sq. in.}$$

END

Guided Missiles

(Continued from page 22)

The Army's Wac Corporal, a miniature V–2, also is a preset guided missile. The Corporal is an American development, created exclusively for research purposes; when combined with the V–2 a two-stage "Bumper Rocket" is created for extremely high altitude research. When the basic V–2 reaches an optimum height, the smaller Corporal, mounted on the nose of the V–2, takes off under its own power. A Bumper of this type attained the greatest velocity and highest altitude ever reached by a man-made object, 250 miles altitude and a speed of 5,000 miles per hour.

A statement by Hanson Baldwin, noted military analyst, illustrates the complexity of and the research needed for solution of guided missile defense problems, "There is today no known way of intercepting or destroying a ballistic guided missile; it cannot even be tracked through the upper portion of its parabolic curve." The awareness of guided missiles must necessarily become part of modern man's life.

Command Guidance

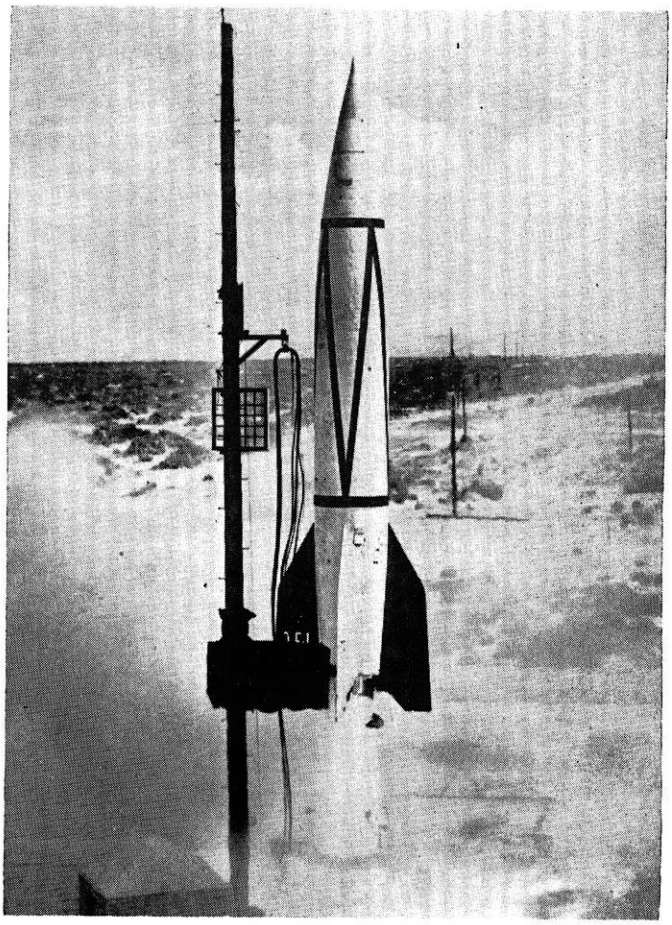
The system of command guidance may be thought of as supervening the preset guidance system as it does not alter in any way the preset theory, but supplements it. Its objective is to provide a missile that can be externally controlled while in flight, so that it can adapt itself to conditions encountered enroute to its target. All command guidance systems retain the gyroscope and automatic pilot as fundamentals, but within the command guidance system three methods of actuating these components have developed, the visual, non-visual, and beam rider command guidance methods.

Imagine a World War II B–17 loaded to capacity with high explosives, cruising towards its target under complete control, with the closest human being twenty miles away. Or picture a transport cutting the Mediterranean Sea, unaware that a Navy Glomb (Naval attenuation of Glide Bomb), after being released at a height of 15,000 feet seventeen miles away, is bearing unerringly closer. These are pictures of visual or "drone-mother" command guidance systems. The drone houses a completely automatic pilot and gyroscope system, as well as a radio receiver and two television cameras. The television cameras transmit pictures of the plane's flight path and its instrument panel to a remote control pilot on the mother ship, at a maximum distance of twenty miles away. The remote control pilot relays his commands by transmitting signals to a receiver aboard the drone. After passing through frequency selective filter circuits, the signals relay information to control relays and servo motors which perform the muscle work of operating the drone's control surfaces.

Aboard the mother the remainder of the remote control apparatus consists of a television screen and a radio transmitter control box. It's rectangular and equipped with a mock throttle, a steering post, and a series of switches and buttons. Emanating from it, during operation, is a beeping sound; hence, its alias of Beeper Box. The Box transmits radio signals on a single channel within which are audio frequencies corresponding in number to the maneuvers which the drone aircraft can perform. Thus, if the drone must react in 6, 7, or 8 possible flight paths, then 6, 7, or 8 frequencies must exist. It is a relatively simple matter for the remote control pilot to turn his charge to the left if his television eye tells him such a manuever is necessary. A radio transmitted command activates the proper servos, and the drone reacts. Such controls cover not only level flight, but acrobatic dives and bank turns as well.

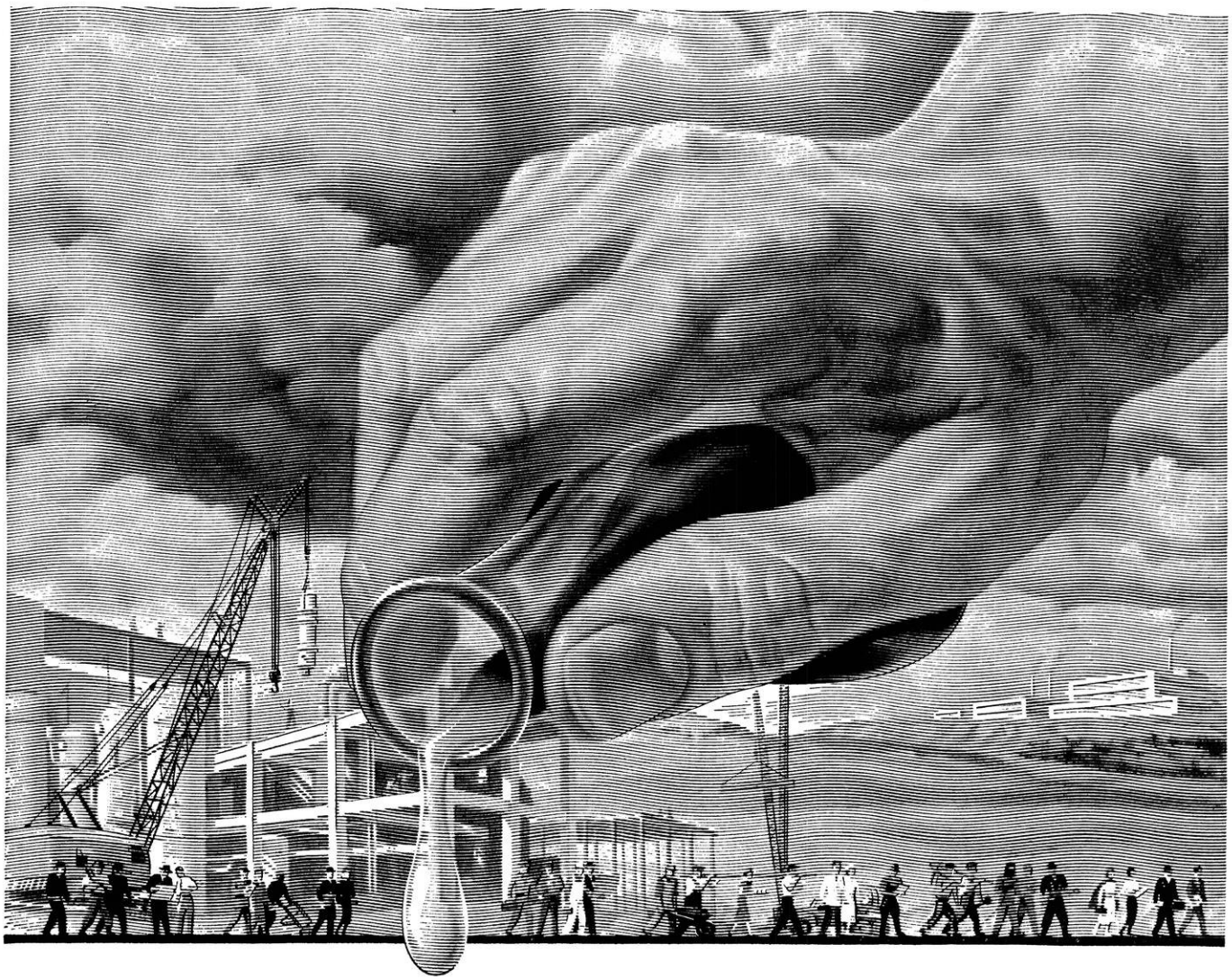
Non-visual command guidance, concerns the control of missiles without the use of visual aids; it removes the control system further from human dependence. In air to air guidance, the missile can be guided by two simultaneously operating radar systems. One system tracks the target in its flight, the other tracks the missile. Both outputs feed into a computor control center

(Continued on page 38)



—General Electric Photo

A critical moment during any rocket launching occurs immediately after the take-off. During this period, the vehicle gradually increases the ratio of its thrust over its weight. Over sixty V–2's like the rocket shown here were assembled and tested by Army Ordnance. This experience in the new and unbelievably complex field of guided missiles has provided scientists and engineers with a firm basis for future advanced development.



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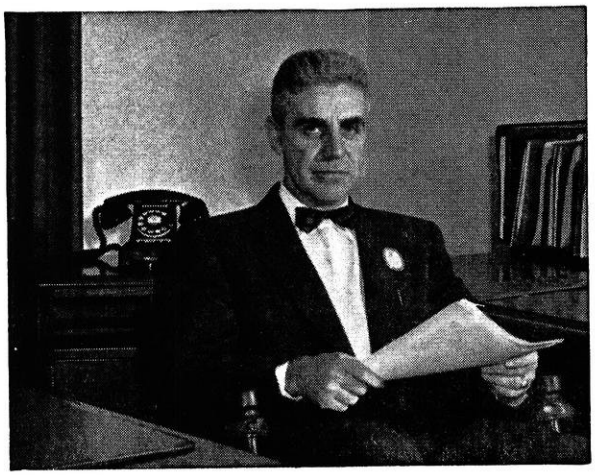

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ABA Representative Addresses WSPE Convention

Mr. Don Hyndman Director of Public Relations for the American Bar Association addressed the annual meeting of WSPE in Milwaukee on Saturday, January 29, 1955. In his talk, Mr. Hyndman spoke to the organization about how the ABA is organized and how it functions. He brought out that the ABA is a national organization of lawyers and judges in which membership is voluntary. To give an idea of the complexity of the organization of the Association, he said that it is built up of 44 regular and special committees and 17 sections which are subdivided into 270 separate committees. He also mentioned that the Association puts out about 40 publications.

Mr. Hyndman gave a short history of the ABA, saying that less than 100 lawyers got together in 1878 at Saratoga Springs, N. Y., to do something to raise the standards of law practice and education. Said Mr. Hyndman, "Actually, they were concerned also about doing something to restore more amicable relations between the lawyers of the North and South in the post Civil War era." He went on to tell about the different eras through which the organization passed, until in 1936 the House of Delegates was formed. Today it is composed of 226 elected representatives who directly represent more than 150,000 of the 220,000 lawyers in the country.

Mr. Hyndman summarized the activities of the association in the following way: "(1) preservation of representative government, (2) the promotion and establishment within the legal profession of organized facilities for furnishing legal services to all citizens at a cost within their means, (3) the improvement of the administration of justice, (4) the maintenance of high standards of legal education and professional conduct, (5) the promotion of peace and (6) the coordination and correlation of the activities of the entire organized bar of the United States."

He said though that the Association feels that it plays a more important role than that of performing tangible services and activities. He said that the "catalysis of the profession, its spokesman and bellwether, and the instrument through which the legal profession carries out its public service responsibilities" is the most important role of the ABA.

Mr. Hyndman, saying that he had been asked about membership dues, replied, "I don't have the faintest idea what you pay to belong to your own national association, but I'll be surprised if it isn't considerably more than the $16 a year lawyers pay for membership in the American Bar Association. We think—and say—that's the best investment a lawyer can make."

TO ALL MEMBERS

Will you please make the following corrections and additions to the 1954 Membership Directory.

Page 14—

Davy, Frank J., 524 Main Street, La Crosse (B); Pres. Davy Engineering Co. (W)

Davy, Philip S., 524 Main Street, La Crosse (B); Vice Pres. Davy Engineering Co. (W)

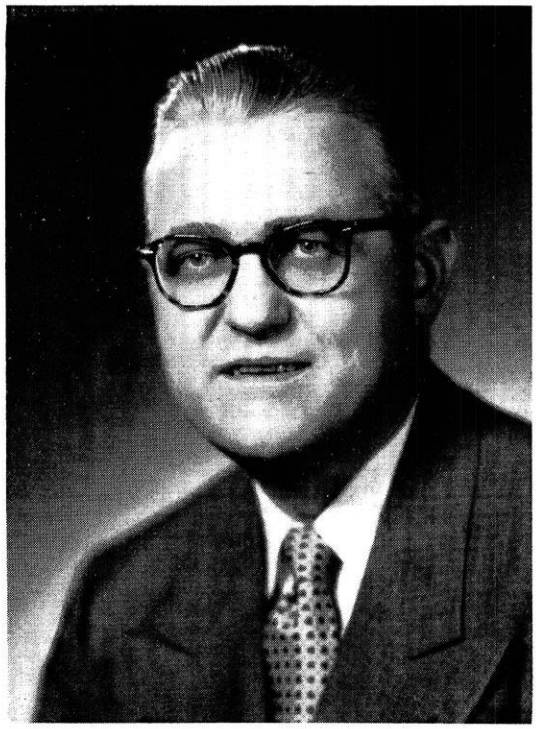
Page 38—

Please insert after Seal, Benjamin Callison—the following name—

Searle, George W., 2825 E. Newberry Blvd., Milwaukee 11 (R);

(Continued on page 36)

Meet the President



GEORGE A. SIEVERS
Milwaukee Chapter President

George A. Sievers, Milwaukee chapter president, is a self-employed consulting engineer, who has a far reaching experience background in Milwaukee Industry. Beginning in 1925, he has been employed successively by the Hamilton Standard Propeller Corp., Harnischfeger Corp., the Falk Corp., the Line Material Co., and Galland-Henning Mfg. Co.

During this time he has done considerable development work on the dynamic balancing of propellers, motors, welders and gears. Also, in close collaboration with army and navy engineers, he redesigned the critical three and four inch navy practice shells. The record also indicates that during his employment with these companies his experience included the gamut of industrial engineering problems, from methods to personnel, from time study to special administration and policy assignments.

In 1947 Mr. Sievers organized the Industrial Engineering Institute. Engaged in consulting engineering, the firm now consists of three divisions: executive, engineering, and the Aluma-Qee Corp., (a prefabricated aluminum marquee and canopy for industrial and business buildings).

Since joining WSPE in 1947 he has served as director of the State Society from 1951 to 1953, chairman of the State Ethics & Practice Committee from 1949 to 1953, and chairman of the WSPE Advisory Board on Ethics and Practice since 1950. He is the Milwaukee chapter President for 1954–55.

A Fellow and national director of the Society for Advancement of Management since 1952, he is active in several technical and professional societies, viz.: AIEE, ASEE, American Military Engineers, Engineers Society of Milwaukee, National Industrial Training Directors Association, Milwaukee County Society for Mental Health, American Society for Public Administration, and others.

He has authored several articles on professional development, engineering ethics and training. He is an inventor with several patents to his credit, also a lecturer and writer. Engineer Sievers was born in Germany, received his early education there and matriculated from the University of Heidelberg (Philosophy and Psychology) before coming to the USA in 1923. He received a diploma in Electrical Engineering in Chicago, and since then has taken many special courses at the University of Wisconsin, Milwaukee, Institute of Technology and others, in engineering, law, accounting etc. He is presently a faculty member of the University of Wisconsin College of Engineering. In spite of his busy professional life, George has a happy personal life. He married his schoolday sweetheart, Florence Thoelke in 1926. A son, John, is attending Michigan State College to become a hotel manager.

Sievers is very active in civic affairs. He is a member of Kiwanis, Milwaukee Association of Commerce, Wisconsin Manufacturers Association and last but not least, the Milwaukee Athletic Club, where he gets his recreation.

W.S.P.E.

(Continued from page 34)

Engineer of Transmission, Wis. Telephone Co., 722 N. Broadway, Milwaukee 2. (M)

Chapter News

NORTHWEST CHAPTER

WM. ROSENKRANZ
Reporter

The Northwest Chapter held a joint meeting with the Eau Claire Technical Society in celebration of Engineers' Week at the Elks Club on Thursday evening February 24. Members and wives as well as pre-engineering students from Eau Claire State College, Stout Institute, and River Falls State College attended to hear an address by Kurt F. Wendt, dean of the College of Engineering, University of Wisconsin.

The business meeting was dispensed with, the only item being the introduction of Mr. Ed Hoeppner as a new member. He was presented with a membership pin by Wm. Baumgartner, Membership Committee chairman.

Dean Wendt's address was entitled "Engineering—Builder of a Brighter Future", the theme of Engineers' Week.

MILWAUKEE CHAPTER

ROBERT J. MENDENHALL
Reporter

Principal event of the Milwaukee Chapter celebration of National Engineers' Week was a joint dinner meeting with the Engineers' Society of Milwaukee and its 13 other affiliate societies on Washington's Birthday. At this meeting Robert C. Johnson, President of the Siesel Construction Company of Milwaukee and a member of the engineering section of the Wisconsin Registration Board of Architects and Professional Engineers, was cited as ESM's Engineer of the Year. The main speaker was Everett S. Lee, manager of technical public relations services for the General Electric Company.

Milwaukee's Mayor Zeidler addressed the chapter at its regular Thursday noon luncheon and many short talks related to engineering were made at luncheon clubs and high schools by members of the chapter.

Television appearances during the week included personal interviews with engineers Robert C. Johnson, Everett S. Lee and Ray Behrens. In addition, Charles Crabb of the Milwaukee Association of Commerce discussed new industries in Milwaukee which are greatly dependent on engineering. A radio appearance was made by a panel consisting of P. B. Harwood, E. W. Seeger and Karl O. Werwath, who discussed automation in industry.

In addition to a favorable amount of coverage by the two large local newspapers, engineering articles, in the form of mats furnished by NSPE, were submitted to 20 other newspapers of this area. The editors of 28 publications of local industries were requested to carry an article on engineers or engineering during the week.

WISCONSIN VALLEY CHAPTER

JESS HOLDERBY
Reporter

MEETING SCHEDULE FOR 1955

April 16—Tomahawk
July 16—Antigo
September 17—Wisconsin Rapids
December 3—Wausau

1955 CHAPTER OFFICERS

Frank J. Henry—*President*
L. W. Lembcke—*Vice President*
William H. Doyle—*Secretary-Treasurer*
P. L. Schroeder—*Trustee*
A. L. Genisot—*State Director*

1955 COMMITTEES

Membership

A. L. Genisot, *Chairman*, Waldemar Neilson, Hans W. Huesler, Murvin G. Johnson, Clarence H. Perry, Walter J. Okray and John Crook.

Registration

Joseph M. Abernathy, *Chairman*, Carl Babcock, John L. Sullivan, Jr. and Edgar J. Carrington.

Engineers in Training

John E. Hoeft, *Chairman*, F. H. Schraufnagel and S. D. Payzer.

Legislative

Carl A. Cajanus, *Chairman*, N. M. Rowinski and E. A. Preston.

Ethics and Practice

P. L. Schroeder, *Chairman*, Walter G. Wefel and Norbert B. Fritz.

Public Relations

Jesse M. Holderby, *Chairman*, Henry J. Olk, L. W. Carlson and L. A. Manteufel.

Education

Carl J. Dvorak, *Chairman*, Yiu Neng Tain and L. W. Lembcke.

Fees and Salaries

Archie E. Becher, *Chairman*, L. A. DeGuere and A. L. Genisot.

Employment

Gordon J. Morrison, *Chairman*, Eugene R. Kelly and R. A. Davel.

Nominating

Henry J. Olk, *Chairman*, R. J. Musgrove and R. G. Laumer.

Engineers Week (Feb. 20–26)

Jesse M. Holderby, *Chairman*, Archie E. Becher, Clarence H. Perry, Waldemar Neilson, Carl A. Cajanus, Walter J. Okray, Henry J. Olk and A. L. Genisot.

Program

L. W. Lembcke, John E. Hoeft, for Tomahawk; Henry J. Olk, for Antigo; William F. Mengel, John Crook, for Wisconsin Rapids; Carl W. Giesler, A. C. Keene, for Wausau.

FOX RIVER VALLEY CHAPTER

JOHN K. PRIMM
Reporter

Membership activity under the able direction of Lyle Kingston, Green Bay, is still gathering steam. If Kingston keeps on building up as he has in the past, FRV will have to buy him an outsize file to keep his member cards in—and take away the "Prospect File," because there won't be any prospects left to work on until a new generation is grown up.

The W.S.P.E. convention in Milwaukee saw most of our officers present and a good sprinkling of

the "main body" was also in evidence. Many comments were heard which were very complimentary to our Milwaukee friends and state officers for doing their difficult job well. It was a fine convention.

A special National Engineers' Week meeting of the chapter was held on Thursday, February 24, at the Elks Club, Appleton, with dinner being served at 6:30 P. M.

The meeting honored National Engineers' Week February 20–26, and also marked the 10th anniversary of the Fox River chapter. Officers of WSPE attended. Featured speaker at the meeting was Virgil E. Gunlock, P.E., of Chicago who is vice-president of NSPE. He spoke to the engineers on "Professional Activities of the National Society." Mr. Gunlock, a 1927 civil engineering graduate of the University of Illinois, is Chairman of the Chicago Transit Board.

SOUTHWEST CHAPTER

L. W. STOCKNER
Reporter

The southwest chapter carried out an extensive Engineers' Week program. The general committee for Engineers' Week consisted of Al Ahearn, W. F. Turner, Prof. T. Higgins, and S. W. Stockner, Chairman. The work of the committee was eased by the help of several Southwest Chapter members.

There were four areas for the Engineers' Week activities including a dinner meeting during the week, radio and television coverage, publicity and display, and a speakers bureau for talks to service clubs and organizations.

Al Ahearn, as program chairman, took charge of the arrangements for the dinner meeting. The meeting was held at the Nakoma Country Club on Tuesday, Feb. 22 at 7:00 P. M. The dinner was followed by a talk by Dean Kurt Wendt of the College of Engineering of the University of Wisconsin. Dean Wendt spoke on "Engineering—Builder of a Brighter Future."

Prof. T. Higgins was in charge of publicity and display activities. Windows at the Wisconsin Power and Light Company on Fairchild Street and at Wolff, Kubly, & Hirsig on Carroll Street were appropriately decorated for Engineers' Week. The chapter's activities were published as a full page story in the Feb. 20 issue of the Wisconsin State Journal.

W. F. Turner took over the Speakers' Bureau, and with the aid of J. D. Hamilton arranged short talks by members of the chapter to various service clubs in Madison, Janesville, Beloit, and Monroe. Also arranged were various engineering vocational panels, each composed of three or four chapter members who talked to students at West, East, Central, and Edgewood High Schools in Madison.

The radio and television field was covered by the chairman of the general committee, S. W. Stockner, and the Public Relations Committee of the Chapter which consisted of Fay Morgan and W. T. Stephens. The group arranged a wide variety of radio and television programs over Madison stations and also many spot announcements over stations in the area.

WESTERN CHAPTER

D. W. GRUNDITZ
Reporter

Engineers' Week activities of the Western Chapter of WSPE were preceded by the regular monthly chapter meeting, February 15th. Pre- and post-meeting articles on this meeting were printed in the *La Crosse Tribune*. The February 20th edition of the *Tribune* contained only the proclamation of Henry Ahrens to point up the week, although much more material was furnished in a ready-to-set-up form. The letter of President Eisenhower and a similar letter by Governor Kohler to WSPE President Steinmetz, articles covering the Mayor's Proclamation, the program outline, and the tape broadcast topics (the logotypes) were not used—presumably because they lacked sufficient local flavor. We have very little difficulty getting meeting notices and accounts publicized; the "canned" material generally fares poorly unless considerable local flavor can be injected into it.

We fared much better with radio coverage and would have fared better with television, had plans been made earlier. The Nautilus tape was broadcast on Tuesday, February 22nd, on two stations, and "Medicine, The Law, and Engineering" was broadcast Sunday, February 20th, on the third station. The spots were used by all three stations throughout the week and the slide with a spot announcement appeared on the local TV station Sunday night, February 20th.

A poster display in the Northern States Power Company windows and a generous sprinkling of posters at members' places of business rounded out the picture.

SOUTHEAST CHAPTER

JOSEPH H. KURANZ
Reporter

The Southeast Chapter held its quarterly meeting at the Nelson Hotel in Racine on Wednesday, March 9th, at 6:30 P. M. Speaker at the meeting was Mr. Emerson Donnel, Patent Attorney for the Case Company. Mr. Donnel spoke on "Patents."

The chapter took an active part in the observance of National Engineers' Week. Dinners, newspaper stories and radio programs were but a few of the highlights; however, one of the most outstanding contributions was the *Waukesha Daily Freeman's* 32-page special edition devoted entirely to Professional Engineering.

END

Horatio: "We're not making any money on this amphitheater."

Nero: "Yeah, the lions are eating up all the prophets."

Guided Missiles

(Continued from page 30)

which compares the two flight paths and instantaneously transmits steering signals to the missile.

The Nike (named for the Greek goddess of victory) interceptor missile resides in this category. The result of eight years guided missile research, the Nike is the only operational supersonic anti-aircraft missile that can track and destroy an enemy target regardless of any evasive action. Here is an unclassified look at the Nike in action:

A. The Nike battery receives early warning from advanced warning nets that hostile aircraft are approaching.

B. The target is picked up and tracked by radar, and a running account of its position is transmitted to the control center.

C. The missile's control mechanisms and stabilization and navigational gear are checked, and safety mechanisms are disengaged.

D. As the target crosses a predetermined deadline the Nike is fired, and within seconds it has passed the sonic barrier, powered now by its own rocket engine.

E. A second radar system picks up the missile, feeds the control center with information about its flight path, and then returns commands from the central controls to the missile.

F. The Nike achieves victory by giving its life for its country when she explodes on contact with target.

Third, and last, in this category of command guidance is beam rider guidance. As in dissemination of all missile guidance system information for unclassified use, the government is also vague in its description of beam rider guidance. All that is known of the system is that the missile follows a directional radar or radio beam. Deviations from the beam are sensed and the missile control system is actuated to return the missile to its path. Such a missile would be limited to line of sight distances. These could, however, be of considerable length if control were executed by controlling from a high-altitude mother plane.

Homing Guidance

It must be kept in mind that each missile developed does not always fall into one distinct category of control, just as all humans are not classified as endomorphic, mesomorphic, or ectomorphic. Most humans are some happy, or workable, combination of these physical makeups. Missiles, in the same way, may be guided in various ways throughout their flight paths, but the three categories of guidance discussed here—the preset, the command, and the homing guidance systems—are the most convenient and distinct classifications of guidance.

An example of how homing guidance could be combined with radio command guidance to produce an intercontinental missile was afforded by an experimental run on September 21, 1947. In Newfoundland an Air Force C–54 was boarded by nine crew members. Theirs was not a busy day, although it may have proven anxious, for the plane accomplished its flight completely free from direct human control. Launched by command radio guidance, it picked up a radio beam from London, England, on which it homed. Air speed was judged and corrected for, wind direction and velocity were checked, and fuel consumption was noted. Twelve hours and five minutes from launching time a radio command guidance system again picked up the plane and delivered it safely to the runway.

Homing, or self-seeking, guidance usually actualizes in a missile just prior to the missile's final approach to the target. A missile may be made to home on heat radiation, infra-red radiation, magnetic radiation, sound, electric radiation, radio beams, or any quality that is characteristic of the target that is to be eliminated. For use against Japanese transports in World War II the Navy developed a glide bomb, christened the "Bat", which utilized a self-contained radar transmitter and receiver. The energy impulses reflected from the ship served as a path for the "Bat", and evasive action by the ship was of no avail.

This field is especially open to experimentation; it is limited, theoretically, only by man's imaginations. Already in the test stage are missiles sensitive to the heat of a man's body from a distance of one quarter mile. Missiles will undoubtedly be designed to sense any natural target radiations, such as heat, light, magnetic fields, and radio. Celestial guidance, a system by which a missile follows a path with reference to the relative positions of the missile and celestial bodies, is being developed for long range intercontinental projectiles. Possibly some birds may be taught to exercise a sense of smell.

* * *

And what of the future? Is the book on guided missiles to be closed during peacetime periods? On the contrary, it's hoped that the work done for war purposes will be only a primer, giving us the necessary fundamentals to continue research into missile utilization for bettering men's lives. Guided missiles can aid in atomic research and mapping and can perform intercontinental express service. The most imaginative proposed uses of missiles are in upper air research and in the possible establishment of earth satellites. The satellites might serve as radio and television relay stations for furthering the study of astronomy and as a launching site for space travel. If any such satellite, traveling at speeds of 25,000 miles per hour in an orbit 500 to 4000 miles above the earth's surface, ever becomes a reality, it will surely be a type of guided missile. And any scientist with his eyes on the moon is certain to send a missile before he attempts his maiden voyage.

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END

EYE-EXAM for a BATTLESHIP

Western Electric field engineers supervise installation of complex electronic equipment made for Armed Forces

Marco Polo had nothing on Western Electric's field engineers. They travel the world to advise on use, installation and maintenance of the electronic equipment we produce for the Armed Forces . . . like radar bombing systems, anti-aircraft fire control systems, and the Nike guided missile control system.

Western Electric is called upon to make these things because of its vast experience with highly complex electronic equipment as the manufacturing unit of the Bell System. It's a job that presents an unending challenge to our engineering staff.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

Western product and development engineers are responsible for turning out some 50,000 different items annually for the Bell System – everything from tiny transistors to giant bays of electronic switching equipment. Shown is one stage of transistor manufacture.

Schroeder's

ENGINE-EARS

by Ron Schroeder m'57

ASME

The ASME student branch held their annual speech contest in February. Vern Averbye won first place and $15.00 for his talk on "The University of Wisconsin Heating Station." Jim Bley took second place laurels and $10.00 for his speech on "Unionization of Engineers." Vern will represent the University of Wisconsin in the regional contest at Minneapolis on April 22 and 23. Following the Speech contest, films were shown Plastics and Needle Bearings.

Another meeting was held on March 9, featuring Mr. Robert Crone of North American Aviation. Mr. Crone spoke on "Problems in the Designing of High Speed Navy Type Fighter Planes." Movies and slides supplemented the talk.

Election of officers for next year will be held at the next meeting. Any ASME member interested (Freshman through Junior) is urged to see one of the present officers or Professor Harker before the next meeting. An ASME 75th Anniversary Award will be presented to the outstanding Engineering Student at this meeting. Exclusive word has it that his initials are C. R.

★

KAPPA ETA KAPPA

The Delta Chapter of Kappa Eta Kappa under the guidance of its new officers: President, John Coruthers; Vice President, Jerry Rolefson; Secretary, Thomas Jones; Treasurer, Thomas Zander; Social Chairman, Earl Schoenwetter; Assistant Social Chairman, John Leiker; Athletic Chairman, Dick Krueger; Publicity Chairman, Barney O. Rae; has pledged the following for the spring semester of 1955: Douglas Cleerman, James Czech, Joe Dattilo, Bob Iverson, Vic Kreuziger, Charles McKnight, Eugene Pezon, James Raymond and E. Herscher.

Two parties have already been held, one on March 4, 1955 which was known as a gangster party. It turned out to be just that. On Saturday, March 26, another party was held. This was a Gambling party with all the trimmings, wheels, dice, etc.

Kappa Eta Kappa proved its worth in the sale of St. Pats buttons as it sold 400 of the 500 sold in the department of electrical engineering. The fraternity was well represented at the St. Pat's dance as nearly everyone attended.

★

AIEE–IRE

The joint student branch of the AIEE–IRE held a meeting on February 17. An open house for freshmen electrical engineers was given the support of the society. The open house planning was initiated by Eta Kappa Nu, National Honorary Electrical Engineering Fraternity, and further support was lent by Kappa Eta Kappa, Professional Electrical Engineering Fraternity.

The February meeting was held in conjunction with the Madison section of AIEE. Mr. Everett S. Lee, Editor of the *General Electric Review* talked on the general subject "What's New In Science and Engineering?"

END

CAMPUS NEWS

DEANS' COLUMN

KURT F. WENDT
Dean, College of Engineering

•

W. R. MARSHALL, JR.
Associate Dean

•

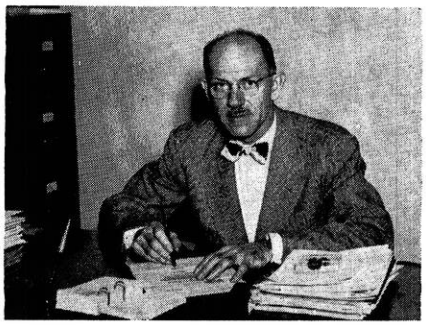
K. G. SHIELS
Assistant Dean

Engineering and Ethics

During the past few years a number of leaders in the engineering profession have expressed concern about the traditional honor and integrity of engineers. They fear that during a period when dishonesty and bribery are found all too often in government and business, frequently in activities closely related to engineers, we may tend to let our own standards relax. How long is it since you have reviewed the Canons of Ethics for Engineers and considered your personal standards?

"Honesty, justice, and courtesy form a moral philosophy which, associated with mutual interest among men, constitutes the foundation of ethics. The engineer should recognize such a standard, not in passive observance, but as a set of dynamic principles guiding his conduct and way of life." . . .

The engineer, as a professional man, is frequently in a position where the health, welfare, and safety of the public are entrusted to him. By virtue of his opinions, designs and recommendations he often assumes great responsibility. Only by conducting himself at all times according to the highest standards of conduct and performance can he earn and maintain the trust and respect of his associates, his employer, his clients, and the public.



KURT F. WENDT

Personal and professional integrity cannot be treated as a cloak—something to be worn when convenient. A truly professional attitude must be cultivated continuously and consistently, now during college as much as later on the job. Remember that compromise in small matters inevitably leads to compromise on large issues.

Consider for a moment the responsibility of the student in the University. The situations that confront him are counterparts of those he will meet in industry and government. Details will change, to be sure, but the issues will be duplicated. The student is entrusted with many thousands of dollars worth of facilities in the form of buildings, furniture, laboratory equipment, books, and supplies. How often have you seen carved table tops and chair arms, mutilated library books, damaged tools and machines? Minor, you may say, and principally the result of thoughtless or irresponsible use. But every hour of time and every dollar of funds required for repair and replacement either reduce the facilities available for others or subtract from the funds needed for improvements.

Extensive and unacknowledged collaboration on individual assignments, copying themes, cribbing from old reports, and outright cribbing in exams lead one into the other. Where will you draw the line? There simply is no room for compromise. The same applies to flouting the rules and regulations of the university—and the community—regarding conduct. "Everybody's doing it" is not an excuse, it is nothing more than admission of personal failure.

We are proud of the record of our engineering students on this campus, but we must be ever alert and make a conscious effort to maintain and strengthen our traditions. Without integrity there is no profession.

—KURT F. WENDT

★

ENGINEERING INSTITUTES

GRAPHIC SOLUTIONS METHODS

April 21 and 22, 1955

Graphical presentations of mathematical material enable the reader to more easily visualize the relationships involved and frequently are of value to the user in obtaining shortcut solutions to complex or cumbersome equations. Topics that will be discussed are: fundamental equations and curves, families of curves, statistical analysis of data, curve fitting, network charts, alignment charts, nomographs and special slide rules. This institute will be of interest to all technical personnel having need to represent physical data. Research findings, presentation of standard data, report writing, economic analysis and sales devices are but a few areas where these methods will apply.

Fee: $15. Robert A. Ratner, Institute Co-ordinator.

* * *

METALLOGRAPHY

April 27, 28 and 29, 1955

This is an institute for metallographers, metallurgists, technicians

and supervisors of such personnel. Its purpose is to refresh them in current metallographic techniques, acquaint them with improved techniques and the handling of new metallographic materials and equipment. There will also be presentations on the analysis and properties of new alloys and materials.

Fee: $20. Robert A. Ratner, Institute Co-ordinator.

* * *

ENGINEERING ORGANIZATION
May 12 and 13, 1955

It is the purpose of this institute to present methods of coordinating the various engineering activities, with each other and with the rest of the organization. By so doing, a more efficient, dynamic organization should result. Chief engineers, works managers and others concerned with the administrative problems of an engineering office will find the institute a valuable source of information.

Fee: $15. Robert A. Ratner, Institute Co-ordinator.

* * *

INDUSTRIAL HEATING APPLICATIONS
May 18, 19 and 20, 1955

It is the intent of this institute to present practical information concerning the design, use, selection and control of industrial furnaces of various types. To obtain the most efficient operation of furnaces and optimum application to the product, it is important that the user be familiar with the basic purpose of the furnaces, how they act upon various materials and the operation of accessory equipment. For those who wish to improve the quality of their product and to decrease costs, this institute should be of benefit and interest. Product designers, superintendents and foremen, heat treat specialists, tool engineers and metallurgists are some who would be concerned with the problems that will be discussed.

Fee: $20. Robert A. Ratner, Institute Co-ordinator.

WATER CONDITIONING
May 24 and 25, 1955

The conditioning of water for industrial use will be studied at this institute. Water will be considered as a raw material and ways of determining the substances present in the water will be summarized. Methods of modifying or eliminating deleterious substances will be discussed.

Fee: $15. Leonard F. Hillis, Institute Co-ordinator.

★

1955–56 WISCONSIN ENGINEER STAFF NAMED

Robert A. Hentges and C. Barclay Gilpin have been named to the two top positions on the 1955–56 *Wisconsin Engineer* staff—Editor-in-Chief and Business Manager, respectively. The positions were awarded by the Faculty Board of Directors upon the recommendations of the present Editor and Business Manager, Kneeland Godfrey, Jr. and Carroll Rands, respectively.

The Editorial Staff, as named by Bob Hentges is as follows:

Associate Editor
Jon Baumgartner, ChE'56.

Issue Editors
Ron Schroeder, ME'57, Carl Burnard, CE'57, Bob Elton, ChE'57, John Bollinger, ME'57, Tom Kanneman, EE'57 and Philip Noth, ChE'57.

Story Co-Editors
Don Edwards, ME'56 and Dick White, Ce'56.

Stories Staff
John Bollinger*, Tom Kanneman*, Carl Burnard* and Phillip Noth*.

Copy Editor
Bill Gresenz, ChE'56.

Photography Editor
Jim Richards, MetE'58.

Publicity Editor
Alan Black, EE'57.

Feature Editors
Alumni Notes—John Albrecht, CE'56.
Science Highlights—Dick Tomlin, ChE'56.
Engine Ears—Ron Kuchera, EE'58.
W.S.P.E.—Ron Schroeder* and Bob Elton*.
Campus News—Larry Barr, ME'57 and Dick Peterson, ME'57.
So You Think You're Smart—Sneedly (again).

* Also will act as issue editor for one issue.

The Business Staff, as named by Barclay Gilpin, is as follows:

Local Advertising Manager
James Cherwinka, ChE '57.

National Advertising Manager
Robert Walter, MetE '57.

Circulation Manager
John Radke, MinE '56.

Sales Manager
James Rydzewski, ChE '56

The position of Art Editor for the 1955–56 Staff has not yet been filled. Anyone interested in working on the staff in that capacity should contact Bob Hentges for arranging an interview.

UNDERGRADS ATTEND POWER CONFERENCE

Fourteen University of Wisconsin engineering students were among the 121 college students to be guests at the 17th annual American Power conference at the Sherman hotel in Chicago March 30 through April 1.

They are David P. Hartman, Robert C. Costen, Joseph F. Pech, Jerome Rolefson, Robert J. Schauer, David L. Hannon, electrical engineering juniors; Aaron Grady, Roger W. Sackett, Robert F. Engel, F. A. Luhman, Robert G. Burke, Milo O. Swanson, Wallace Yeskie and Irvin J. Bernard, mechanical engineering juniors.

"Progress in Power" was the theme of this year's conference, sponsored by Illinois Institute of Technology in cooperation with 14 universities and nine engineering societies.

Topics discussed at the conference included atomic and solar energy, the St. Lawrence seaway, salt water conversion, natural gas substitutes, automatic controls, and efficient production methods.

Among the displays at the conference were models of the first nuclear reactors for power and for industrial research. Westinghouse Electric corporation displayed its power reactor and Armour Research Foundation of Illinois Institute of Technology showed its proposed research reactor. **END**

STATIC

or jaded jokes for slow pokes

The dime isn't entirely worthless —it makes a fairly good screwdriver.

* * *

Three men were sitting on a park bench. The man in the middle was sitting quietly as though asleep. But the two men on either side were going through the motions of fishing. With deadly seriousness they would cast, jerk their lines gently, then swiftly wind their imaginary reels. This had gone on for some time when a policeman sauntered over, shook the man in the middle and demanded, "Are these two nuts friends of yours?"

"Yes, officer," replied the man.

"Well, get them out of here then."

"Right away, officer," said the man as he began to row vigorously.

* * *

EE: "Well, what would you like to drink?"

Coed: "I guess I'll have champagne."

EE: "Well, guess again!"

* * *

When Steve Allen told this one on his TV show it brought down the house:

A grouch went into a barber shop and said to the barber: "I want a shave, see? I don't want a haircut. I don't want a shampoo. I don't want a shine. I don't want a manicure. I don't want any chitchat, see? I just want a shave. You understand?"

"Lather?" asked the barber.

* * *

America is the only country where they lock up the jury at court recess and let the prisoner go home.

* * *

Vocational adviser to youth: "Your vocational aptitude test indicates that your best opportunities lie in a field where your father holds an influential position."

* * *

And then there is the one about the near-sighted snake that eloped with a rope.

(To be kept in stitches, see page 60)

Petrochemicals

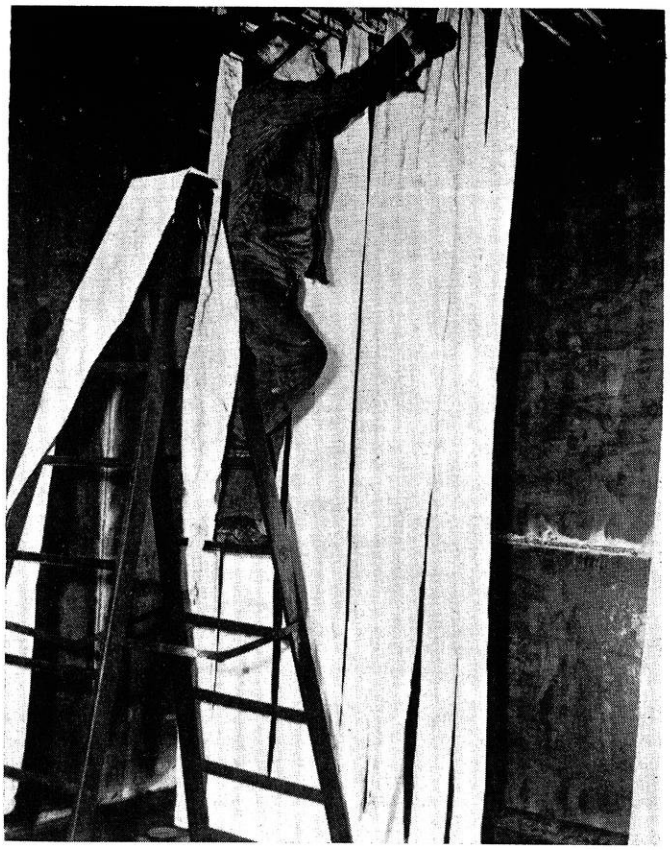
(Continued from page 16)

of iso-propene at $-38°$ C gives butyl rubber,the superior new rubber used for innertube manufacture. Polymerization of ethylene produces several types of products including lubricating oils and the plastic material, Polyethene, which is used extensively as an insulation for high frequency electrical cables.

All of the processes discussed above have one factor in common. That is that during the reaction no elements outside of carbon or hydrogen have been involved directly. Other compounds were used as catalysts but did not react with the petrochemicals. In the following processes outside elements such as oxygen and chlorine, will be involved.

Oxidation is the combining of hydrocarbons with oxygen to form compounds not ordinarily found in petroleum. To bring oxidation about a substance called an oxidizing agent is used. Oxidation of petroleum fractions produces some of the more familiar chemicals. Formaldehyde, acetone, and acetic acid are all oxidized hydrocarbons. Paraffin waxes can be oxidized to obtain high molecular weight fatty acids which in turn can be reacted with glycerine to produce synthetic, edible fats.

These curtains will keep their fresh newness for years even if hung in the sunniest windows, because they are made of "Orlon" acrylic fiber. Curtains of the Du Pont fiber also resist deterioration from other destructive elements such as radiator heat and acid city soot, which tend to quickly weaken many ordinary curtains. Use of "Orlon" means that the curtains can be washed over and over again without starching or stretching.



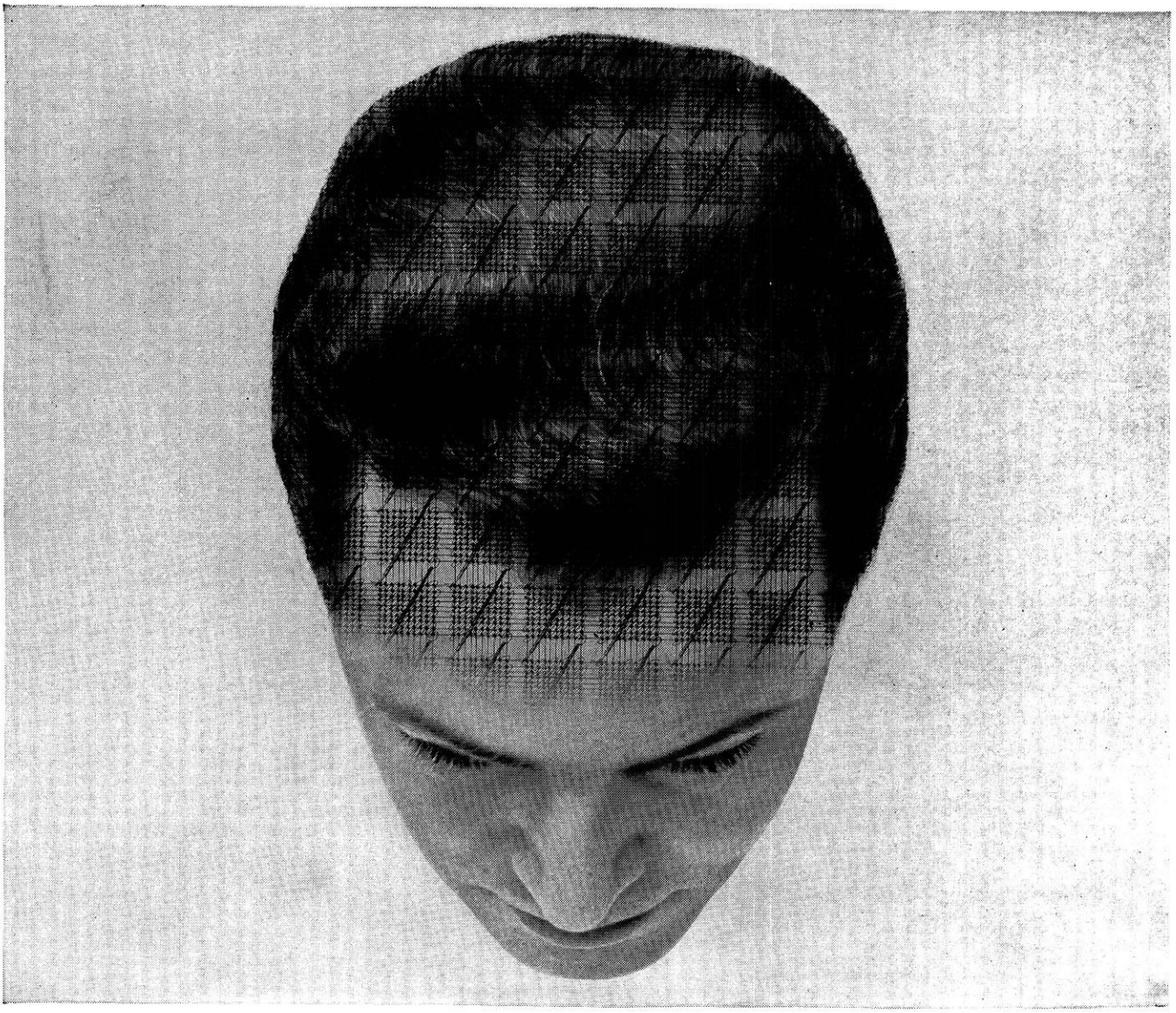
Dust filtration bags made of Du Pont's "Orlon" acrylic fiber being installed at the Ville Platte, La., plant of the Cabot Carbon Company to recover costly carbon black from smokestack wastes.

Halogenation is the adding of the halogens; chlorine, bromine, flourine, and iodine to hydrocarbons. Halogenation of paraffins, olefins, and aromatics produces a large number of compounds which in themselves are useful or which are useful in making other products. Halogenation of ethylene to ethylene dichloride and the removal of HCl gives vinyl chloride which is the basic material for many plastics and resins. One of the most widely known of halogen derivatives is 1,1,1-trichloro-2,2-bis (p-chlorophenyl) ethane, better known as that famous insecticide D.D.T.

In many cases the final product obtained in the refinement of petroleum fractions to petrochemical products is a combination of several of the before mentioned processes. One of the biggest developments during World War II is a good example of this. Ethyl benzene which has been produced by alkylation of benzene with ethylene is dehydrogenated to form styrene. This then is combined with butadiene which is the dehydrogenation product of butane and butylene. These products are allowed to stand and a polymer of butadiene and styrene is formed which is GR–S rubber (Government Rubber–Styrene). In another combination reaction, iso-butylene is polymerized using sulfuric acid as a catalyst to the dimer (diiso-butylene). The dimer is then hydrogenated to 2,2,4-trimethylpentane which is used as the standard for 100 octane rating.

Although few people realize it, the fact is that petrochemical products are widely used throughout the

(Continued on page 46)



Superimposed over this man's head is the matrix (or heart) of RCA Electronic "Memory." See description below.

New RCA Magnetic "Memory" recalls thousands of facts in a fraction of a second

Each dot you see in the squares above is actually a magnetic "doughnut" so tiny that it barely slides over a needle point. Despite its size, however, each "doughnut" stores away one bit of information for future reference. And 10,000 of them fit on a framework smaller than the size of this page!

Here are the cells of the RCA magnetic "memory" that is the key element in virtually all high-speed electronic computers. The greatest significance of this "memory" is its ability to deliver, in a few millionths of a second, any information it holds.

Almost instantly, an insurance company can process a claim. Just as fast, a manufacturer with inventories spread around the country can determine what products are making money—and *where*.

With such "memories," electronic computers predict accurately the next day's weather for the nation, using data on atmospheric pressure, temperature, and wind velocity from every part of the United States.

The leadership in electronics that created this man-made RCA "memory" is responsible for one achievement after another in television, radio, radar and other RCA products.

WHERE TO, MR. ENGINEER?

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 to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, N. J.

RADIO CORPORATION OF AMERICA

ELECTRONICS FOR LIVING

Petrochemicals

(Continued from page 44)

country and the world in every field of endeavor. These products have come upon the country making life easier, and bringing happiness to millions of people everywhere.

Petrochemicals and petrochemical products are used widely in industry as solvents, lubricants, etc. Polyethylene glycol (carbowax) is a recent development. It is oily and wax-like but is water soluble and thus has found its place as a lubricant in the textile industry where hydrocarbon lubricants are undesirable. Acetone and carbon tetrachloride are two important solvents used in industry today.

Petrochemicals are used by chemical concerns as starting materials and intermediates in the manufacture of a multitude of products. These products and their uses are so numerous that it would be impossible to mention all of them. Some of the more common ones are mentioned in the next few paragraphs.

Today's housewife uses petrochemicals in many ways. Synthetic detergents that she uses to wash dishes and clothes are derived from petroleum. Lipstick, face powder, and other cosmetics have petrochemical bases. Perfume is also based on petrochemicals. If she is cooking, synthetic flavorings from petroleum will make the food taste better.

The man of the house also finds many uses for petroleum derived products. His hair oil, shaving cream, and after shave lotion all contain petrochemicals. If he has a basement workshop he uses petrochemicals as lubricants and greases. His car burns gasoline which in itself is a petroleum derivative and has additives in it which are petrochemicals. Lead tetraethyl is the most common additive. Antifreeze used in the radiators of automobiles can also be produced from petroleum.

Everybody uses plastic. It is used as a replacement for cloth, silverware, dishes, wood or metal parts in tools, and even as a replacement for glass. Such uses depend on the variety of properties exhibited by different plastics. Plastic tablecloths, hoses, and tubing depend on the pliability and strength of the material each is made out of. Yet dishes and tool parts require stiffness and strength.

The rise of the petrochemical industry in the United States is truly phenomenal. The industry might well be called the newest brainchild of American Industry. Aren't we lucky that it has enjoyed such good health in its early years that it seems destined to become a leader in our search for a better life?

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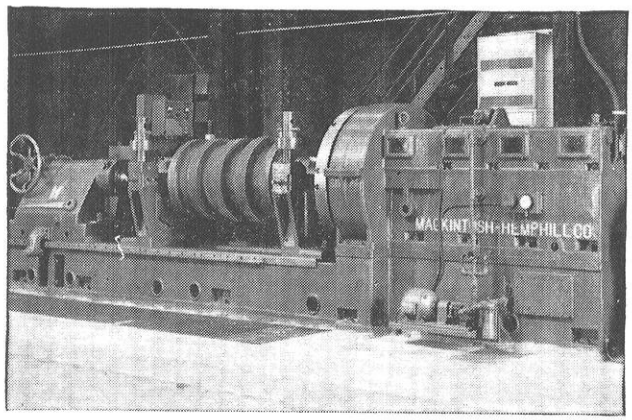
2. Kuhn, W. E., "Petrochemistry Comes of Age," The Texaco Star, Volume 39, Number 1, Pages 3, 6, 7, 8.
3. Kiddoo, "Petrochemical Processes", Chemical Engineering, Volume 59, Number 9, Pages 149–168.

END

Another page for **YOUR BEARING NOTEBOOK**

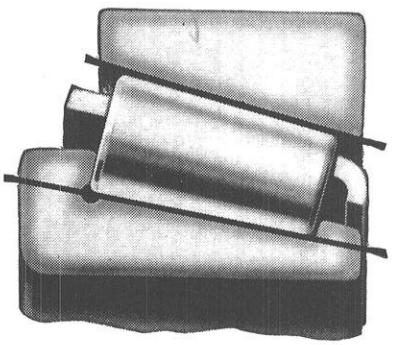
How to carry 35-ton loads in a roll-neck lathe



The engineers who designed this roll-neck lathe were faced with three problems. 1) To build a lathe that would cut finishing time as much as 75%; 2) To build a lathe that would give great accuracy and 3) To provide great load-carrying capacity as well. Their answer was this electronically-controlled mill roll lathe. To carry the 35-ton loads with a maximum runout of .0003 and still do the job quickly, they specified Timken® tapered roller bearings.

Why TIMKEN® bearings have high load capacity

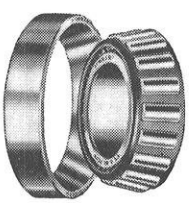
This cross-section of a Timken tapered roller bearing illustrates one reason why Timken bearings do such a good job under heavy load conditions. Notice that there is full line contact between the rollers and races. It's this full line contact that distributes the load over a wider area, gives Timken bearings their extra load-carrying capacity.



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 "This Is Timken". The Timken Roller Bearing Company, Canton 6, O.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS



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

SCIENCE HIGHLIGHTS

Edited by Carl Burnard, CiE'57

ELECTRICAL MARVELS COMING SOON

Cordless electric clocks automatically regulated by short wave from Arlington, Va., picture-on-the-wall television, New York to Paris flights in three hours, an oven roast in a few minutes, luminous ceilings . . .

These and many other marvels of the electrical industry will come sooner than we realize.

Despite the marvels already wrought, the electrical age is actually only beginning and future developments based on electricity will over-shadow all the accomplishments thus far.

It has been predicted that within five years many homes will be heated entirely by electricity at a cost comparable to present fuels. Flexible lighting is not far off, with every room having luminous ceilings which can be varied in brightness and color for any seeing needs. Switches will turn on the lights automatically, as one enters the room. New types of insulation will allow room for 18 cubic feet of food storage space, both frozen and conventional, in the area now required for an 8 cubic-foot refrigerator.

Progress such as this will be equaled or exceeded by similar advances in factories and on farms.

This progress presents a challenge, for, as in the flowering of the electrical age, its continued growth will demand the best in human imagination, ingenuity, fortitude and plain, hard work.

Atomic energy holds the promise of alleviating the misery of millions of people, if enough men will stay up enough nights and work hard enough. If atomic energy can be put to the creative uses for which it holds great promise, the material well-being of the people of the world will be improved tremendously.

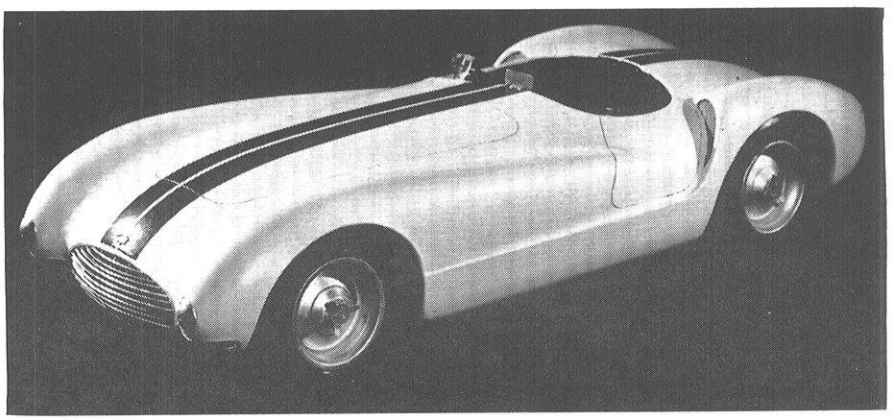
MORE RADAR FOR REDS

Soviet forces in Austria have added a new link to the chain of radar stations stretching from the Baltic to the Black Sea. Although most Soviet radar units in Austria are small and mobile, the latest bases in the Soviet zone are equipped with permanent radar installations.

FLAME STUDY—POINT BY POINT

In the never-ending research to learn just how hydrocarbons react with oxygen—i.e. fire—some ingenious techniques and devices have been created at the Westinghouse Research Laboratories. One phase of the study calls for a point-by-point examination of what is happening within a flame of propane and air.

First a special kind of flame had to be created so that the temperature and gas compositions might be accurately determined at closely spaced intervals within the flame. For this purpose a means was devised for creating a horizontal flat flame, i.e. all the burning takes place in a very short distance vertically. At atmospheric pressure it



LATEST CUNNINGHAM NEARS COMPLETION

In line with the proposed reduction of engine displacement which may become effective in 1956 for International Sports Car competition, Briggs Cunningham, America's post-war pioneer in bringing America to the forefront of international racing, announces his new 3-liter model—designated the C-6R.

This advanced design is a culmination of racing experience gained since 1951 and is expected to exceed previous models in acceleration, top speed, braking and road-holding. The entire chassis and suspension is an integrated unit designed and built entirely by Cunningham with no compromise to mass production economies.

The famous Offenhauser engine, manufactured by Meyer & Drake Engineering Company, has been selected and is presently undergoing rigid dynamometer testing incorporating experiments in manifolding and carburation for the purpose of obtaining high power output from the ordinary highway gasoline to which sports car racing is officially confined.

The prototype C–6R is entered for the 12-hour race at Sebring, Florida, on March 13th. The decision as to whether or not this model in its present form will be raced in Europe next summer will be determined shortly after the Sebring event.

is almost the size and shape of a thin pancake; at pressure equivalent to 65,000 feet altitude it is somewhat thicker.

To measure the temperature at intervals of each millimeter vertically, i.e. along the thin dimension, very special thermocouples were devised. So that the thermocouples would not disturb the gas flow the wires of platinum and rhodium were made as small as possible—down to 0.2 of a mil thick, or about one tenth the diameter of a human hair. Also, to prevent the platinum from acting as a catalyst in the flame, it had to be coated with an inert material.

BASEBALL IN THE AIR

The World Series was telecast live in Cuba through use of a DC–3. The plane, flying at 8,000 feet, picked up the signal from Miami and relayed it via microwave to the Cuban national network.

RAILS SLIPPERY?—JUST WASH 'EM

Every day could be wash day somewhere on the railroads if a revolutionary new theory uncovered by the General Electric Company proves economically feasible.

The theory points to washing rails—with a detergent possibly—to help eliminate one of the railroads' oldest and most expensive problems – slipping of locomotive wheels.

The theory holds that slipping is caused by an extremely thin, practically invisible layer of oil approximately one molecule thick, which spreads itself over the running band of a rail at the onset of rain or when there is dew. Despite its thinness, this "monomolecular layer" can withstand pressures so high (up to 75,000 pounds per square inch) that locomotive wheel loads ordinarily used will not break through it.

From the earliest days of locomotives pulling trains, the slipping of locomotive wheels has been a problem. Slippery rail conditions often result in stalled trains, overspeeded traction motors, delay, and expense.

At many places on railroad track, accumulations of journal oil can be observed outside the wear band. When the rails become moist or damp, the oil spreads over the rail, pushing the water off. The result is a thin film of oil which causes slipping and often stalls crack trains traveling on grades.

Journal oil, used in the bearings of freight cars, contains some percentage of animal oils which spread rapidly over a polished surface in the presence of a small amount of water. Oxidized mineral oils seem to exhibit the same characteristics as animal oils or fish oils and spread over a polished surface in the presence of moisture.

One drop of oil in the presence of moisture has the ability to cover a surface of five square meters. If tracks were not interrupted by rail joints, this one drop would spread along the polished running part of the rail (⅝ inch wide) to form a slippery film for a distance of two miles.

It has been known since the earliest experience with railroads that rails which looked perfectly satisfactory would, with the introduction of moisture, lose adhesion. Even before the turn of the Century it was observed that if rain continued, adhesion would be restored, but no satisfactory explanation of this was offered.

Cleaning methods now under investigation, in addition to water, include detergents, solvents, open flame, and ultraviolet light. If a suitable cleansing agent is found, much of the sand currently used on locomotives to improve traction on wet days can be eliminated, with the added benefit of a reduction in the drag of the train.

FASHION NOTE

New Lockheed Super Constellations are wearing two coats on their wing assemblies this year.

Coat No. 1 is the normal zinc chromate primer applied to detail parts of interior metal surfaces of inner and outer wing assemblies.

Coat No. 2 is—take a deep breath—a specially applied catalytic type aluminized epoxy resin material, which means it's as durable as baked enamel and impervious to combustion products from exhaust stacks.

SELFWELDING PROCESS

Look, no hands—Welding without touching his work, this do-it-yourself enthusiast is using a new Selfwelding process to make an ash tray stand. The new process, developed by The Lincoln Electric Company of Cleveland, Ohio, is said to make welding for the amateur as easy as turning on a light switch. The process employs a special electrode, electrode holder and small AC welding machine which makes it possible for a person without experience or training to make excellent welds the first time he tries. The company developed the process, it says, so that every fixit-yourself and hobby craftsman, as well as business and service establishments could have an easy method of working with metals.

BIG BUSINESS

One of the nation's largest steel firms expects to furnish about 600 tons of steel for each million dollars spent on toll roads.

(Continued on page 52)

Engineer Salaries

(Continued from page 19)

The Sanitary Engineering division of the Board of Health has experienced difficulty in obtaining suitable personnel for their Engineer I positions on account of the low salary offered.

Inquiry at the Forest Products Laboratory indicated that there had been no change in the Federal salary scales for engineers as reported last year. It appears that an increase of 5 per cent is being requested for the next biennium.

Changes in Wages Paid Industrial Workers

In connection with changes which have occurred in wage scales, it seems proper to call attention to the following tabulation which was reported by the American Iron and Steel Institute as a supplement to the April, 1954, issue of "Steel Facts". Special attention is called to the marked increases which have taken place since 1950.

There has been for many years and there exists today stronger than ever a very heavy demand for technician services and other services which graduates with technical institute training are qualified to provide. However, we do not have a sufficient supply of such institute graduates; so many engineering graduates are often initially placed in positions involving little exercise of their technical and professional qualifications. No attempt will be made herein to suggest a procedure of regimentation within the educational system as a remedy. The desires of American youths are too strong to be dealt with in such a fashion. The existing situation does provide an opportunity for those youths who are technically, temperamentally and physically qualified to succeed in the profession, and it eliminates the argument of those who enter this highly competitive field that they were not allowed to try.

Actually, many engineering graduate find themselves in positions far less attractive than they had anticipated on account of their own deficiencies or because of unfortunate circumstances surrounding their positions.

TABLE II.–HOW THE INCREASES IN AVERAGE HOURLY EARNINGS IN STEEL COMPARE WITH THOSE IN OTHER INDUSTRIES

Increases in Average Hourly Earnings, Selected Industries, 1939,[a] January 1950[b] and January 1954°

Industry	Average Hourly Earnings Year 1939	January 1950	January 1954°	Increase 1939 to Jan. '54°	Increase Jan. '50 to Jan. '54°
Blast furnaces, steel works and rolling mills	$.838	$1.675	$2.18	$1.342	$.505
Meatpacking, wholesale	.686	1.419	1.91	1.224	.491
Textile–mill products	.460	1.202	1.37	.910	.168
Automobiles	.929	1.715	2.20	1.271	.485
Copper mining	.679	1.585	2.12	1.441	.535
Bituminous coal	.886	1.933	2.48	1.594	.547
Rubber tires and inner tubes	.957	1.763	2.21	1.253	.447
Electrical machinery	.702	1.443	1.80	1.098	.357

Source: U. S. Bureau of Labor Statistics, Hours and Earnings.

(a) 1939 was the last prewar year.

(b) January of 1950 was the base period used for wage stabilization purposes by the W.S.B.

° Preliminary.

Another table from the same source shows that the average hourly savings for workers in all manufacturing industries increased from $0.22 in 1914 to $1.80 in 1954, and for workers in the steel industry the comparable figures were $0.30 in 1914 and $2.18 in 1954. A comparison of these changes in wage scales with the changes in salary scales paid engineers (see M. O. Withey's paper of 1954 WSPE Convention) over the same periods shows that the salaries of professional engineers have not kept pace with the increases in wage scales for these groups of workers.

The Influence of Existing Salary Scales on the Professional Status of the Engineer

In order to appreciate the influence which inadequate salaries have had on many persons who are classified as engineers, it is necessary to review briefly the supply and demand for engineering qualifications. Such conditions cause frustration and feelings of discontent which make the possessor ready to listen to the arguments for unionization. The acuteness of this sense of failure among men who have been out of college for several years is sharpened by the knowledge that green graduates are being paid salaries nearly as high as their own for performing work only a trifle less demanding.

The Suggested Remedy

First, let our engineering college faculties make greater efforts to instill in the minds of their students the fact that engineering is a profession and a profession to be exalted. Let both the colleges and professional employers strive to make clear to embryo engineers the distinction between professional positions wherein applications of discretion, initiative, judgment

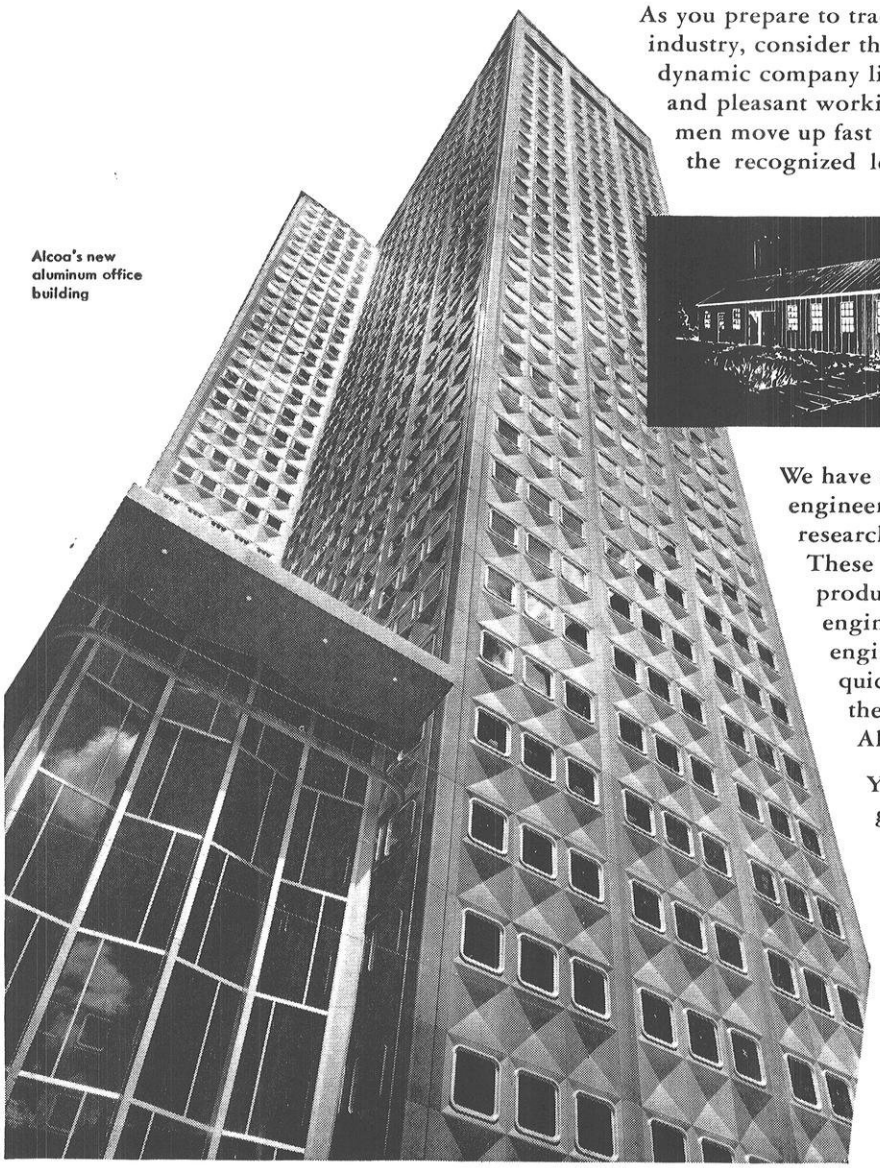
(Continued on page 54)

THE ALUMINUM INDUSTRY WAS BORN ON SMALLMAN STREET

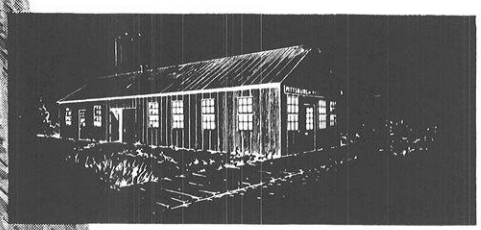
▼ In 1888, the aluminum industry consisted of one company—located in an unimpressive little building on the east side of Pittsburgh. It was called The Pittsburgh Reduction Company. The men of this company had real engineering abilities and viewed the work to be done with an imagineering eye. But they were much more than that. They were pioneers . . . leaders . . . men of vision.

A lot has happened since 1888. The country . . . the company . . . and the industry have grown up. Ten new territories have become states, for one thing. The total industry now employs more than 1,000,000 people—and the little outfit on Smallman Street? Well, it's a lot bigger, too—and the name has been changed to Alcoa. ALUMINUM COMPANY OF AMERICA . . . but it's still the leader—still the place for engineering "firsts".

As you prepare to trade textbooks for a position in industry, consider the advantages of joining a dynamic company like Alcoa—for real job stability and pleasant working conditions—where good men move up fast through their association with the recognized leaders in the aluminum industry.



Alcoa's new aluminum office building



We have fine positions for college graduate engineers—in our plants, sales offices and research laboratories from coast to coast. These are positions of responsibility in production supervision, plant and design engineering, industrial research or sales engineering. Right now it may be quicker than you think from a seat in the classroom to your career with Alcoa. Why not find out?

Your Placement Director will be glad to make an appointment for you with our personnel representative. Or just send us an application yourself. ALUMINUM COMPANY OF AMERICA, 1825 Alcoa Bldg., Pittsburgh 19, Pa.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Science Highlights

(Continued from page 49)

AEROSOL HELPS DO GREASE, OIL REMOVAL JOB

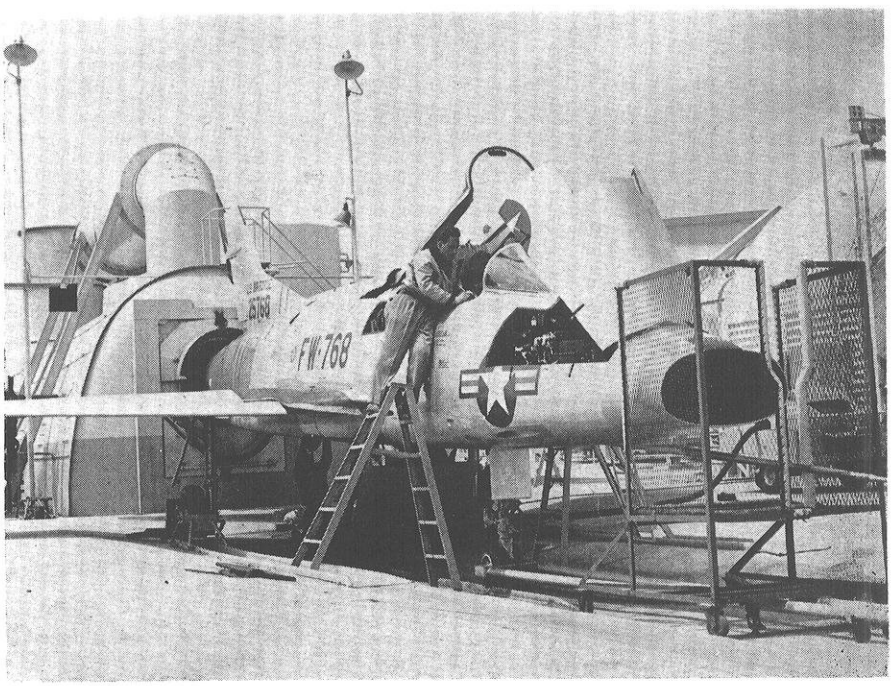
Heavy deposits of grease and oil that are messy and make auto engines, marine equipment, or other machinery appear old beyond their years can be softened and loosened with a new aerosol spray so they can be flushed clean with water.

The product contains no acids or alkali which might harm metal surfaces, its manufacturer claims, and can also be used as a cleaner on painted surfaces, clothing, and upholstery. Big advantage in such cases is the time-saving convenience of application from a push-button, self-spraying container.

An aerosol version of a product which already has proved successful in brush-type liquid applications, the solvent-cleaner washes off as readily with sea water as with fresh water, the manufacturer says, making it particularly adaptable for cleaning marine engines, engine rooms, and decks of tankers.

As a grease remover on engines and metal parts, the product is sprayed over dirty surfaces and allowed to soak in for 15 to 20 minutes before the parts are hose-rinsed, using a fine spray under pressure. In cleaning installed auto engines, the air cleaner should be removed after the engine has been warmed up and waterproof coverings or plastic food-freezer bags should be placed over the carburetor inlet and distributor cap to keep the water spray out of electrical and fuel systems.

The aerosol cleaner, according to its manufacturer, can also be used to remove both oily and water-soluble soil from painted surfaces before refinishing and will help remove wet paint stains, oil, and grease spots from clothing and upholstery.



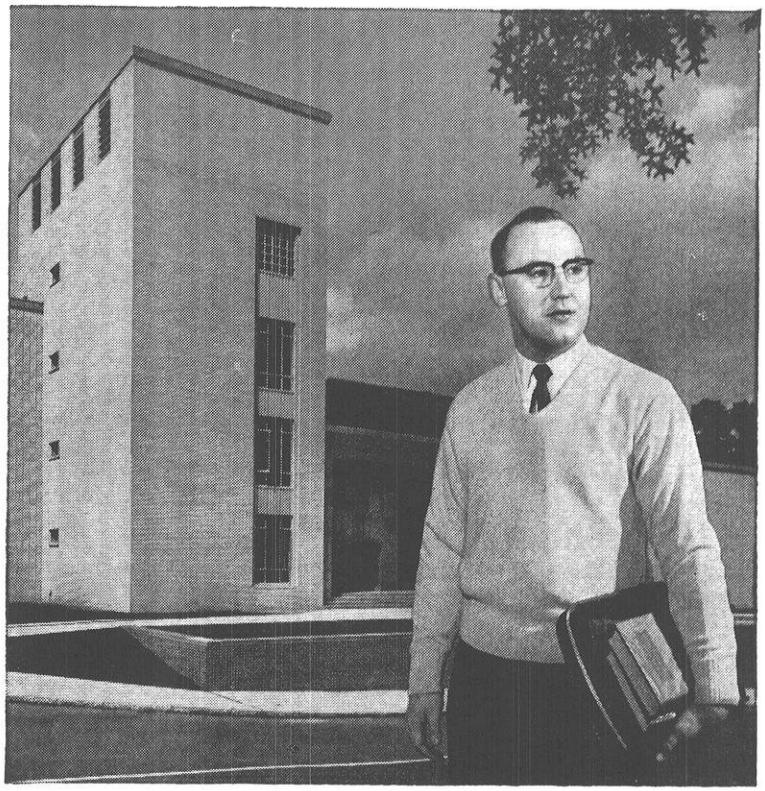
SOUND ABATEMENT CHAMBER FOR SABER F-100

The sound of careful pre-flight operations, the last production step for F–100 Super Sabres, is sharply reduced in this sound abatement chamber on North American Aviation's flight line at Los Angeles International Airport. The tailpipe of the super-sonic fighter juts through an opening in the silencer unit where it is fitted with a nearly sound-proof asbestos collar. The Super Sabre's J–57 engine is tested alone in another sound abatement facility before it is installed in the fighter.

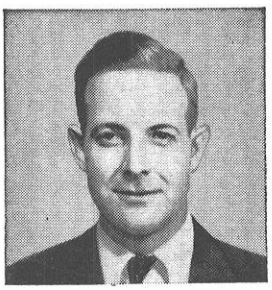
(Continued on page 54)

Jerry Loucks asks:

What sort of work would I do on my first assignment with Du Pont?



R. GERALD LOUCKS is currently working toward his M.S. in Chemical Engineering at Carnegie Institute of Technology. Jerry has served as president of his student chapter of A. I. Ch. E. and participated in intramural sports—besides finding time to play the trumpet in the R.O.T.C. and Kiltie bands. Right now, Jerry is giving a lot of thought to the selection of an employer.



CHARLES W. LOUNSBURY, Jr., worked at Du Pont's Chambers Works for three summers before he received his B.S. in Chemical Engineering from Rensselaer Poly. Inst. in 1940. Since then he has taken an M.S. from Carnegie Tech., and has been continuously employed on interesting assignments at various Du Pont plants. Today Charlie Lounsbury is Technical Superintendent of the Grasselli, N. J., plant of Du Pont's Grasselli Chemicals Department.

Charlie Lounsbury answers:

There is a great variety of first assignments at Du Pont, Jerry, depending on a man's field of training and the general area of work he has selected. For example, I understand you're interested in plastics, and you might start in *development work* on plastics, as I did. I worked with a team of more experienced engineers to increase the capacity of equipment used in producing "Lucite" acrylic molding powder. This was a natural prelude to my next major assignment, where I acted as a liaison between Du Pont's *Design Division* and the plant group—on the design of a new plant for making another form of "Lucite" plastic.

Or take *research work*. Here a new man is generally assigned to minor research problems until he becomes familiar with the general features and requirements of an industrial research program.

A young man interested in *sales* may start in a plant or laboratory dealing with the products he will later sell; or he may join a group of trainees to learn selling techniques right from the start.

A man aiming for *production supervision* may first spend a year or so in laboratory or plant development work. Or he may start as an operator—in a plant producing nylon or "Dacron" polyester fiber, for example. In this way he obtains firsthand knowledge of his process, and establishes a bond of mutual respect with the men he'll be working with on his major assignments later.

In general, Jerry, a man is chosen for a specific job within the scope of his major field of study. His first assignment is intended to help him make the best use of his abilities as promptly as possible.

WANT TO KNOW MORE about working with Du Pont? Send for a free copy of "Chemical Engineers at Du Pont," a booklet that tells you about pioneering work being done in chemical engineering—in research, process development, production and sales. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Del.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

WATCH "CAVALCADE OF AMERICA" ON TELEVISION

Engineer Salaries

(Continued from page 50)

and the principles of science and engineering knowledge are required, and the subordinate positions involving primarily work of a routine nature.

Conclusion

In order to improve the quality of services rendered by engineers both in State services and in private employment, your committee makes the following recommendations:

1. That heads of state departments and other employers of engineers review the qualification standards required for all positions involving engineering, determine those positions requiring the application of professional skill and training, and designate appropriately the grade for each position. The committee believes the WSPE 1952 Classification Schedule will be helpful in arriving at a proper grading of such positions.

2. That the salary scales attached to the various grades be not less than the values recommended in the 1952 Schedule.

3. That both staff members of engineering colleges and employers of engineering students endeavor to impress upon every engineering student and engineer the full importance of the recognition of the professional status of the engineer both by himself and by the public he serves. It is only by making our entire membership fully aware of the importance of the acts of individual members in such recognition that the professional stature of engineers can be fully attained.

This report was signed by the following members of the committee who were present at the meeting on January 28, 1955. END

Science Highlights

(Continued from page 52)

FOR FISHERMEN ONLY

The Soviet Fishing Authority has placed a substantial radio order with a British firm for transmitters, all-wave receivers, combined medium and short-wave direction finders and associated units. The units will be used on 20 deep-sea fishing vessels, now under construction in Russia.

MACHINES IN MOTHBALLS

The Air Forces will mothball 110,000 of its present 120,000 production machines at termination of present contracts. Tools will be stored either near present users' plants or in government warehouses.

X-RAYS MEASURE ALUMINUM FOIL

Housewives can thank X-rays to a great extent for that multipurpose aluminum foil which they use for everything from wrapping food to making Christmas tree ornaments.

Although only one-half the thickness of a newspaper page, it is strong and will not tear easily.

This thickness is gauged by an X-ray measuring device. Sheets of foil, traveling at a speed of 40 per hour are measured to two-thousandths of an inch, or one fourth the thickness of a human hair, as they pass down the production line in aluminum foil plants.

An X-ray beam passes through the sheets of foil at a known intensity. Should the thickness of the foil be other than specified, the beam will travel through the metal at an irregular flow. This is recorded on a control panel to notify manufacturers of the undesirable thickness.

AUTOS FROM SPAIN

A Spanish automobile firm, Sociedad Espanola de Automoviles de Turismo, plans to produce 10,000 cars a year "within a very short time." Ultimately, when the market can absorb them, the firm plans to produce 200,000 cars annually.

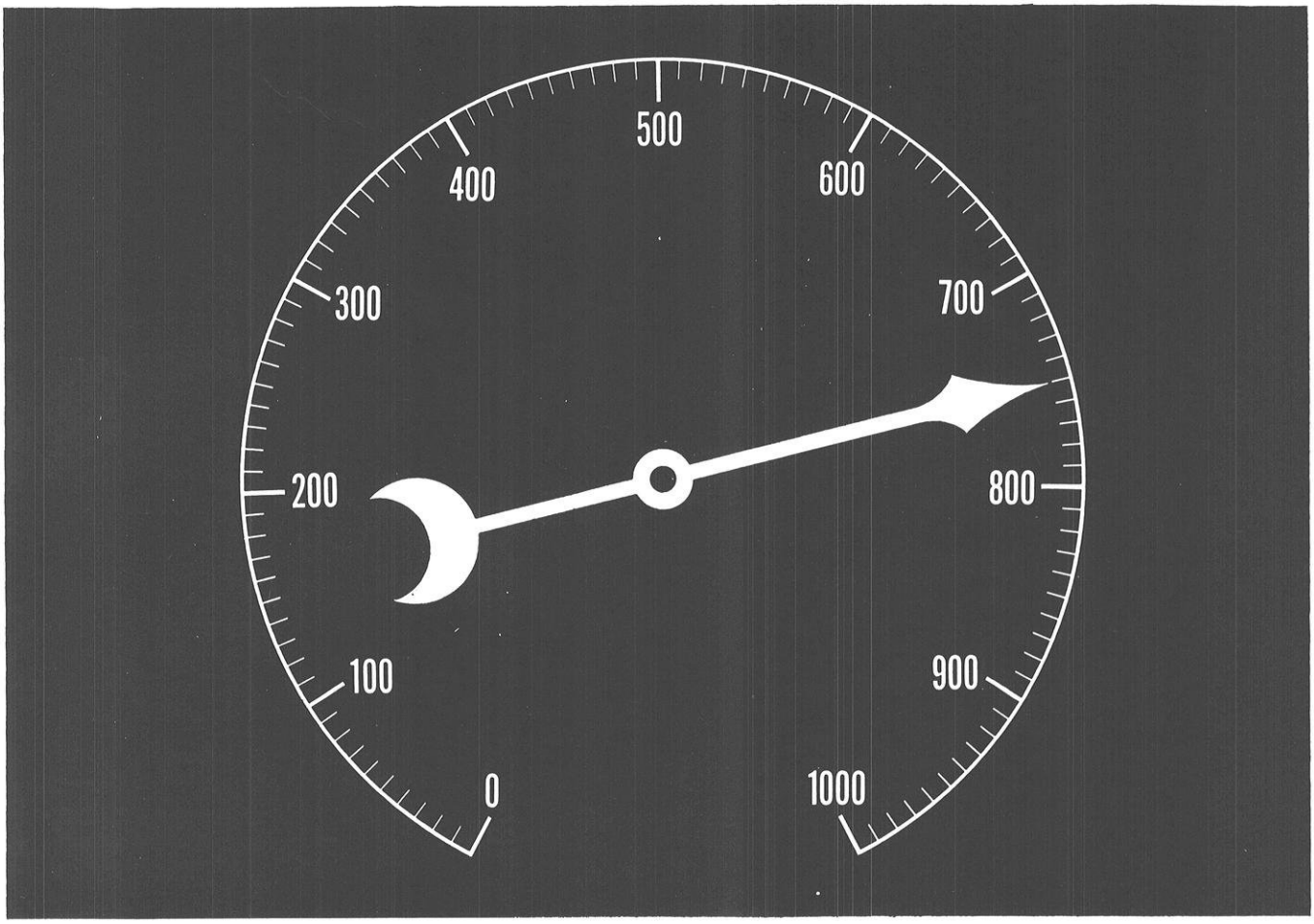
WHAT ABOUT SHEETS?

The Army's "Honest John" artillery missiles are protected with electric blankets prior to firing. The blankets keep the missiles' explosive charge at proper temperature.

ABUNDANCE OF HEAT ENERGY

World resources of uranium and thorium promise 22 times as much heat energy as those of gas, petroleum and coal combined.

(Continued on page 56)



STORY TELLER...

Finding the origin of gages is as difficult as enumerating the types of service for which they are used. But all types of gages have one thing in common . . . they tell a story. They indicate what's going on in inaccessible areas . . . or measure things you cannot see.

Whether actuated by physical force, electrical impulse or mechanical means . . . whether fixed or portable . . . gages are indispensable to modern civilization. They measure the potential of power or pressure . . . the degree of heat . . . the force, flow or level of liquids or gases . . . the strength of solids.

MASTER OF MYSTERY...

In industry, gages have replaced guesses. Physicists, designers, chemists, metallurgists, mechanical and electrical engineers, and a host of technicians and craftsmen have sired this scientific servant . . . to work in power and processing plants, in mines and mills, on highways and skyways, on and under water.

A gage never works alone. Only when it has a point of contact can it function. And minds, too, must have a point of contact that will render the behind-the-scene reports of industry's status. Here, in America, that function is fulfilled in our all-seeing, all-hearing and reporting Inter-Communications System.

THE AMERICAN INTER-COM SYSTEM...

Complete communication is the function, the unique contribution of the American business press . . . a great group of specially edited magazines devoted to the specialized work areas of men who want to manage better, research better, sell better, buy better.

COMMUNICATION IS OUR BUSINESS...

Many of the textbooks in which you are now studying the fundamentals of your specialty bear the McGraw-Hill imprint. For McGraw-Hill is the world's largest publisher of scientific and technical works.

After you leave school, you will want to keep abreast of developments in your chosen profession. Then one of McGraw-Hill's many business magazines will provide current information that will help you in your job.

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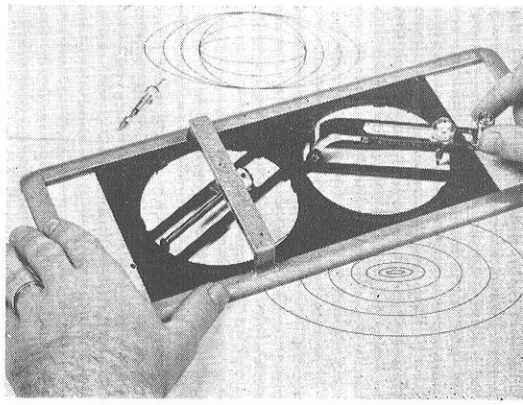
HEADQUARTERS FOR TECHNICAL AND BUSINESS INFORMATION

Science Highlights

(Continued from page 54)



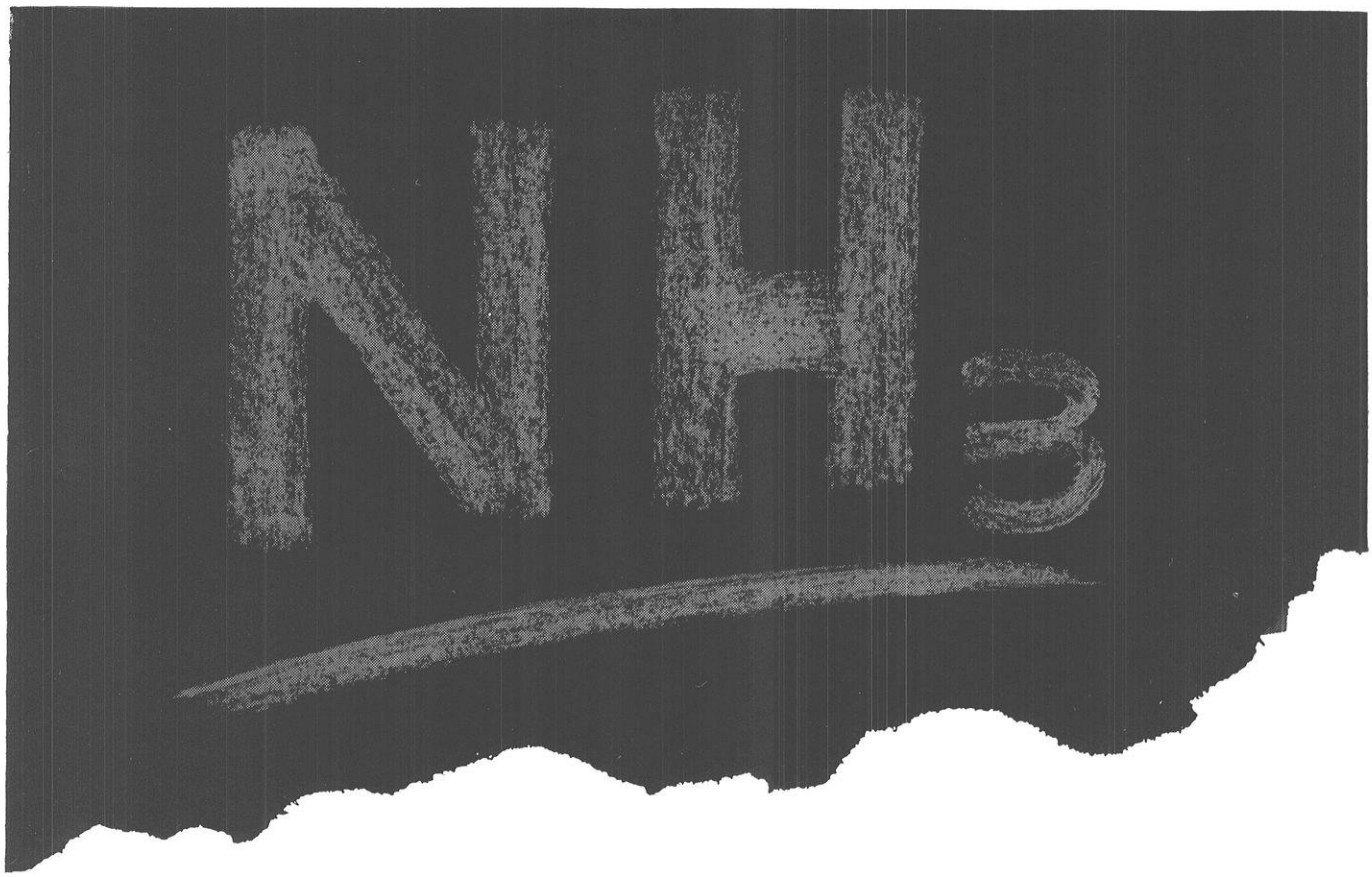
ELLIPSOGRAPH

Now you can draw circular or cylindrical objects in 3–D in a matter of seconds with the mathematically correct, Fowler Ellipsograph.

Easy and simple to operate, this new precision instrument enables anyone, whether a novice or skilled draftsman, to draw consistently perfect ellipses of any desired size and degree. A pin point up to 7 inches or 0° to 90° ellipses—all the way from a straight line to a full circle are made with pencil or ink in one fast operation.

Designed by one of the nation's top draftsman–engineers, this remarkable new tool is the answer to many requests by industry for a device that would enable inexperienced personnel to produce complicated three dimensional drawings quickly and efficiently. Hitherto regarded as too costly and time consuming for the experienced draftsman, the Ellipsograph enables anyone to transpose orthographic flat plans to pictorial drawings with perspective. Hours of constructional drawings are eliminated as well as a multitude of templates. No mathematical calculations are necessary, since self-calculating charts are provided for every possible ellipse situation—even for isometric ellipses.

The Fowler Ellipsograph is made of fine precision machined steel with important working parts chrome-plated to insure a life-time of efficient service. Measuring 5¾" x 13½" it costs only $22.50. **END**



FORMULA FOR BETTER FARMING

THE PETROLEUM INDUSTRY seeks constantly to extract the ultimate in valuable and useful products from every barrel of crude oil. And progress along this line in one area frequently brings with it advances in other related areas.

For instance, improved catalytic reforming methods developed by Standard Oil have increased high octane gasoline yields. This improvement is accompanied by substantial increases in available by-product hydrogen, which can be combined with nitrogen from the air to produce ammonia. Standard has therefore completed plans to enter this important chemical manufacturing field.

Anhydrous ammonia and nitrogen solutions are increasingly favored by midwestern farmers and fertilizer processors as sources of nitrogen. This nitrogenous soil enrichment raises crop yields and farm profits.

Young scientists and engineers enjoy working where such constructive projects are constantly discussed, planned, and developed.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

Wind Tunnels

(Continued from page 13)

with four super-sonic tunnels, including a 10 by 10 ft. tunnel capable of speeds up to Mach 3.5.

U. S. Air Force. The largest existing wind tunnel center, outside of the NACA, is the Wright Development Center near Dayton, Ohio. It contains three subsonic tunnels, including a 20 ft. circular jet tunnel with air velocities up to 425 mph.

Now under construction and in partial operation is the Arnold Engineering Development Center at Tullahoma, Tennesee. When completed AEDC will operate some 14 test units in its three major divisions: Engine Test Facility (ETF), Gas Dynamics Facility (GDF), and Propulsion Windtunnel (PWT).

Recently completed is the ETF which was developed in Germany during the war and was shipped to this country as reparations. Redesign and new equipment have raised the air capacity to about 300 lb. per sec. Altitude capability has been almost doubled from the original 45,000 ft. The four test calls, 12.5 ft. in size will be used to carry on research and development of turbojets, turboprops, and ramjets. In addition to ETF, the Ram Jet Addition (FJA), now in early construction stages, is for the testing of large remjets.

The GDF will consist of four super and hypersonic tunnels with speeds up to Mach 10.0. The first tunnel in operation, called E–1, is a 12 by 12 in. intermittent type tunnel (2–5 min) with a speed range between Mach 1.2 and 5.0. Also in operation is GDF–A with a 40 by 40 jet. The most impressive of the three facilities, PWT will consist of two 16 by 16 ft. tunnels, one transonic and one supersonic. The transonic tunnel is scheduled to make its first runs late this year. The purpose of the PWT is to test full scale powerplants as installed in their airframes. **END**

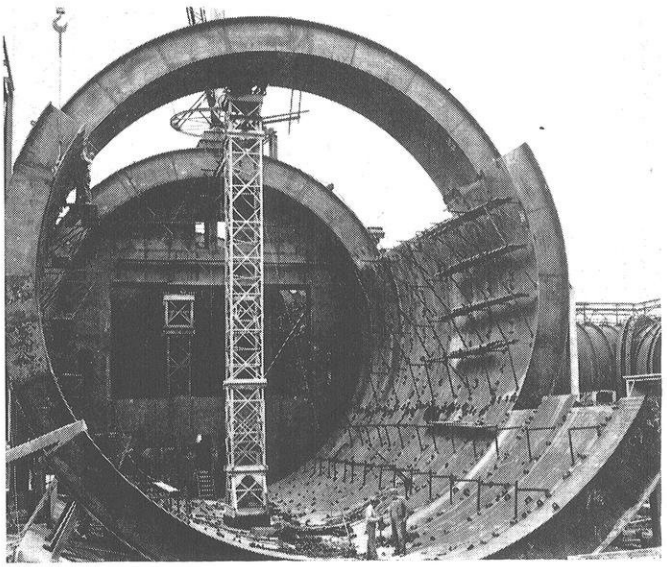


Fig. IV.—Transonic Circuit—of the Propulsion Wind Tunnel facility nears completion at the Air Research and Development Commands development center. The tunnel at this point is 55 feet in diameter.

So You Think You're SMART!

by Sneedly, bs'59

Due to an oversight by the secretary who took Sneedly's dictation last month, the deadline on the $5.00 problem was given as March 15; the correct date should have been April 15, 1955. Sneedly has taken precautions to prevent such gross errors in the future—that damn secretary is collecting unemployment insurance back in Monroe.

Last week Sneedly was picking up points in Experimental Psychology and came across the following problem: Well, actually, he didn't come across it, he was thrown into it head-first. It was an experiment in deduction, held appropriately just before April 15. Sneedly was placed at the head of a column of five people, all of whom were facing in the same direction. Upon each person's head the psych grad student placed either a white or red cap and told all of them that there were three red and two white caps. Since each person could not see the cap on his own head and only those on the heads in front of him, each was to deduce the color of the cap on his own head.

At first glance under such an arrangement, good old Sneedly didn't stand a chance. However, the grad student first asked the third man the color of his own cap. The third man truthfully answered, "You've got me, buster!" After a long, long wait, the M&Met immediately behind me said, "Da-a-a, I don' know neider." (I don't know how he got into a psych class, unless perhaps he was a subject for another experiment.) The psych major conducting the experiment interpreted for me and said, "You may assume that he was telling the situation as he saw it; that is to say, he was telling the absolute, 100% truth, by jumpin' jingo."

Stopping to think for just a moment, giant wheels spinned rapidly in Sneedly's head. "……!" he yelled, and the gallery broke out into a tremendous ovation. When interviewed later, Sneedly replied, "It was really nothing, though I admit that there aren't many who could have done the same thing in my shoes."

* * *

This is no puzzle, or shouldn't be. Having passed French 1a last semester, Sneedly decided to put it to use. This is what Sneedly has come up with—a little verse to help remember the value of pi to thirty places. Each of the thirty words contains the appropriate number of letters so that by counting them up, word after word, one can answer that pi equals 3.1415926 . . . etc.

"Que j'aime a faire apprendre un nombre utile aux sages!
Immortel Archimede, sublime ingenieur,
Qui de ton jugement peut sonder la valeur?
Pour noi ton probleme eut de pareils advantages."

For any prizes in functional literature, Sneedly can be reached c/o *The Wisconsin Engineer.*

It took a Journalism student to do it, but as Sneedly told you last time, the bad penny of the twelve can be determined in three weighings on a simple balance. Here's how it's done:

1 2 3 4 5 6 7 8 9 10 11 12 (the pennies numbered)

First case:

(1) 1 2 3 4 vs. 5 6 7 8 even
(2) 1 2 3 vs. 9 10 11
(3) Keeping a record of how the pointer on the balance swings the bad penny can be found in one more weighing.
  (a) If the second weighing was even, then 12 was the bad penny. One more weighing would determine whether it was light or heavy.
  (b) If the second weighing was uneven: eliminate 9, and set up the balance as follows:
    4 10 3 vs. 1 2 11
  by remembering how the balance had tilted before, you can immediately pick out the bad penny, and tell whether it was heavy or light.

Second case: Using a similar attack, you can determine the bad penny in three weighings if

1 2 3 4 vs. 5 6 7 8 were uneven.

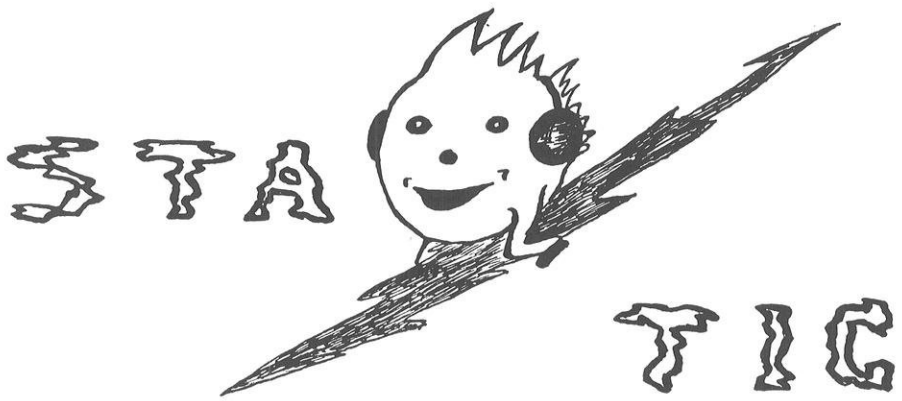
Of course, with all these clues, you cannot help but obtain the right answer. Ah, such is life!

* * *

Here's the best problem of the year:

Who in the h. . . is Sneedly?

No prizes will be given for the answer, 'cause let's face it, Sneedly is a prize in himself. Any answers or reasonable facsimiles will become the property of Sneedly and none can be returned. All answers sent by mail will be strictly confidential. Oral answers will be discreetly disregarded. **END**



by I. R. Drops

Ohm On the Range

Oh give me an ohm
Where the impedances roam
Where the fields are not fluxy all day
Where you'll never see
A field without phi,
And the flux is not leaking away.
Ohm, ohm on the range,
Where the flux is not charging all day;
Where never is seen
A shunt field machine
With its armature running away.

* * *

When a conductor of a Long Island local came through the train collecting tickets, an elderly gentleman couldn't seem to find his in any of his pockets. Suddenly the man next to him laughed and said, "Al you are holding your ticket in your teeth." The conductor punched the ticket and moved on down the aisle. "Al you sure are getting absent minded lately," remarked the friend. "Absent minded nothing," whispered Al angrily. I was chewing off last year's date."

* * *

Stories about a succession of child marriages in the feudin' country down South started Eva Nelson thinking of the time a Blue Ridge mountaineer fell ill. The doctor reassured the patient's worried husband, "That little wife of yours'll be perfectly all right in a couple of days, son. She's just teething.

* * *

I like exams,
I think they're fun
I never cram, and
I don't flunk one—
I'm the teacher.

* * *

He: "You remind me of the ocean."
She: "You mean I'm wild, romantic, and restless?"
He: "No, you make me sick."

* * *

Soldier: "Say fellow, you think you are a pretty hard guy, don't you?"

Marine: "Your darn right. I wasn't born, I was quarried."

M. E. "Tell me Joe, how can you keep drinking that coffee in the cafeteria every morning?"

C. E. "It's easy, I take a spoon full of saniflush once a week."

* * *

An Engineer was getting ready to go to a dance, and his house mother noticed that he got dressed in a record time. "Son" she asked accusingly, "Did you take a bath?"

"No, Mom," came the reply.

"Now listen, son," she demonstrated. "You wouldn't go to a dance without taking a bath would you?"

"Why not," the engineer replied, "It isn't formal."

* * *

The gas company advertised in a local newspaper:
Wanted: Hard-boiled, beauty-proof, woman-hater to read meters in sorority houses. We haven't made a cent this year.

* * *

"Sadi, did you stop at the postal office this morning and git the mail?"

"Yeah, Pa."

"Where'd you put it?"

"I didn't, there weren't none."

* * *

"What was the hardest thing you learned in college?" asked the M.E.'s father.

"How to open beer bottles with a quarter," replied the prodigal son.

* * *

"Hello, Honey, I could hardly wait to tell you what's happened . . . Dad's cut off my allowance, I had to sell my car and drop my fraternity, but we can still have fun just . . . Hello? . . . Marilyn? . . . Hello . . .

* * *

"Heard you were moving a piano, so I came over to help."

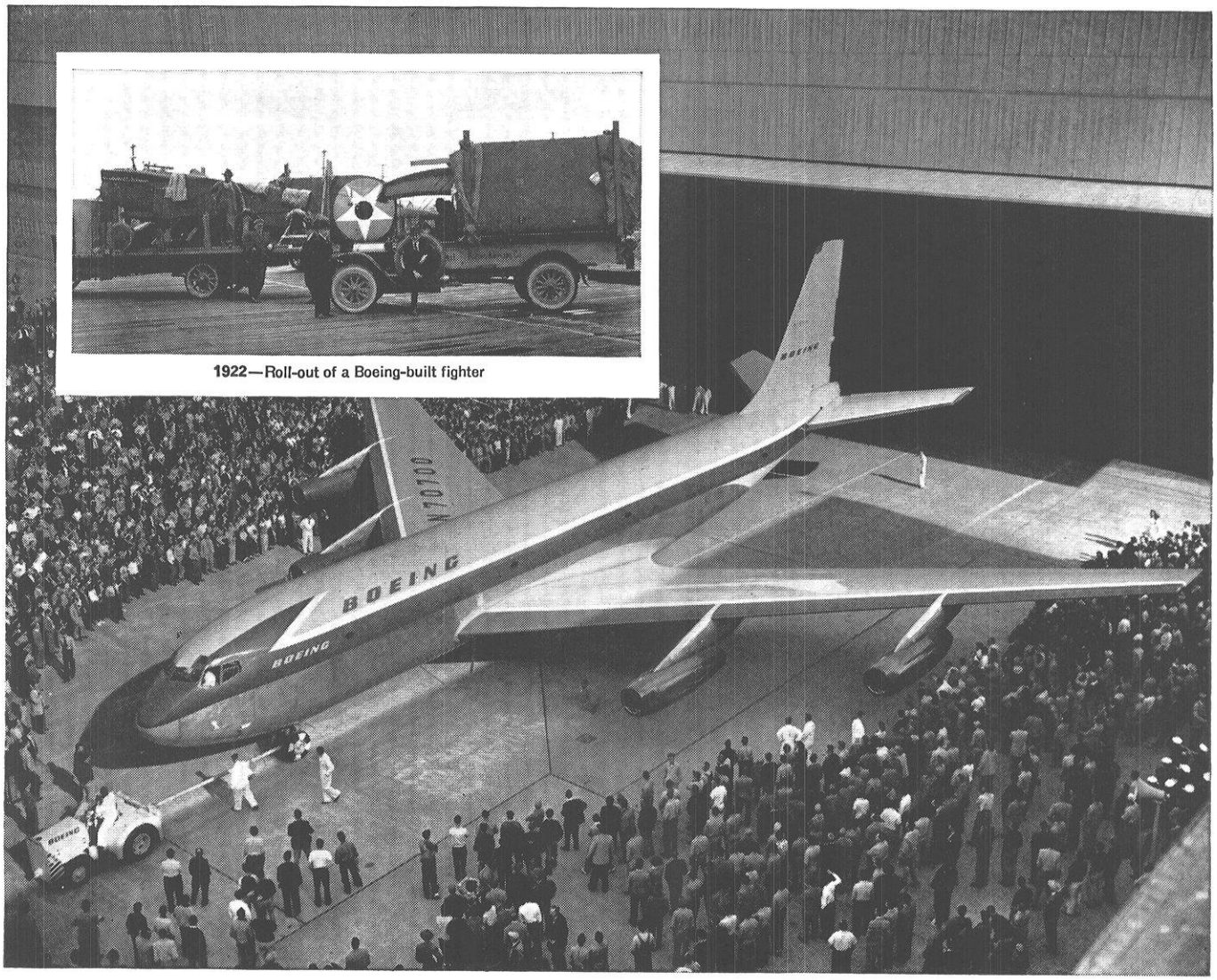
"Thanks, but I've already got it upstairs."

"Alone?"

"Nope, hitched a cat to it and drug it up."

"You mean your cat hauled that piano up two flights of stairs? How could a cat pull a heavy piano?"

"Used a whip!"



1922—Roll-out of a Boeing-built fighter

1954—Roll-out of America's first jet transport, the Boeing 707

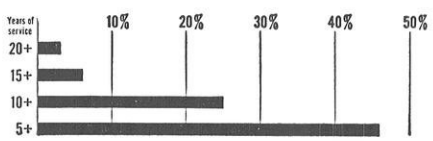
Progress is a Boeing-career hallmark

From the earliest days of aviation, Boeing engineers have produced an impressive number of trend-creating "firsts"—including the 707, America's first jet transport, shown above.

Boeing's 38-year history of Research, Design and Production progress has continuously opened up new career opportunities for engineers. Today Boeing employs more engineers than even at the peak of World War II.

At Boeing you'd work with engineers who developed: The world's first all-metal, 3-mile-a-minute commercial transport. The first pressurized airliner. The first effective four-engine bomber (the B-17). Today's fastest operational bomber (the six-jet B-47). The even more advanced B-52 eight-jet global bomber, and the 707, America's first jet transport. Boeing engineers continue to design "years ahead," doing research on nuclear-powered aircraft. They are also developing a new Air Force defense weapons system, based on the Boeing F-99 Bomarc pilotless interceptor. These long-range programs project Boeing progress far into the future.

One measure of the satisfaction of Boeing careers is given in the chart below. It shows that 46% of Boeing engineers have been with the company for five or more years; 25% for 10 or more years, and 6% for 15 or more years.



Here are other advantages: Boeing promotes from within and holds regular merit reviews to assure individual recognition. Engineers are encouraged to take graduate studies while working and are reimbursed for all tuition expense.

Of technical graduates at Boeing, 28% hold Mechanical Engineering degrees, 24% Electrical, 19% Aeronautical, and 9% Civil. The remainder is comprised of other engineering graduates, physicists and mathematicians.

For further Boeing career information consult your Placement Office, or write:

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Company, Seattle 14, Wash.

BOEING
SEATTLE, WASHINGTON WICHITA, KANSAS

Meet the Authors

by Fritz Callies, m'55

LELAND R. BRIGGS

Briggs, a junior Chemical Engineer, is a member of AIChE and the captain of the "Chem Engineers" bowling team. His home town is Madison, and he knows his way around it rather well, since he is working his way through school by driving cab here. Most of his spare time is spent collecting and tinkering with old radios.

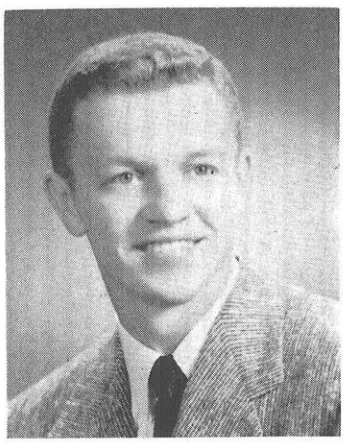
Briggs is also Past Master Councilor of the Madison Chapter of DeMolay.

RICHARD W. GROTH

Dick, a senior in electrical engineering, is from Appleton, Wisconsin. No stranger to the *Wisconsin Engineer* and its readers, Dick was an associate editor last year.

Some of his interests and activities include membership in Eta Kappa Nu, Tau Beta Phi, and Phi Eta Sigma. He is also a student in the Air Force ROTC advanced corps, and expects to receive his commission when he graduates in June.

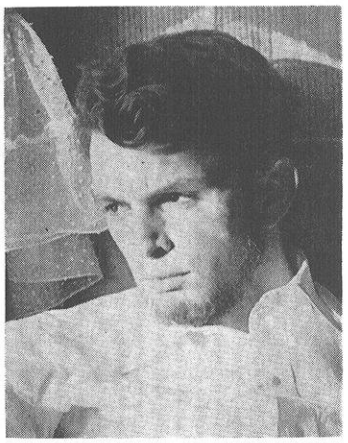
In the past, Dick has pursued his interest in electronics by working during the summer with the Eastman Kodak Company. After spending a few years with the Air Force, Dick hopes to enter the field of servo-mechanisms, which is his special interest.



BJORN J. THOMPSON

Know anything about ice-boating? If you're like most of us, chances are that you don't. So why not take a look at the readable and interesting article, "Ice Boating", by Bjorn Thompson? If you can't get away from your slide rule, there are coefficients of friction and vectors aplenty to calculate, but, according to the author, the best thing to do with an ice boat is to have fun. And he sounds convincing.

Bjorn's a junior in M.E., and in addition to studying and ice boating, he finds time to be a pole vaulter on Wisconsin's track team. (Where he is, we hear, a consistent point maker.) After graduation and the army, Bjorn hopes to be able to specialize in sales or research.



STEPHEN K. CARTER

Carter is a senior in Mechanical Engineering from Madison, and is a member of both ASME and SAE. As a sophomore, he was WSPE Editor for the *Wisconsin Engineer*.

He is married and has two little Carters: three-year-old Jeanie and four-month-old Steve, Jr. In the rest of his spare time he works as an accountant.

Sailor's wife: "Remember when we were first married—you used to say I had a shape like a beautiful ship?"

Sailor: "Yeah, but your cargo has shifted."

* * *

Dear Pop: Everything fine at school. I'm getting lots of sleep and am studying hard. Incidentally, I'm enclosing my fraternity bill. Your son, Pudge.

Dear Pudge: Don't buy any more fraternities. Your Pop, Pop.

* * *

If every boy in the United States could read every girl's mind, the gasoline consumption would drop off fifty per cent.

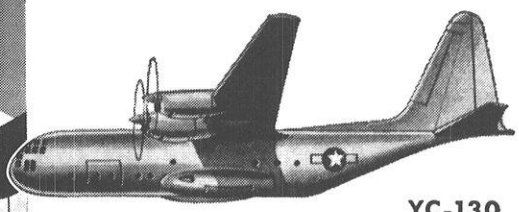
* * *

Overheard in Engineers office: "The editor just hung himself!"

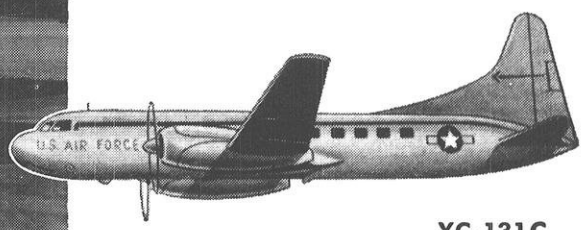
"Omigosh! Have you cut him down?"

"Heck no, he isn't dead yet."

Allison Engineers Pioneer Turbo-Prop Development



YC-130



YC-131C

William J. Layne received his B.S. in Aeronautical Engineering from Purdue University in 1950. Before joining the Allison engineering staff, he served as a captain in the Air Force 1942-46 and 1951-53. Bill, now a Flight Test Engineer, is shown taking gas turbine compressor readings from the equipment used to start turbo-prop engines at the Allison Test Facility in Indianapolis.

ALLISON is out in front, leading all U. S. aircraft engine manufacturers with more turbo-prop flight experience than has been accumulated by all of the nation's other engine manufacturers combined.

That's because Allison—working closely with the military—was a pioneer in the design, development and production of both engines and propellers for turbo-prop aircraft. First flight with an Allison turbo-prop engine was made in a Boeing B-17G at Indianapolis in 1949. Today, eight different types of military aircraft—including the VTO's—are making history with the Allison Turbo-Prop.

The Allison Turbo-Liner, shown above, was America's first turbine-powered, commercial-type transport. This flying test bed, which is a Convair 240 converted to Allison Turbo-Prop engines and Aeroproducts propellers, was the forerunner of modern military transports such as the Lockheed C-130 and the Convair YC-131C. After its first flight in 1950, the Turbo-Liner was used primarily as an engineering flight test aircraft, checking out problems for military application. More recently, the Turbo-Liner has been used on demonstration flights to show the many advantages of a turbo-prop powered transport. To date, the Turbo-Liner has made nearly 700 flights and has accumulated nearly 500 hours of flight time.

Now available for commercial application, Allison Turbo-Prop engines and their matching Aeroproducts propellers today are setting new standards for transport aircraft in speed, load-carrying ability, and economical operations.

Looking ahead, with our extensive development and expansion program, we need more engineers to carry on in a field where you'll find unlimited opportunity. We have immediate openings for the well-qualified, technically-trained, young graduate who is interested in starting his engineering career with a recognized leader in the industry. Allison representatives are interviewing prospective June graduates now. Write for further information: R. G. Greenwood, Engineering College Contact, Allison Division of General Motors, Indianapolis 6, Indiana.

GM AIRCRAFT POWER

Allison DIVISION, GENERAL MOTORS CORPORATION, Indianapolis, Ind.

Design, development and production—high power TURBINE ENGINES, PROPELLERS and ACTUATORS for modern aircraft . . . heavy duty TORQMATIC DRIVES for Ordnance and Commercial vehicles . . . DIESEL LOCOMOTIVE PARTS . . . PRECISION BEARINGS for gasoline and Diesel engines and special application.