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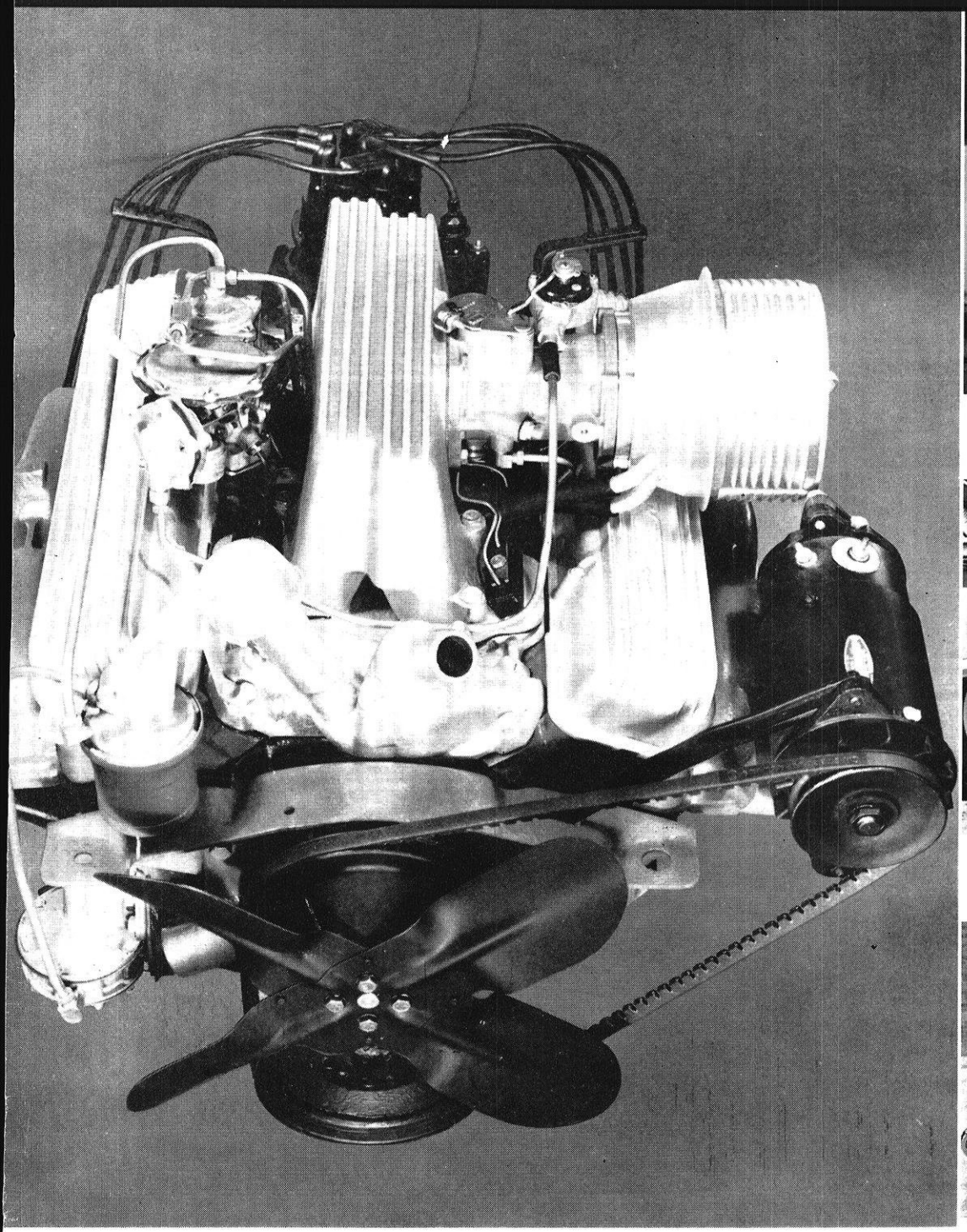
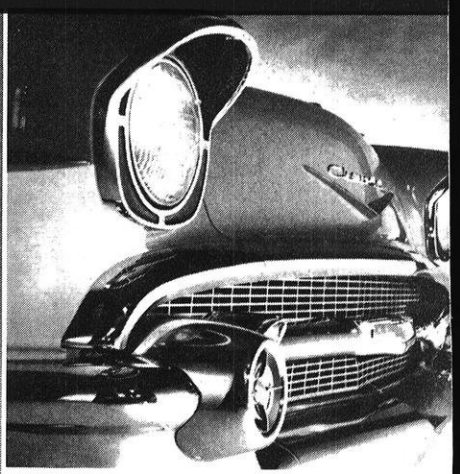
OCTOBER
1956
The Wisconsin
25¢

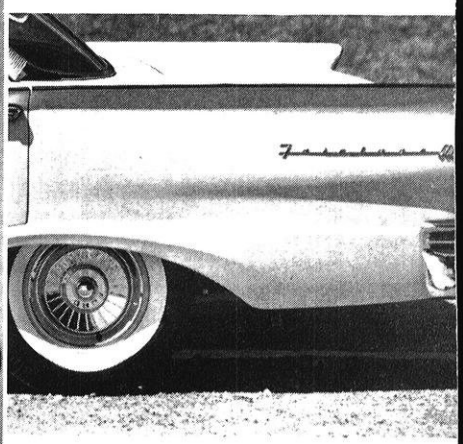
engineer



CORVETTE V8



CHEVROLET



FORD

LINCOLN

THE GOODYEAR WORLD

VOL. 2 NO. 1

NEW TIRE MAY REVOLUTIONIZE CAR DESIGN

Akron, Ohio – Goodyear's new Captive-Air safety tire is one of the greatest developments in automotive history–a tire that may revolutionize the body design of the American car.

Startling statement? Sure. But, just think of this.

Think of a tire that gives lifesaving protection against blowouts and punctures. Think of a tire that will carry you safely at *legal speeds* for 100 miles or more–with a two-inch gash in the wall. Think of a tire that *eliminates* the need for a spare.

These are some of the advantages of the new Captive-Air–the safety tire with the built-in spare. It introduces a whole new concept in motoring. And by eliminating the need for a spare tire well, it opens many new avenues of design for automotive body engineers. Goodyear was not alone in the search for this "no-spare" concept. But, Goodyear is the *only* company which has made it a practical, economical reality.

Why Goodyear?

For several reasons. First of all, the Captive-Air is backed by 22 years' experience with the double air chamber principle proved by millions of LifeGuard Safety Tubes and LifeGuard Blowout Shields.

Add to that the creative "imagineering" of Goodyear Tire Development Engineers who advanced the double air chamber principle to this most modern refinement and the foresighted encouragement of Goodyear Management.

Add the know-how and enthusiasm of the entire Goodyear engineering organization–the chemists who compound the rubber–the chemical engineers who figure out how to make it – the tread designers – the testing and development engineers–the production engineers – and many more. And then add one more thing–nylon cord. Not ordinary nylon cord. But 3-T Nylon Cord made by an exclusive tension, temperature and time-balanced process conceived and developed by Goodyear engineers.

Put them all together, and you can readily understand why Goodyear scooped the industry – with the Captive-Air, just as they have been first with so many significant developments–from rubber pipe that outlasts steel to airships that guard the frontiers of our continent.

Wouldn't *you* be proud to be a member of this up-to-the-minute engineering team?

Career with A Future

TODAY, the graduate of an engineering or technical school can make no more promising choice of careers than the modern petroleum industry . . . with its amazing new offspring, *petrochemicals*. This is truly the "industry of the future."

Phillips Petroleum Company is one of America's great integrated oil companies, engaged in exploration, production, manufacturing and distribution of many types of petroleum products; and Phillips leads in the fast-growing petrochemical field. The company is a major factor in the fields of synthetic rubber, carbon black, chemical fertilizers, plastics, rocket fuels and special chemicals. Phillips also is active in the field of atomic energy and operates one of the government's major reactor installations.

At Phillips <u>You</u> choose your career

At Phillips you can decide among *many* promising careers in an industry with an unlimited future. And Phillips policy of "promotion from within" offers you the opportunity for advancement to positions of increasing responsibility and importance.

PHILLIPS PETROLEUM COMPANY
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Send this coupon for the new booklet "Career with a Future," describing your opportunities with Phillips.

D. R. McKeithan
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Dear Mr. McKeithan: Please send me your new booklet "Career with a Future."

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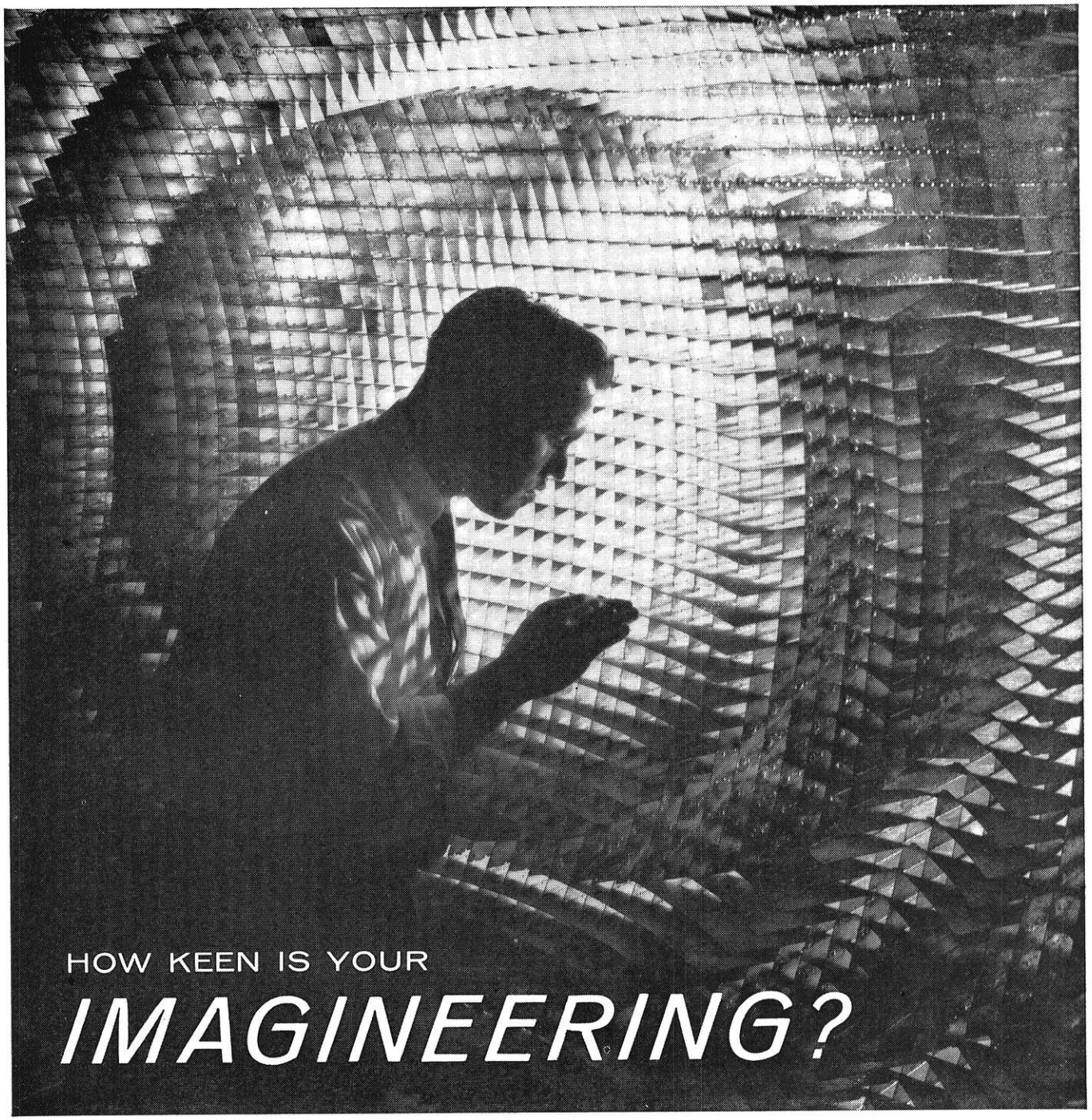

Behind this Sperry engineer you see a complex development in one of the nation's guided missile programs. Can you imagine what it is?

■ Imagination is a valuable trait for the engineer making his career with Sperry. For here there are many challenging opportunities to be met in such fields as missiles, inertial guidance, radar, computers, microwaves and gunfire control. And while you work with the acknowledged leaders in these fields you can further your formal education—with Sperry paying your full tuition for advanced or continuing studies.

■ Whether you elect to work with Sperry in its modern plant in Long Island, or in Florida, California, Virginia or Utah, there is a bright future for you at Sperry, and one limited only by your own desire to get ahead.

■ Check your Placement Office for dates when Sperry representatives will visit your school. Make it "a must" to talk with them or write J. W. Dwyer, Sperry Gyroscope Company, Section 1B5.

P.S. In case you *didn't* identify the equipment shown above, it is part of an 8 ft. Sperry-designed radar antenna for long range missile guidance.

SPERRY GYROSCOPE COMPANY
Great Neck, New York
Division of Sperry Rand Corporation

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Volume 61 OCTOBER, 1956 Number 1

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WISCONSIN ENGINEER

The Student Engineer's Magazine

FOUNDED 1896

Features

Departments

Frontispiece

This 1600-hp Westinghouse "canned" motor pump shown on test is the largest ever built. The first of three main coolant pumps the Company is building for the 60,000-kw Pressurized Water Reactor at Shippingport, Pa.

Rambling WITH THE EDITOR

WELCOME FRESHMAN. By the time this belated welcome reaches you, you have probably braved many lines and have been stopped by many people wanting to sell you something. I would like to take this space to ask you to seriously consider joining the student society of your branch of engineering. More than 100 years ago, a prominent French author Alexis De Tocqueville, after visiting the United States, wrote:

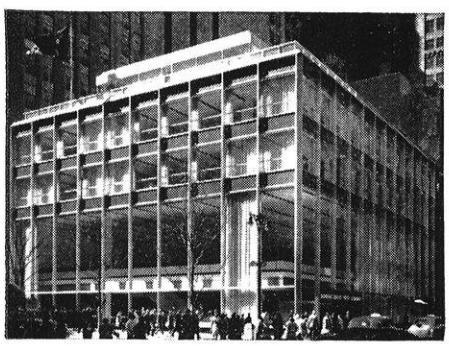
> "The Americans of all ages, all conditions and all dispositions constantly form associations. They have not only commercial and manufacturing companies in which all take part but associations of a thousand other kinds: Religious, moral, serious, futile, restricted, enormous, or diminutive. The Americans make associations to give entertainments, to found establishments for education, to send missionaries to the antipodes . . . Wherever at the head of some new undertaking you see the government in France or a man of rank in England, in the United States you will be sure to find an association."

When De Tocqueville made this observation there were only a few hundred associations in America. Today each of you has an opportunity to join a group that has your specific interest at heart. Later on in life you may be leading "some new undertaking" as a member of that group. Industrial leaders of today all are active in groups the same or similar to the ones you have a chance to join today. Get an early start and don't wait until your a senior to become active.

—R.F.S.

NEW PRODUCT in the air conditioning field is Worthington's ultra-modern winter and summer home air conditioner. It's a compact package that heats, cools, circulates, filters, and controls humidity. Like every Worthington product, this good-looking unit is designed and built for a lifetime of quiet, efficient service.

Making today's BIG news in air conditioning



NEW BUILDING in New York is the glass-sheathed Manufacturer's Trust Building. It's cooled by a Worthington central station system—so big it does the same job as melting 300 tons of ice daily.

NEW LIFE FOR OLD STORES. Shoppers stay longer, buy more in stores cooled by Worthington units with the new "Million Dollar" compressor. New 3-D circulation aims comfort right where you want it.

Worthington's new residential air conditioners, packaged units, big central station systems — all are making headlines in the air conditioning field. And the same research and engineering skills responsible for their development are applied to all Worthington products — engines, turbines, compressors, construction machinery, as well as pumps.

For the complete story of how you can fit into the Worthington picture, write F. F. Thompson, Mgr., Personnel & Training, Worthington Corporation, Harrison, New Jersey. 4.25D

See the Worthington representative when he visits your campus

See the Worthington Corporation exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 40th Street.

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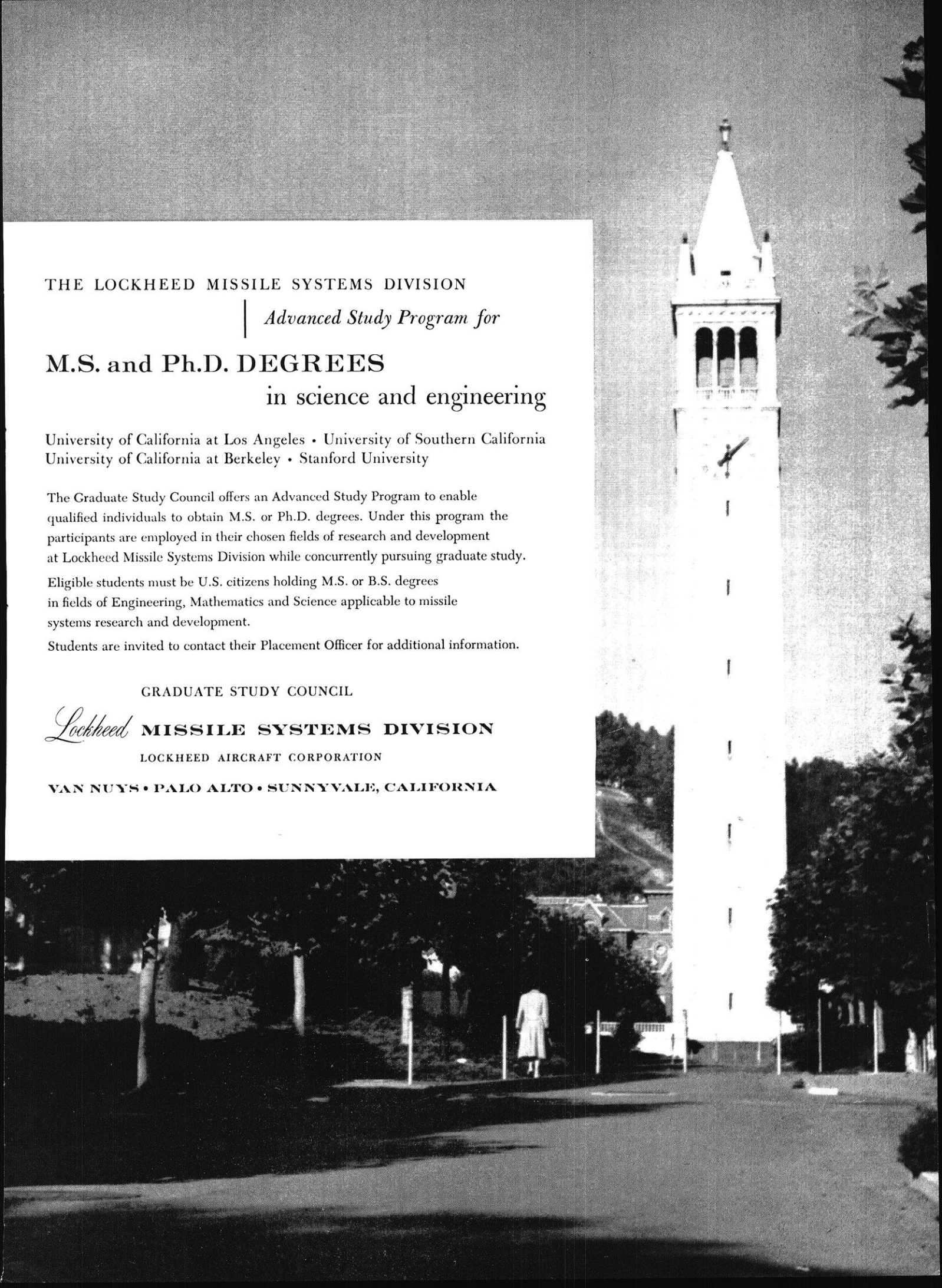

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The Graduate Study Council offers an Advanced Study Program to enable qualified individuals to obtain M.S. or Ph.D. degrees. Under this program the participants are employed in their chosen fields of research and development at Lockheed Missile Systems Division while concurrently pursuing graduate study.

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Students are invited to contact their Placement Officer for additional information.

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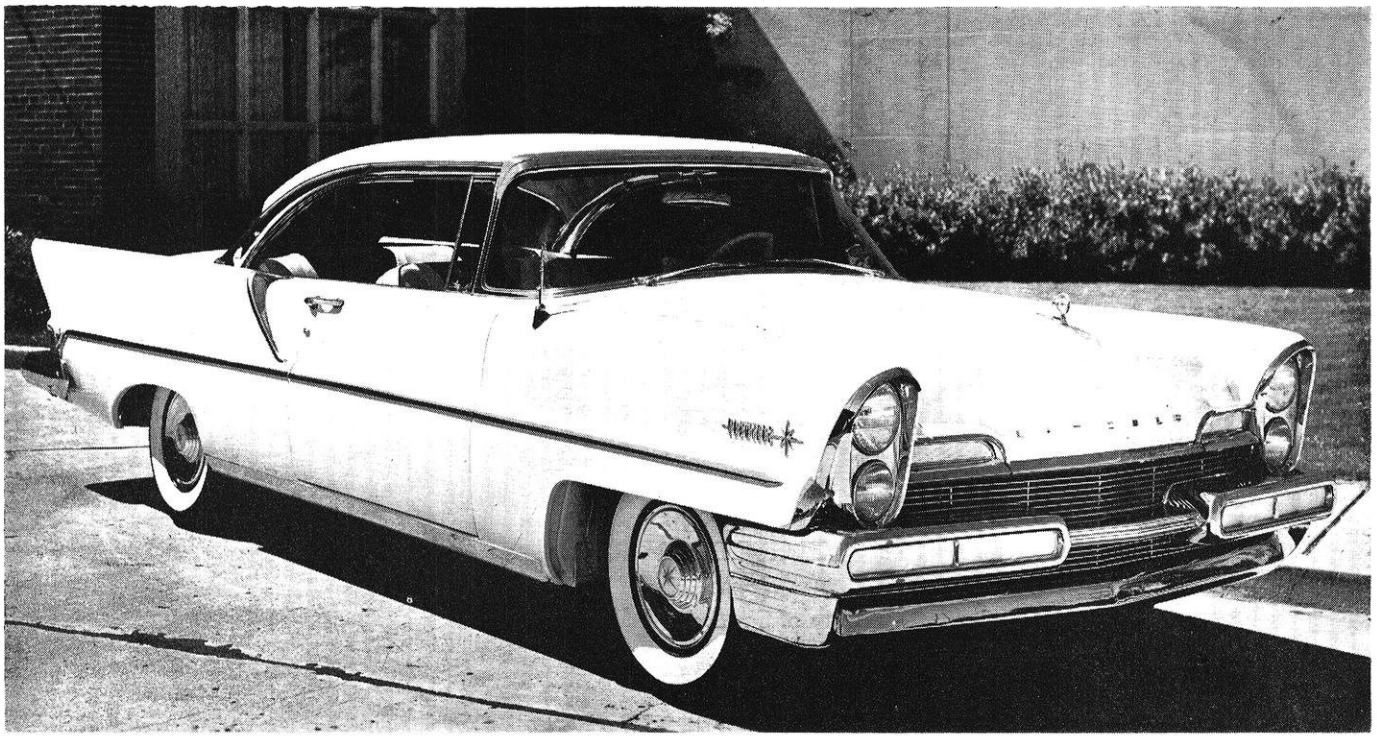


'57 LINCOLN

Four Headlights—More Power

The 1957 Lincoln will have seven models, two more than last year. A new four-door hardtop model in the Premiere and Capri series has been added. Regular sedans in both series will have thin pillars which give an appearance of a hardtop when the windows are rolled up.

The major exterior style change is in the front end with Quadra-Lite styling. Large 5 and ¾-inch road lamps, positioned below the headlights in an oval shape, chrome-edged bezel, provide the driver with the choice of using headlights for country driving and roadlamps for city driving or both roadlamps and headlights together.

The new front end also has a newly-styled combination bumper and grille, larger parking lights and directional signals.

The rear quarter panel with its canted fender blades and flared rear wheel openings adds a look of motion. The blades originate well forward on the panel with a simulated air scoop.

The exhaust pipes are concealed, under the bumper eliminating the jet pod outlets and preventing the untidiness of exposed, bumper-located exhaust pipes.

New accessories in the 1957 Lincoln are power vent windows, power-directed differential which prevents the car from being immobilized when one wheel is stuck in snow or mud, electric door locks operated from a master switch on the instrument panel, Adjust-O-Matic shock absorbers, and six-way power seat. A remote control sideview mirror and an automatic low-fuel warning signal are standard equipment. The fuel signal flashes red when approximately three gallons of gas remain in the tank.

Power brakes have been added as standard equipment on the 1957 Lincoln Premiere to supplement power steering, power seats and power windows which were standard equipment in 1956.

Engine displacement is 368 cubic inches, as in 1956, but horsepower and torque have been increased by better breathing, a new distributor, a redesigned combustion chamber and higher compression ratio. New reshaped pistons are also included in the improved engine package which has a rating of 300 horsepower at 4800 rpm and 415 foot pounds of torque at 3000 rpm. An increase in compression ratio from 9.0:1 in 1956 to 10.0:1 in the 1957 engine was accomplished by adding .01 inch to the piston head and by reducing the volume of the combustion chamber.

A new distributor is designed to give properly timed ignition at all engine speeds and loads and incorpo-

(Continued on page 90)

'57 CHEVROLET

Fuel Injection and New Transmission

Fuel injection and a new triple-turbine automatic transmission will make their debut on the 1957 Chevrolets.

Fuel injection will be introduced on the Corvette engine, a lively new V8 of 283-horsepower that is to be available as an option throughout the line of Chevrolet passenger cars.

In addition to the trail-blazing RAMJET fuel injection and the new transmission, the latest models present a multitude of other styling and preformance features.

Fuel injection, a long-time objective of American automotive engineers in the quest for ideal flexibility in performance, replaces the customary carburetor. Because of quicker power response and faster warm-up, it is expected to gain almost universal adoption within a few years. Chevrolet pioneers the device in its field and will be one of the few makes, regardless of price, to offer the advance on engines this year.

The new transmission, known as Turboglide, is a Chevrolet exclusive. It carries the principle of torque conversion—first introduced in Chevrolet's Powerglide in 1950—to a new peak in efficiency.

The triple-turbine—with infinitely variable ratio characteristics—produces an uninterrupted driving force at all speeds. There is no feeling of "shift" at any level.

In eye-appeal the 1957 Chevrolets differ strikingly from 1956 models. While two and one-half inches have been added to overall lengths, the horizontal sweep of new styling motif gives the impression that the car is even longer than its 200 inches. All bodies are lower, with a reduction of an inch and a half in height of the cowl and substantially increased windshield areas.

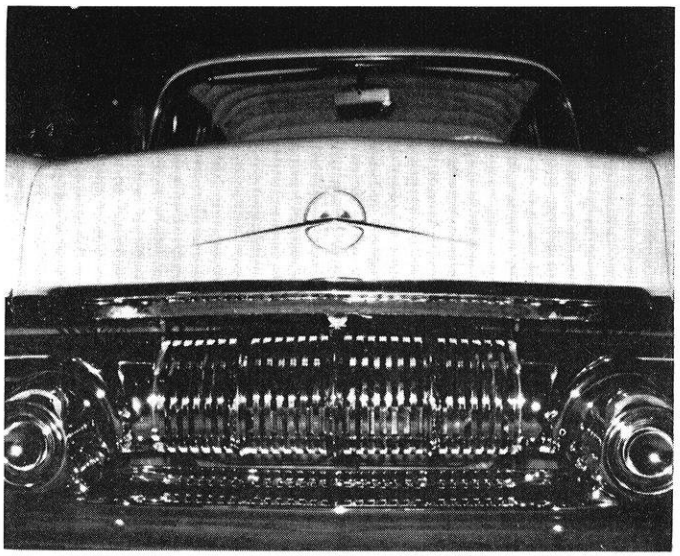
On the seven bodies in the Bel Air series, for instance, a lean chromium spear extends rearward from the headlamp, spreading gracefully downward to the bumper and also branching upward as a rear quarter molding. The area encompassed by the diverging lines of the spear may be two-toned to conform with the body roof color or fitted with an optional panel of rolled aluminum. Two-Ten models, eight in number, have a single downswept lance molding from front to rear. One-Fifty side moldings on four body models extend downward from the sash and then horizontally across the rear fenders.

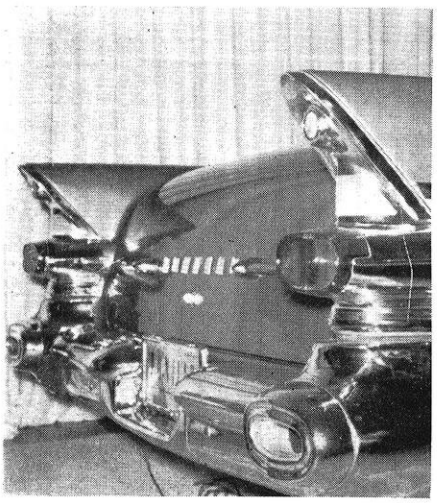
A variety of sparkling new colors in combination with the body selections furnishes the customer with 460 choices in the appearance of the Chevrolet he buys. Interiors, marked by rich upholstery in nylon cloth and plastics, have been completely re-fashioned. Seats have added comfort and are of an attractive slender Gothic form. Easily read instruments are sheltered under a cove, with all control knobs recessed as a safety measure. Other body highpoints include a new ventilation system that has inlets under the headlamp hoods and supplies up to 22 per cent more air.

(Continued on page 80)

'57 PONTIAC

COMPLETE RESTYLING

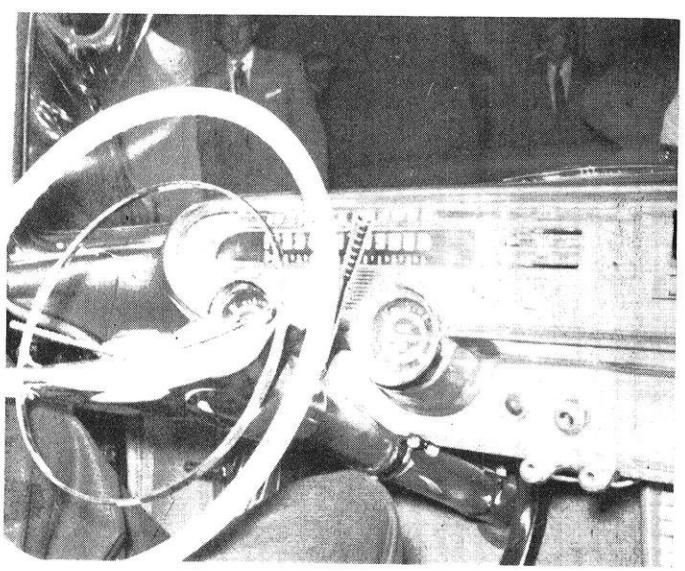




The 1957 Pontiac will have three great new series: the Chieftan, Super Chief and Star Chief.

Horsepower has been increased from 205 to 250 without powerpack and from 227 to 270 in the powerpack engine. Among the engine improvements are a heavier block, 10–1 compression ratio, larger oil filter, and minor changes in the carburation and exhaust system.

Pontiac has been completely restyled, with special attention given to front and rear treatment. Dual exhaust equipped models have their outlets through the large rear bumper pods. Models not equipped with dual exhausts have the conventional exhaust outlet under the bumper and a plate covering the pod opening.



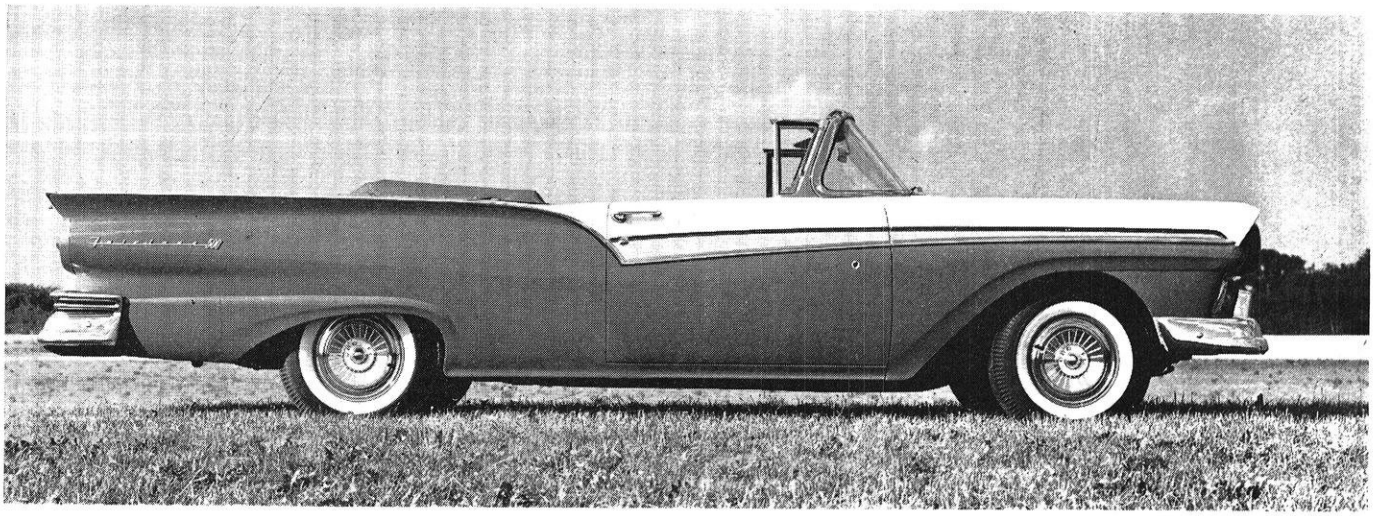
The rear fenders have been raised and extended, being cut back at the rear. A pod similar to the exhaust pod in the bumper houses the taillight, the backup light being located above it in the cut back section of the fender.

Pontiac again has a combination bumper and grille which extends across the entire front of the car.

A chrome enclosed streak runs almost the entire length of each side, and distinguishes it readily from the side view.

The restyled dash has a linear type speedometer, in contrast with the conventional oval type. The steering wheel is a two spoke dished type.

People in the Madison area can see the 1957 Pontiac at Waters Motors Company, 754 East Washington Avenue. **END**



'57 FORD

Lower Body—Larger Fins

For the first time in its 53-year history, Ford Motor Company will produce two sizes of Ford cars.

R. S. McNamara, Ford Motor Company vice president and Ford Division general manager, said the 1957 Fords "represent the biggest change in the modern history of the Ford car."

The new Ford line divides into two basic sizes, Fairlane and Custom, plus the station wagon series, each with its own body and chassis. In addition, the Fairlane series has been expanded to offer "Fairlane 500" models, which have extra luxury features.

The biggest Ford body—the 1957 Fairlane and Fairlane 500 sedans are nine inches longer and four inches lower than last year's comparable models. A separate body shell is used on the Custom and Custom 300 sedans which are more than three inches longer and nearly three and one-half inches lower than the 1956 models. Station wagons are three and one-half inches lower and nearly six inches longer. Fairlanes and Fairlane 500's are built on a 118-inch wheelbase. Station wagons, Customs and Custom 300's have a 116-inch wheelbase.

The design and styling are new from the ground up. Every dimension is changed. Wheels, frame, rear axle, drive shaft, engines, and every inch of sheet metal in every body style are definite departures from past models.

In the biggest change in modern Ford history, the 1957 Ford chassis has been completely redesigned for improved riding comfort and reduced car height.

There has been no sacrifice of headroom inside the car, in spite of their reduced height. The new frame extends to the sides of the car, and this permits the floor to be lowered inside the frame rails.

Major inovations begin with wide-flaring frame design, a radical departure from previous years. Side rails extend around the passenger section, almost as wide as the body itself. In effect, the rails become side bumpers which protect the passengers. Heavier side rail stock and tubular cross-members make the new frame 27 per cent more rigid, Ford engineering tests reveal.

A tapered drive shaft enters the underslung hypoid rear axle almost an inch lower than in 1956. This improvement made it possible to lower the car's height without reducing passenger space.

Swept-back ball joint suspension eliminates 33 per cent of the parts on previous models. Upper and lower suspension arms are now single units, hinged with rubber bushings. Wheel motion on bumps is upward and rearward in a roll-with-the-blow action.

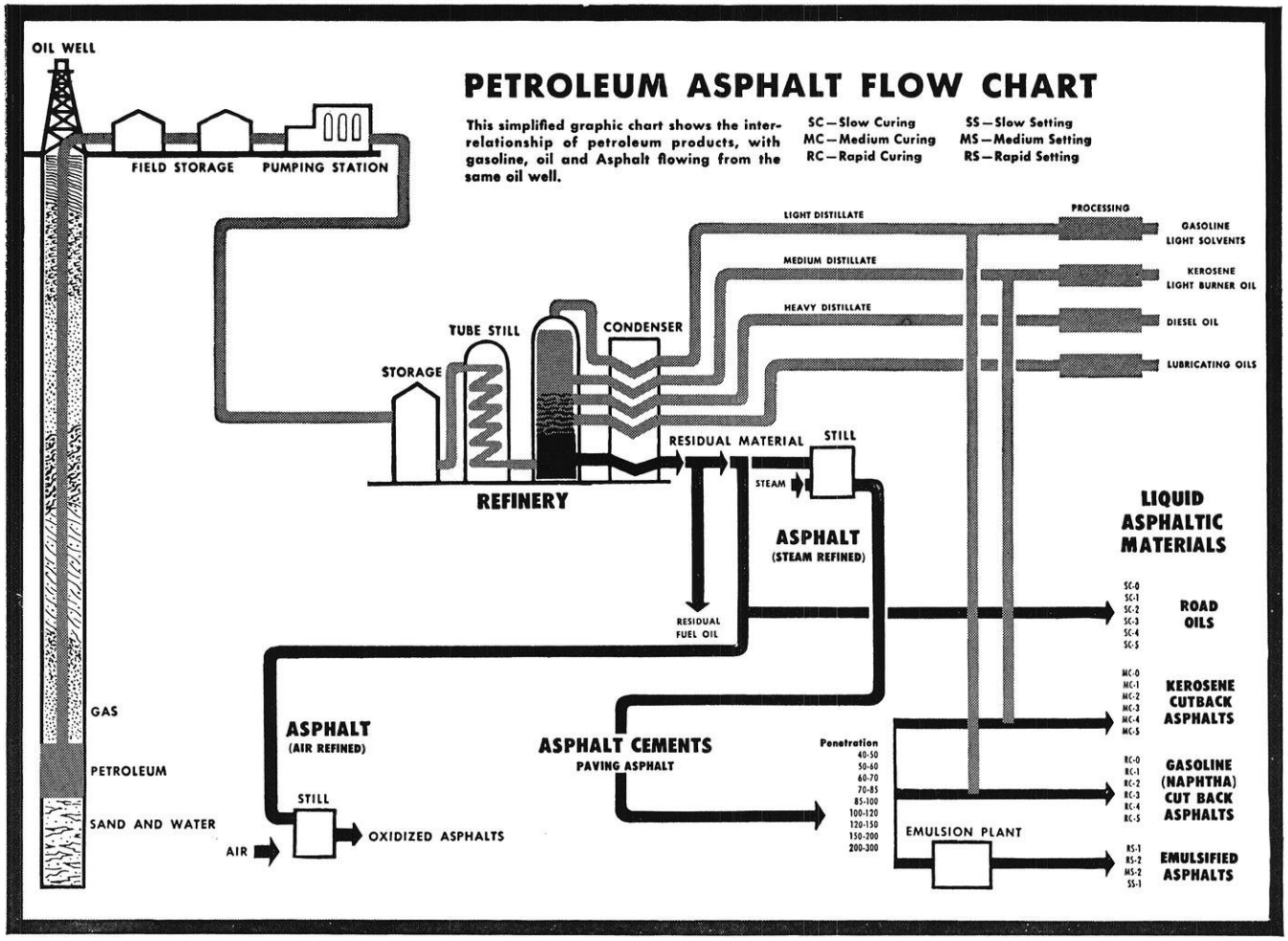
Wheels are 14 inches in diameter—one inch smaller than last year. Without sacrificing steering ease, the lower pressure tires have more tread surface on the road for better control. New wheels have rims with broader shoulders to give tubeless tires a firmer grip for severe turns in emergencies.

Fuel tanks have been increased in capacity to 20 gallons, three more than last year, for greater cruising range.

A lower angle steering column and smaller diameter deep-dish safety steering wheel provide better visibility over the hood. Steering ratio is up from 25.3 to 1 to 27.0 to 1, for easier turning.

New outboard-mounted springs are two inches longer than on the 1956 model. An even keel ride,

(Continued on page 78)



4 out of 5 miles of paved roads are surfaced with ASPHALT

ASPHALT is a durable and powerful bituminous adhesive used in surfacing more than 80% of the nation's streets and highways.

With it, engineers build strong, enduring pavements that are smooth and flexible. What's more, Asphalt construction is fast, simple and low-in-cost.

Asphalt is a natural constituent of most crude petroleums. From them, it is separated by various distillation processes that also yield gasoline, lubricating oil and other refinery products. ***Asphalt is a petroleum product and is not to be confused with tar, a black substance commonly derived from the destructive distillation of coal.***

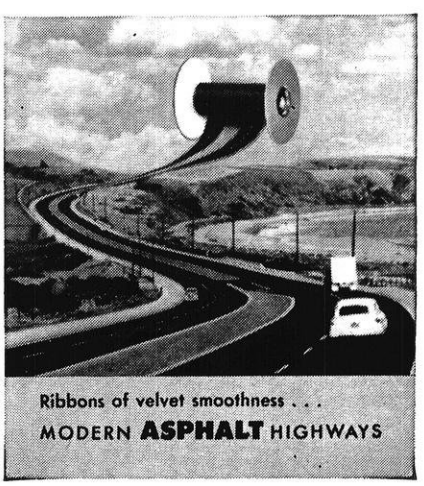
The chart shows grades of Asphalt produced by distillation, blending and oxidation. These range from watery liquids to hard, brittle solids.

The semi-solid form, known as Asphalt cement, is the basic paving material. It is used in hot-mix Asphaltic pavements for roads, airfields, sidewalks, parking areas, dam facings, swimming pools, industrial floors and other structures that require paving.

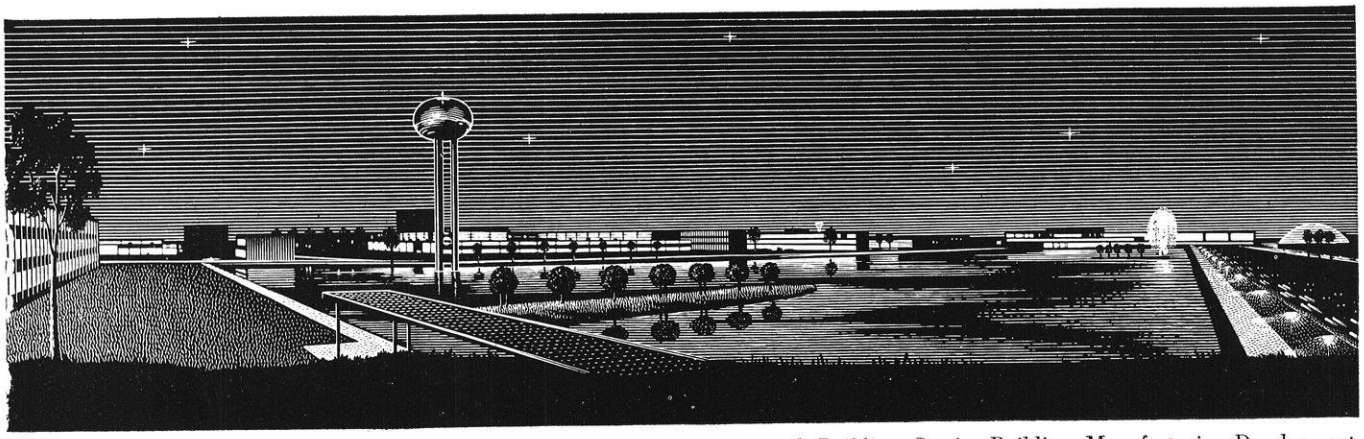
It's the basis for membrane linings of irrigation canals and reservoirs, protective coating on pipe lines, and structural waterproofing. In fact, Asphalt cements are "tailor-made" for literally thousands of applications, including such every-day items as tires, battery cases, roofings, paints, wall boards, electrical insulating tape and the like.

Liquid Asphaltic materials are likewise used extensively. In the form of road oils and cutback Asphalts they meet a variety of demands for both paving and industrial applications. Road construction and specialty applications also call for ever-increasing quantities of emulsified Asphalts . . . minute globules of Asphalt suspended in chemically treated water.

The engineering advances that Asphalt makes practical warrant your study of the art and science of using this durable, economical material.



THE ASPHALT INSTITUTE, Asphalt Institute Building, College Park, Maryland



Left to right: Main Research Building, Service Building, Manufacturing Development Building (behind water tower), Engineering Building, Styling Building and Styling Auditorium Dome facing 22-acre lake, focal point of GM Technical Center.

The young engineer's opportunities with General Motors

A FEW MONTHS AGO—after nearly 11 years in the planning and construction—General Motors officially opened its vast new Technical Center on the outskirts of Detroit.

Here, on 330 acres of beautifully landscaped campus, stand twenty-five superb air-conditioned buildings, replete with all the new wonder instruments of modern science and engineering.

It is the world's largest institution devoted to the industrial arts and sciences. It houses more than four thousand engineers, scientists, stylists and technicians delving into the unknown in search of new materials, new forces, new techniques.

Its huge resources and research facilities are at the beck and call of GM engineers in any of GM's 126 plants in 68 American cities.

Between the engineers at the Center, and those with any of GM's 34 decentralized manufacturing divisions, there exists a two-way flow of stimulating ideas and mutual assistance.

For young engineers now faced with the problem of building their careers, this new Technical Center is a monumental symbol of the importance that GM attaches to engineering and research.

It is a living affirmation of GM's faith in the future that modern technology will create.

It is a multimillion-dollar investment in what General Motors President Harlow H. Curtice has termed *"the inquiring mind."*

And above all—if you are a senior engineering student who can measure up to the challenge—it is further proof that you will find at all General Motors divisions a creative climate for building a rewarding career in your chosen profession.

GM Positions Now Available in These Fields

—in GM Divisions throughout the country

MECHANICAL ENGINEERING

CHEMICAL ENGINEERING

ELECTRICAL ENGINEERING

INDUSTRIAL ENGINEERING

METALLURGICAL ENGINEERING

AERONAUTICAL ENGINEERING

GENERAL MOTORS CORPORATION

Personnel Staff, Detroit 2, Michigan

YOUR FUTURE—
Research and Koppers?

If yours is the inquiring mind . . . the mind that never rests until it has an answer to every "why" . . . then perhaps research is your future.

There are many types of research, but whatever your choice it will be a future of challenge.

For example, more than a century ago a synthetic chemical, styrene monomer, was discovered by some curious research chemists. But not until 1937 did research engineers find a way to produce it commercially. It has been made in large quantity only since 1944, when it became the principal ingredient of synthetic rubber for tires, hose, belts and other products.

Ordinary men would have stopped and rested at this point . . . but not research men. Thanks to their research, styrene monomer has become basic in today's improved paints, plastics, paper and a host of other products. Its volume has more than doubled in the past ten years. And there are more uses to come!

In addition to styrene monomer, other chemicals and plastics, Koppers is a leading producer of tar products, metal products, pressure-treated wood. It designs and builds coke, steel and chemical plants.

If you would like to know more about a future in chemistry or engineering at Koppers, contact your College Placement Director, or write Industrial Relations Manager, Koppers Company, Inc., Koppers Building, Pittsburgh 19, Pennsylvania.

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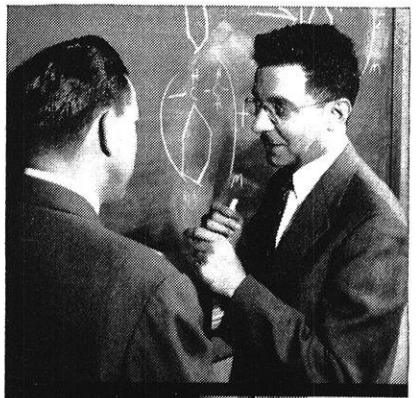

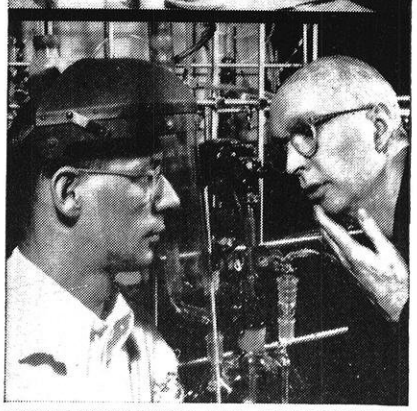

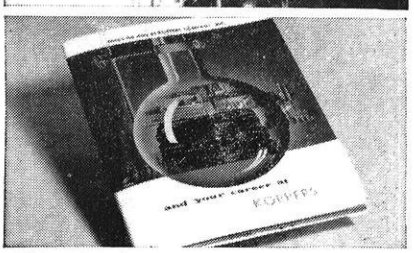

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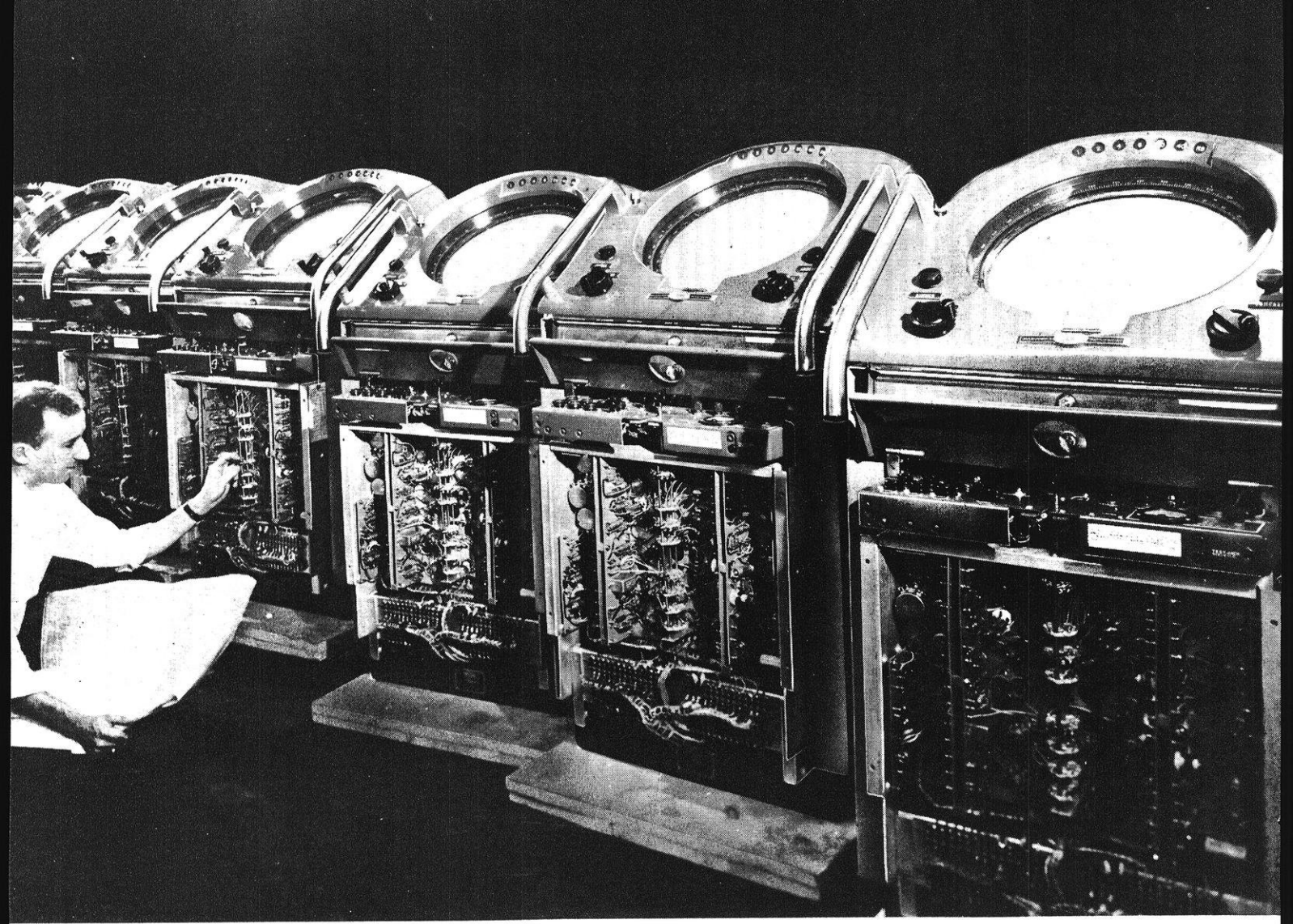


Radar–Its Evolution & Use

by Larry Adornato, m'57

One of the outstanding achievements of radio-science in World War II was the development of radar. The story of its growth into a decisive weapon in that war is a fascinating chapter in the history of science.

History

Ever since Marconi invented the wireless, scientists felt that radio impulses could be reflected from objects much the same as light and sound waves. Impulses were found to be bounced back to earth by a mysterious "mirror". This mirror, called the ionosphere, is a region of electrically charged air, beginning about twenty-five miles above the surface of the earth. The technique of bouncing radio waves from the ionosphere permits long distance transmission.

Why not, then, produce these waves and direct them at an object? The reflected impulse could be used to spot ships and aircraft if for no other reason than to prevent collisions.

Eventually, scientists developed the cathoderay tube, better known as the television picture tube. They linked the cathode-ray oscillograph 10 the waves sent out by a radio transmitter and timed the beam in the oscillograph with the outgoing pulse. When the pulse hit an obstruction and returned, the oscillograph beam indicated the magnitude of the reflected signal.

—Courtesy Raytheon Mfg. Co.

Lab testing of a console model radar set.

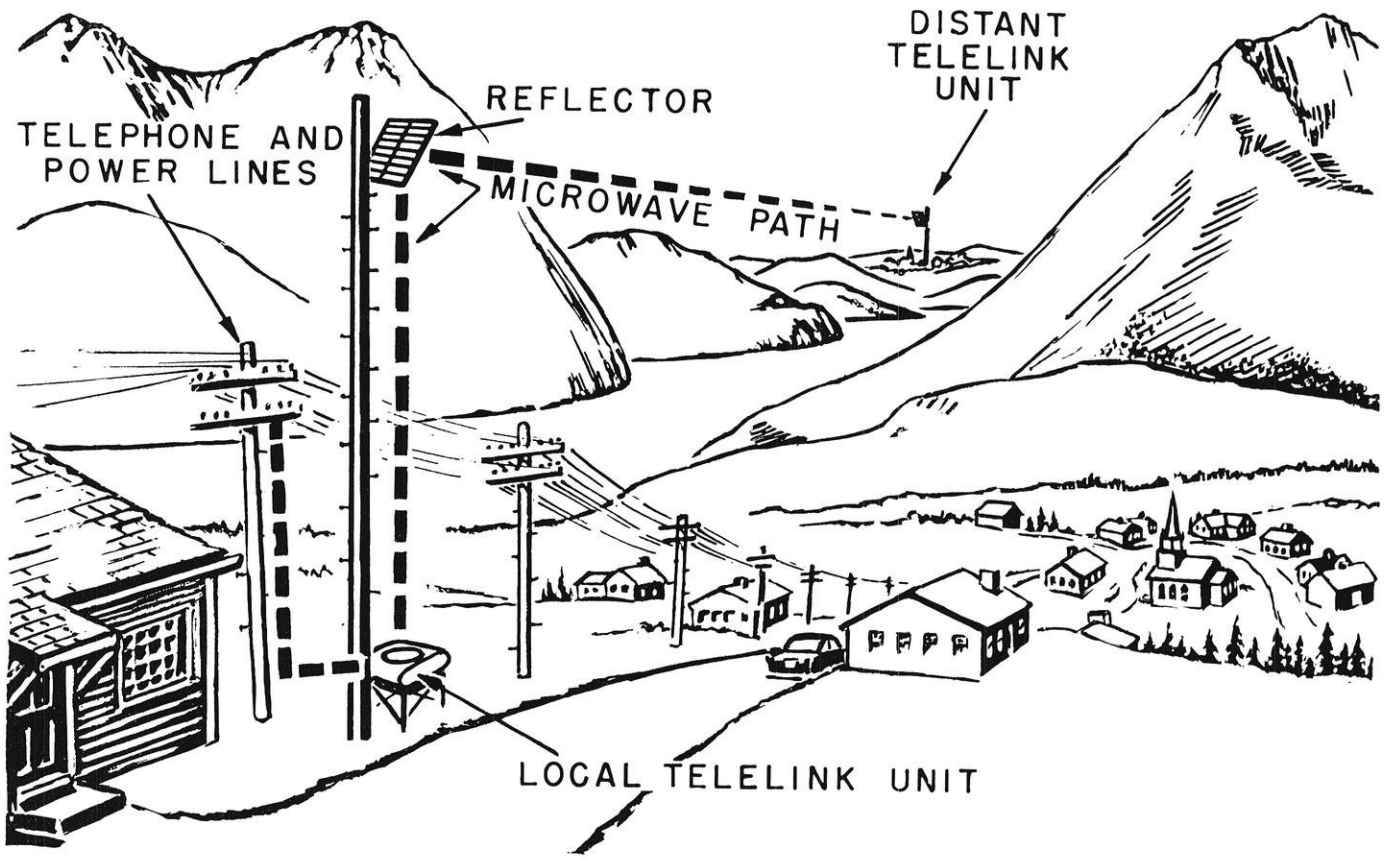
A simple illustration of this idea occurs when a stone is cast into a pool of water a series of ripples is started that spread out concentrically from the center. The radio transmitter does likewise in the atmosphere. Just as the tiny wavelets gradually die out in the water, at great distances the radio waves become too faint to be picked up.

Radar, then, is more of a development than an invention since it needs so much other equipment to make it work, that no one man could have invented it. Many men had a hand in its creation—Hertz and Marconi, Tesla and Thomson, Braun, Edison, De Forest, and many others.

Yet the first direct evidence of ascertaining distances by using radio waves was obtained by Sir Edward V. Appleton and M. A. F. Barnett in England. They used a system much like our F. M. radio station today. Almost at the same time in 1925, Dr. Gregory Breit and Dr. Merle H. Tuve, in the United States, devised a similar method.

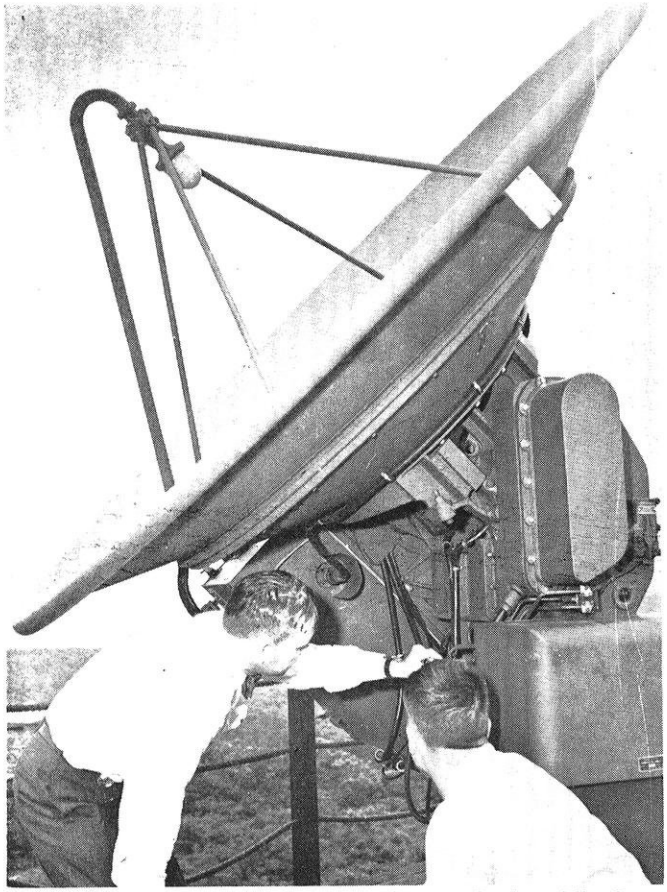
The first actual use of a radar set, however, was on board the S.S. Normandie. Six-inch waves were swept over an arc of forty-five degrees on the course of the vessel. The reflected waves were made audible in a telephone receivers, more of an ear than an eye. With this set-up, a ship could be detected at a distance of four miles, a channel buoy at two miles, and a coastline up to twelve miles.

The United States Navy, however, went back to September, 1922, to "stake its claim" as a radar pioneer. It was observed that certain radio signals were reflected from steel buildings and metal objects. It was also noticed that ships passing by a transmitter and



—Courtesy Raytheon Mfg. Co.

Reliable telephone service is provided for isolated rural areas over a narrow microwave beam.



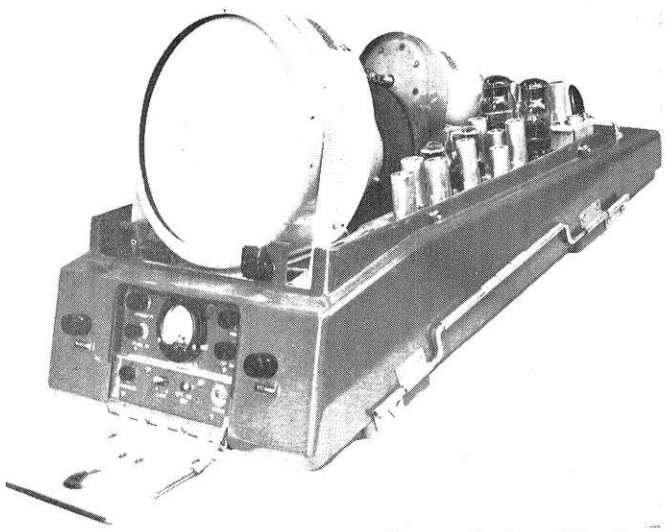
—Courtesy Raytheon Mfg. Co.

Antenna for CPS-9 storm detector radar set.

receiver at high frequencies (three hundred megacycles and up), gave a definite interference pattern.

This suggested the possibility that an arrangement could be worked out whereby ships located on a line a number of miles apart could be aware of the passing of an enemy vessel between them.

Certain phases of radar are, naturally, of more concern to the Army than to the Navy. The Army's first pulse radar was designed as a detector for use with anti-aircraft batteries. By 1936, radio pulses



—Courtesy Raytheon Mfg. Co.

The indicator section of Raytheon's Mariner's Pathfinder radar.

directed at commercial planes had returned echoes to the detecting equipment. This equipment not only detected the aircraft but gave information about their direction, elevation, and range.

These demonstrations resulted in substantial Army funds being specifically allocated for the development of radar for the first time. What, actually, is radar? By definition, radar is "a pulse or beam of high-frequency radio energy, timed and molded by precision electronic instruments, projected into space." In simpler terms radar is R–radio; D–detection, or direction finding; A–and; A–ranging.

If you have ever tried to time the echo of your voice reflected from a cliff, you remember that instead of shouting continuously, you shouted in bursts. Likewise radar men found their results better if they used pulses of one of two microseconds in lengths. They left relatively long resting periods in between to give

—Courtesy Sperry Gyroscope Co.

New Mark 5 12-foot radar scanner atop a ship mast. A narrow beam provides good bearing resolution.

the pulse time to reach the target and return before being obscured by the next pulse. The greater the range, the longer the resting time.

Radio waves like lightwaves, travel in a straight line at a constant velocity of 186,000 miles a second. Take a flash light into a dark room and try to located an object, say the door knob. To locate the knob accurately you must know two angles, one of elevation, the other of bearing. Swing the flashlight from right to left and note when the light strikes the knob. This gives you bearing.

—Courtesy Sperry Gyroscope Co.

Here a mobile radar unit pinpoints mortar locations for destruction.

Move the light up and down and note when it strikes the knob. That will give you the angle of elevation. If you could use this information, you could strike the knob every time even in the dark. *It is easily seen* that the narrower the beam of light, the more accurately you can determine the angle of elevation and bearing. The same is true of radar.

In the past no great naval battles were fought at night, but in World War II radar, as far as sight is concerned, turned the darkness into light. If enemy ships passed within range of a radar set, guns synchronized with the radar beam could pick them off like clap pigeons in a shooting gallery.

An enemy ship could be "discovered, identified, tracked, fired upon, and sunk," without a man seeing her visually. In the night or through the thickest fog, American warships could pin-point a target and demolish it or send it to the bottom.

In the battle of Suriago Strait, one of our new warships was looking for the enemy among the Solomon Islands in the South Pacific. Radar aboard the American ship probed the night and discovered the presence of a Japanese vessel more than eight miles away. The big ship fired her guns toward the stars. The second salvo, despite both darkness and the extreme range, landed squarely on the target. So sensitive was the set that the operator could "watch" the shells move across his screen and see the ship disappear from sight.

Radar was the nemesis of the submarine, which relies on submersion for concealment but cannot live indefinitely underwater. With radar-equipped airplanes, there was not a safe square mile in which a U-Boat could escape the radar eyes.

Coastal gun positions also took a blasting from the air. Just before dawn on D day, June 6, 1944, cloud

—Courtesy Raytheon Mfg. Co.

A console radar indicator used in storm detection.

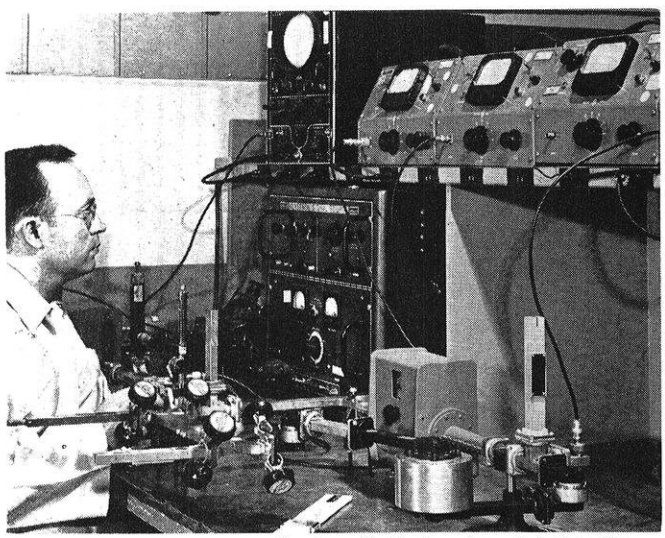
—Courtesy Sperry Gyroscope Co.

Mark 3 ship-board radar is world's most powerful commercial marine radar.

banks hid the German guns, but on the radar "scopes" they stood out clearly. One hour after a thirty minute barrage, the first infantry landed on the beach and found the Nazi defense paralyzed.

The buzz-bomb, however, challenged radar anew. It took time, but finally anti-aircraft batteries were hooked up with radar sets, and they proceeded to hang up a record for accuracy which still stands; one buzz-bomb downed for every forty rounds fired.

These successes must not lull the reader into thinking that radar can make our country positively secure from enemy attack. Radar fences aren't fool proof. Radar beams ride a straight line and run off the earth's curved surface into space.



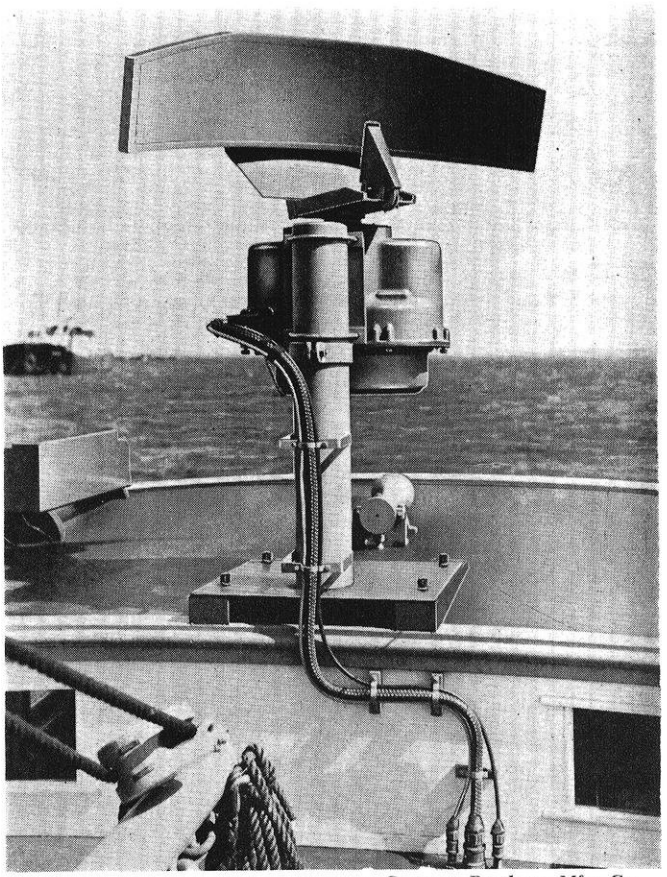
—Courtesy North American Aviation, Inc.

Here the microwave portions of a radar system under-go accurate testing.

If you could see a cross section of the beams of two radar sweeps, 300 miles apart, they would look like two pairs of butterfly wings, side by side. Beneath the bottom edges, there would be a wide, triangular gap of open air through which enemy planes could fly undetected.

The Germans found they could blind Allied radar scopes by the use of "window" or "chaff", thin aluminum foil strips cut to such a length that they return an echo similar to that produced by a plane.

The Americans soon showed that two could play at that game. They developed long ribbons of foil called "rope" which could jam the best radar the Nazis could make. In spite of these drawbacks, the government has spent $50,000,000 to build a fence of early warnings radar across North America's back door alone.



—Courtesy Raytheon Mfg. Co.

Antenna and transmitter-receiver unit for the Pathfinder ship-board radar.

In peace, radar is aviation's best weapon against the menace of the thunder storm. Radar beams can detect either the water droplets or the ice crystals in a cumulus cloud from which a thunder storm is born at the very moment it may start developing. Even if a plane is forced to fly through a thunder storm, radar will enable the navigator to pick the safest route.

Experiments by United Air Lines, Inc. using a 125-pound weather radar set built by R. C. A. have been successful in allowing a pilot or navigator to select the course which offers the least turbulance. Thus, turbulance in the atmosphere caused by thunder storm

(Continued on page 66)

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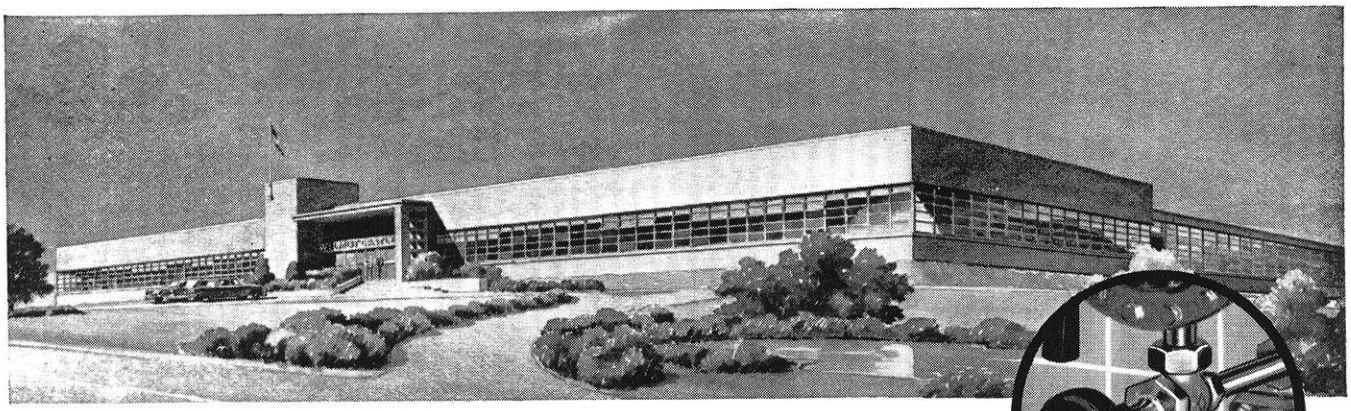

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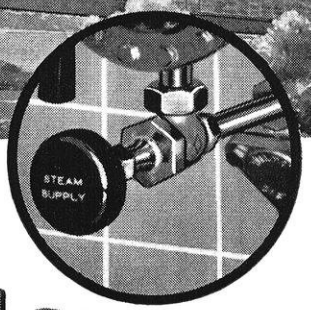

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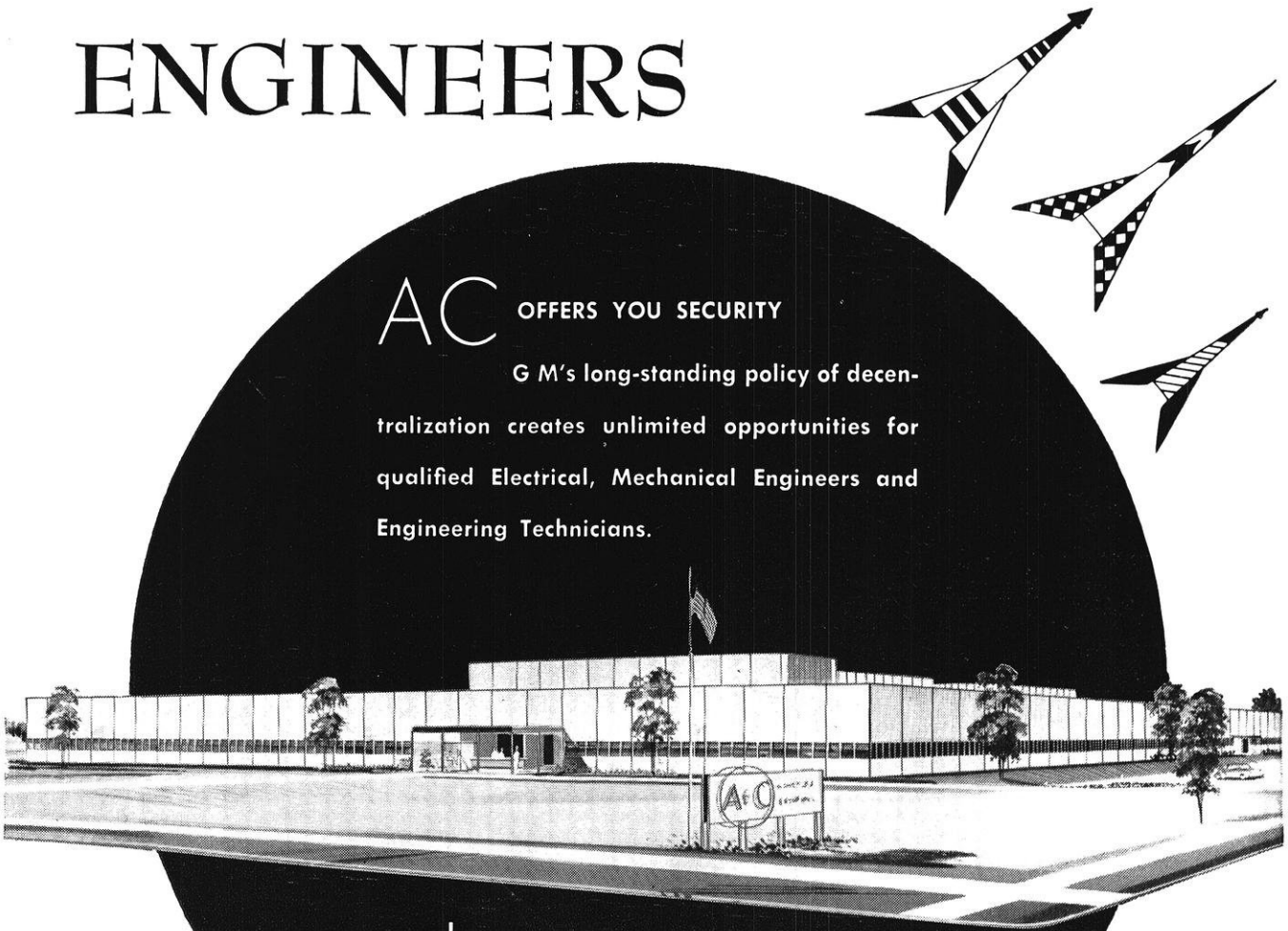

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TURNTABLE — A LA HI FI

John Misselhorn m'57

In order to make a satisfactory selection of a high fidelity turntable or pickup, a thorough knowledge and understanding of their construction and operating characteristics is necessary.

This article discusses the more important aspects of construction and operation. Although the explanations are limited in technicality, it is hoped they will enable the hi–fi layman to make a decision in the selection of components. Of course, his final choice will depend upon individual requirements and budget.

The motor is the heart of the turntable and must rotate it smoothly and silently at a constant speed.

The simple induction motor, used for most small applications, is entirely unsuitable for high fidelity turntables. The speed of an induction motor is determined by the line voltage supplied to it. Since the line voltage is rarely constant at all times, the pitch variation resulting during musical reproduction would be intolerable.

Because the frequency of the alternating current supplied by power companies is essentially constant, a motor whose speed is dependent upon the line frequency would be most desirable. Such a motor, called synchronous motor, may be of the two-pole, four-pole, or hysteresis type.

Low cost equipment employs a synchronous motor which has only two poles. Each armature coil, therefore, passes a region of maximum torque only twice during an entire revolution. Not only does this result in uneven rotation, but the magnetic field produced by a two-pole motor is very difficult to shield. Consequently, a serious hum problem is also encountered.

Considerable improvement results when using a four-pole motor in place of a two-pole motor. The rotor in a four-pole motor passes twice as many regions of maximum torque. This results in greater smoothness of operation, while reducing the hum problem to about one-half of that encountered in a two-pole motor.

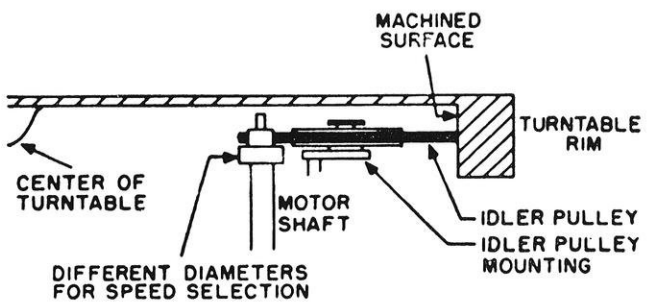
This type of motor is standard equipment on all medium priced turntables, and a wide-range system should be equipped with nothing less. The four-pole motor is not perfect, however. Some noise is generated in the 30–60 cps range, which interferes with the bass response in that region of the audio range.

For a system with a bass response which is flawless, the only choice is a hysteresis synchronous motor. It has smoothness of operation which is unapproached by any other type of motor. The primary reason for this is the constant torque, right up to synchronous speed. The only drawback of a system equipped with a hysteresis motor is the cost.

A hysteresis system costs about twice as much as a system with a four-pole motor. If the listener feels that his high fidelity system is good enough to merit such perfection in motor design, the choice would necessarily be a hysteresis motor. The results will certainly speak for themselves.

The most obvious method of rotating the turntable would be to attach the table to the motor shaft. The table then would have to rotate at the same speed as the motor. Actually, a constant speed of about 1800 rpm is about the best compromise point for efficiency, smooth operation, and adequate cooling. A motor whose rpm is varied will necessarily be subject to overheating, vibration, and poor speed regulation.

When direct-drive systems are incorporated in the manufacure of turntables, a set of gears and some



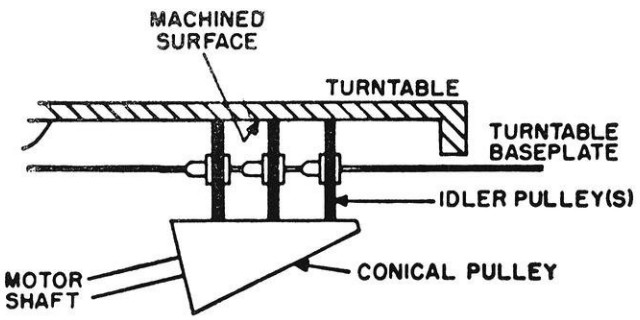
means of vibration filtering is used between the motor and the turntable.

A direct-drive system is unquestionably the best, provided the components are machined to a high degree of accuracy. Unfortunately the manufacturers cannot produced a popular priced direct-drive system which will perform adequately under ordinary home use.

In place of an expensive direct-drive system, a gearless system has been developed using a smooth idle-wheel. This friction drive is just as satisfactory as a direct-drive assembly, is much less expensive, and much more reliable because of the simplicity of construction. Although the idler is made of rubber and subject to wear and deterioration, the amateur can replace it quickly and inexpensively.

Several manufacturers offer turntables with continuously variable speed between 15 and 100 rpm. One method employs a conical member on the motor shaft which presses idler pulleys against the turntable. Others incorporate an idler wheel, of fixed speed, which bears on the underside of the turntable. The idler can be positioned at any desired distance from the turntable shaft.

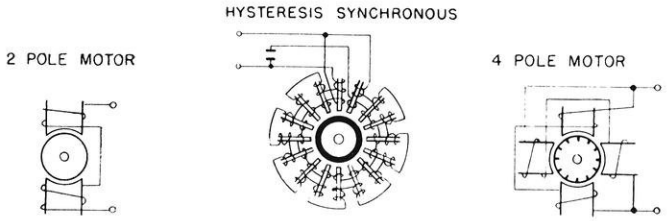
These methods of speed variation are really unnecessary because record manufacturers hold the recording



speeds exact. Any gain in using such a system is usually offset by mechanical problems.

A properly designed table can aid smooth rotation greatly because it will act as a flywheel and oppose tendencies toward speed fluctuation. Good turntables are necessarily made from heavy castings, precisely machined and balanced. Most high fidelity pickups operate on magnetic principles and, it is therefore, absolutely essential that the turntable be a non-magnetic metal. Due to magnetic fields, any other material would interfere with the reproduction.

The less expensive turntables are covered with a wool or cotton felt, or a plastic flock. These materials have very poor wearing quality and often become imbedded with dust. The plastic flock very often induces electrostatic charges on the records so that they also catch dust. The use of a rubber covering for the table is a great improvement, since rubber is not subject to any of the above difficulties. Perhaps the best surface available today is a neoprene rubber impregnated cork.



The turntable should be no less than 12 inches in diameter so that the record may have complete support. Smaller sizes would support only part of a LP record. Although the dust problem may be reduced, slippage and record wear will result.

The serious hi–fi fan should not consider purchasing a record changer for his music system. Its only advantage is that several hours of music can be played without any interruption. All record changers have at least some of the following disadvantages:

1. Abrasion between groove surfaces when records are stacked.
2. Possible damage to center holes or edges from the platforms.
3. Wear on the center hole, as the spindle remains stationary while playing.
4. Change of pickup angle with respect to record as height of stack changes.
5. Possible sacrifice of motor smoothness in favor of more power to operate changer mechanism and move heavy stack of records on turntable.
6. Slippage of disc as it is played on stack.
7. Slowing down of turntable as weight of stack increases.
8. Uneven groove wear at inner section of record, as underneath extension of pickup arm begins to bear against pawl and ratchet mechanism.
9. Exceedingly difficult maintenance and adjustment.

It is quite obvious that a much better turntable can be purchased at the same price as a changer.

The stylus translates the striations on the disc face into mechanical motion which is conveyed to the cartridge. By the use of a special shape of stylus, both standard and micro-groove records can be reproduced. Since a small (.001″) stylus will give better seating and hence better tracking of micro-groove records, the use of two styli is a solution to the problem. This can be accomplished by using two separate pickups or some sort of turnover mechanism. Not only are two styli needed, but they must be made of a suitable material.

Early attempts at manufacturing styli involved steel and the needle of the cactus plant. Record wear was excessive and reproduction poor. The clarity of reproduction was greatly improved, however, through the use of osmium, a very hard metal of the platinum family.

The osmium stylus was shaped and polished so that minimum record wear was encountered. The solution

(Continued on next page)

to the problem of better reproduction and longer record and stylus life seemed to be in the use of harder materials. The search led quite logically to the precious stones.

The introduction of the sapphire stylus brought fantastic claims for its performance. But limitations elsewhere in the system now assumed increasing importance. The records were so hard and gritty, and the pickups so heavy, that the sapphire chipped, and gouged the record grooves.

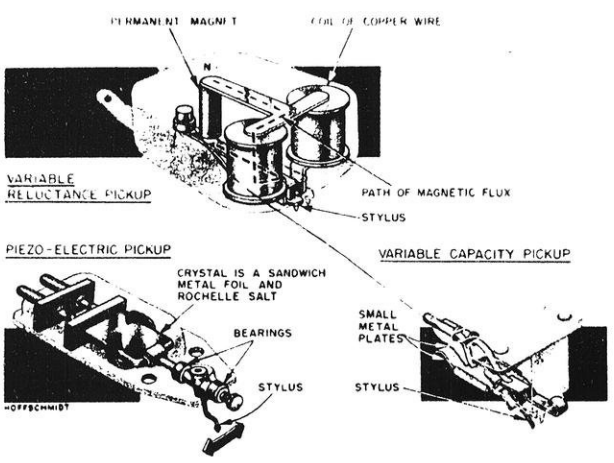
At the same time, in the radio broadcast industry, records made of a plastic compound instead of abrasive shellac were being used. Pickups were lighter, and a stylus of even harder material, the diamond, was used. With this, reproduction was excellent and wear was at a minimum.

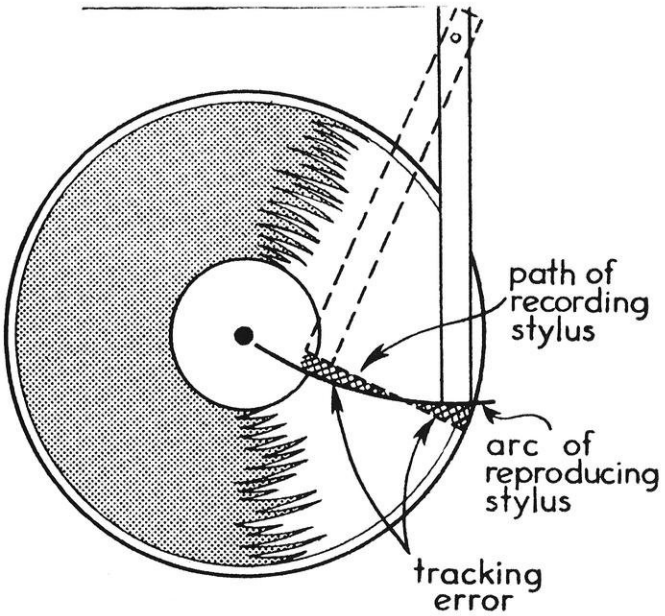
Very high temperatures are generated at the points of contact between the stylus tip and the groove walls. The diamond is capable of withstanding these high temperatures. Despite the higher initial cost of the diamond, it will generally outlast a sapphire by at least 20 to 1, and is therefore a better buy. Today the diamond stylus has become an integral part of the hi–fi system.

The cartridge transfers the mechanical motion of the stylus into a comparable audio-frequency electric current. The first requirement of the cartridge is that it must do as little as possible to impede the motion of the stylus. This means that it must have excellent compliance, not only in the lateral plane, but vertically as well. At high frequencies there is a narrowing of the groove, causing a vertical movement of the stylus. The cartridge must permit this vertical movement, but must not respond electrically to it. All of the desired sound is contained in the lateral movements.

Until recently the use of ceramic cartridges was unsuccessful, but some cartridges have been developed which employ synthetically produced materials having piezo-electric properties.

In the piezo–electric effect, certain substances tend to twist out of shape when an electric voltage is applied to them. These substances also tend to generate their own electric voltage when their shape is distorted. One





such unit has a frequency response which covers the entire audible range. The output signal of this cartridge is high enough that a preamplifier is not required. These features, plus the low cost, make the ceramic cartridge a strong contender as a high fidelity cartridge.

Cartridges which use a Rochelle salt crystal and depend upon the piezo-electric effect are called crystal cartridges. This type of cartridge is widely used. It is light weight and low in price. Because it is fragile, sensitive to temperature extremes, and rarely has frequency response beyond 10,000 cps, it is not capable of true high fidelity reproduction.

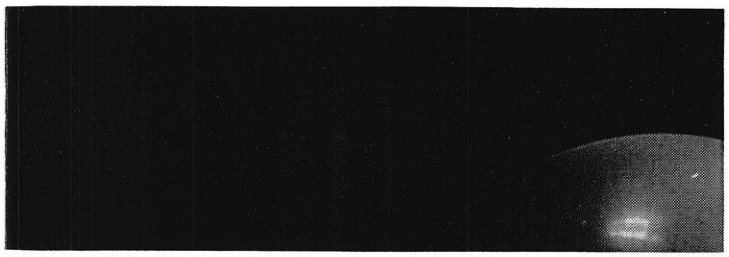
For true reproduction, attention was turned to magnetic cartridges. This cartridge is based upon a simple law of physics which states that whenever magnetic lines of force are cut by a conductor, a voltage will be induced in the conductor.

Usually, a small coil of wire is fastended to the stylus mounting. When the stylus moves, the moving coil cuts magnetic lines of force, and the voltage generated is fed to an amplifying system. The magnetic cartridge is used almost exclusively in present high fidelity systems. It is highly dependable, has low distortion, and has a frequency response which extends beyond the audible range.

The primary purpose of a tone arm is to transport the cartridge and maintain the stylus in the proper relation to the record grooves. It should have very little mass and high compliance.

One of the problems confronted in the development of a tone arm is resonance, since the materials used in making an arm are resonant somewhere between 10 and 100,000 cps. Recently a company has developed a viscous-damped arm which minimizes resonance effects by damping the arm with a film or pool of viscous fluid.

(Continued on page 64)



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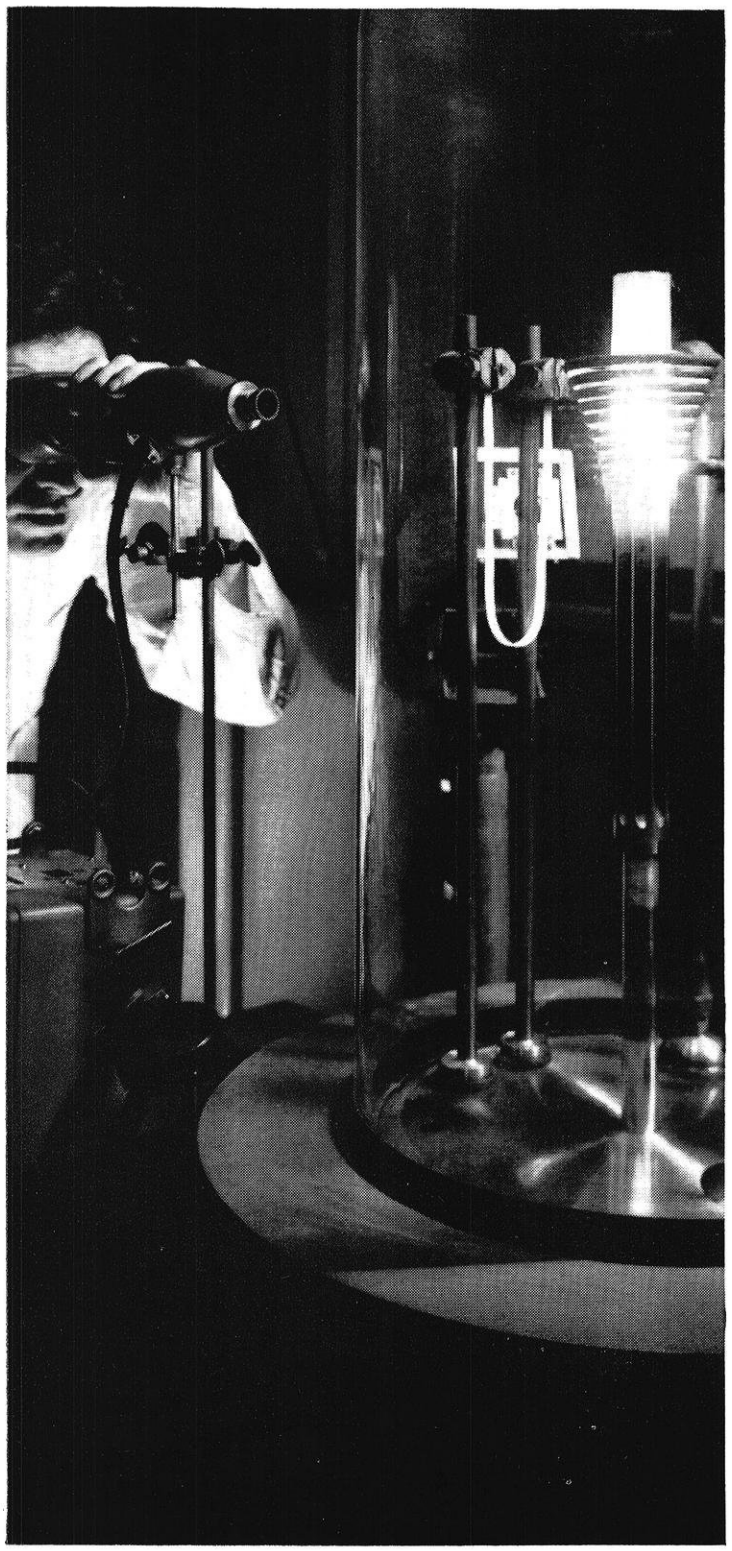

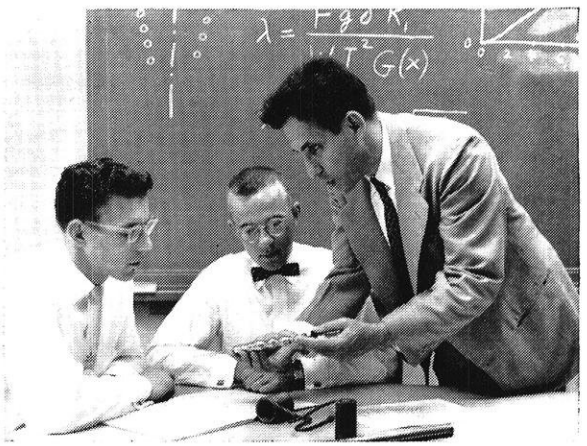

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Write: Mr. C. W. Mills, Regional Educational Co-ordinator, Westinghouse Electric Corporation, Merchandise Mart Plaza, Chicago 90, Ill.

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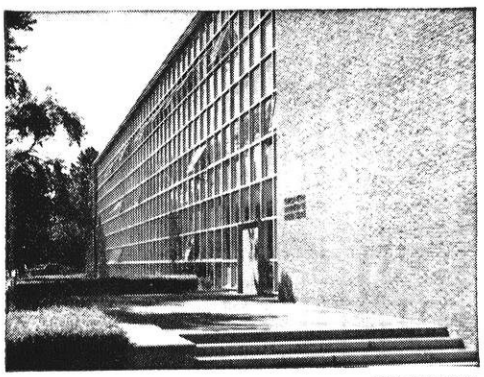
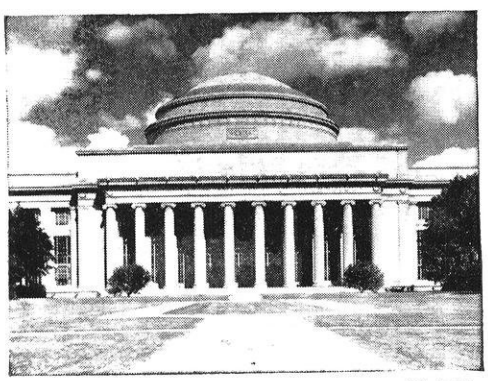


HARVARD



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Wellpoints and Excavation

William B.N. Schultz c'58

When excavation of earth is required and the subgrade of the project is below the water table or saturated ground water level, the handling of wet soil becomes a problem. The earth is wet and sticky and hard to handle. Lowering the natural water table to a level below the proposed subgrade will make excavation as easy as if the subgrade was above the water table. A dewatering process or method for lowering the water table is called Wellpointing.

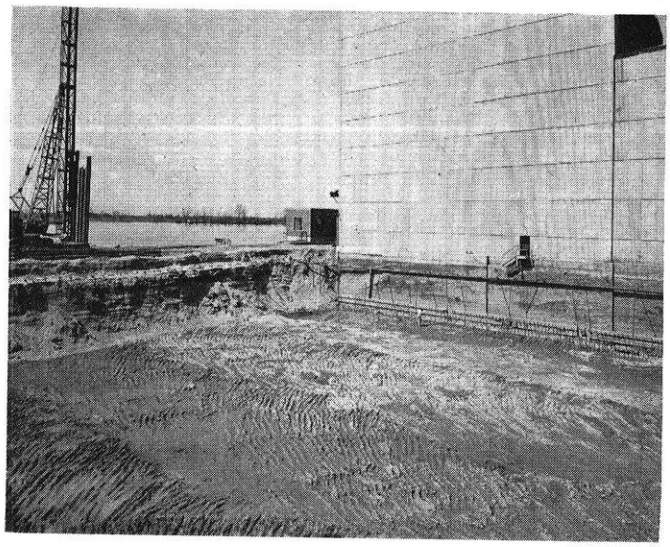
A well point is a device for removing water from the ground. It consists of a tube perforated at the lower end, and surrounded by a screen. A pointed head is attached to the lower end and the other end is connected to a riser pipe. The head diameter is 2 3/16 inches and the overall length of the wellpoint is 39 inches. The wellpoint is installed below the surface of the ground by driving or jetting.

When a vacuum is applied to the wellpoint thru the riser pipe by a vacuum and water pump, ground water is forced through the screen, siphoned through the lower end of the tube into the riser pipe and is discharged by the pump. If the water can be removed faster than the water can seep through the surrounding area, the water table, or saturated ground water level will be lowered.

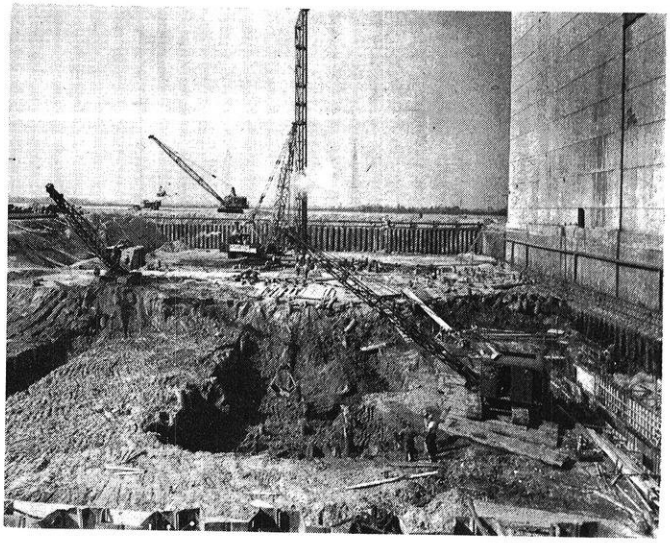
When the water table is lowered below the subgrade of a proposed excavation site and the water table is maintained at this low level, excavation can be done with no harmful effect of water.

A complete wellpoint system consists of wellpoints, riser pipes, header lines, pumps and discharge pipes. Each wellpoint is connected to a riser pipe, which connects to a header or manifold pipe. This manifold pipe is connected to the pump, and the pump is connected to the discharge pipe.

The installation of a wellpoint is a simple process. The wellpoint is connected to a riser pipe which will allow the wellpoint to reach the correct predetermined



Full lot was excavated to bottom of top sand layer, 22 ft. below natural grade, in first two excavation stages under protection of full enclosure wellpoint system.



Excavation stages are clearly shown here. Piledriver is working on top of silt layer, now stabilized by the wellpoint system.

depth. The riser pipe is then connected to a portable water pump. The wellpoint and riser pipe are held in a vertical position and water pressure is applied through the riser and wellpoint by the pump.

Water under pressure flows through the pipe and wellpoint and through orifices or jets in the wellpoint head. The water under pressure bores a hole in the ground and the wellpoint and riser follow this hole. The jetting water pressure is applied until the wellpoint has reached the proper depth.

Then the riser pipe is disconnected from the jetting water pump and is connected to the manifold pipe. Some water escapes through the perforated tube of the wellpoint, but this water keeps the soil around the wellpoint screen in suspension until the wellpoint has reached the final depth. A check valve of bouyant material is installed in the wellpoint head, and after the proper depth is reached and the jetting pressure is released, the ball floats and seats itself so that incoming water must be filtered through the screen.

The rest of the wellpoint system is above ground. The wellpoints are usually installed in rows, and the header pipes are laid along these rows. The pump or pumps are usually stationed centrally. The discharge pipes carry the water away from the immediate area.

The operation of a wellpoint system is even more simple than the installation. All that is necessary in operation is the operation of the pump. As long as the pump removes water faster than the water can seep in from the surrounding area, the subgrade of the excavation will be dry. If the pump is stopped, the water level rises to its usual level.

The effective range of a wellpoint system is unlimited. A single wellpoint installed in the ground will produce a coneshaped deflection of the water table line. The apex of the cone will be at the lower end of the wellpoint, and the gradient or slope of the sides of the cone is dependent on the type of soil involved.

A single row or wellpoint spaced so that their individual cones overlap will produce a wedge-shaped area in which the water table has been lowered. Two rows of wellpoints installed parallel to each other and overlapping will produce a trapezoidal cross-sectioned area.

As atmospheric pressure is the largest force applied to the ground water, it forges the water into the wellpoint when a vacuum is applied. The old axiom 'Nature Abhors a Vacuum' is used here. The condition to that axiom is also used. The condition states that 'Nature Abhors a Vacuum Only up to 32 feet'. This means that the maximum depth that a wellpoint could possibly lower the water table would be 32 feet. The limit of economically effective range, however, is considered to be about 18 feet. This level is chosen with respect to speed and economy of the water removal.

Any area can be dewatered to any depth. Although one line of wellpoints is limited to 18 feet, wellpoints in series can be installed where successive wellpoint

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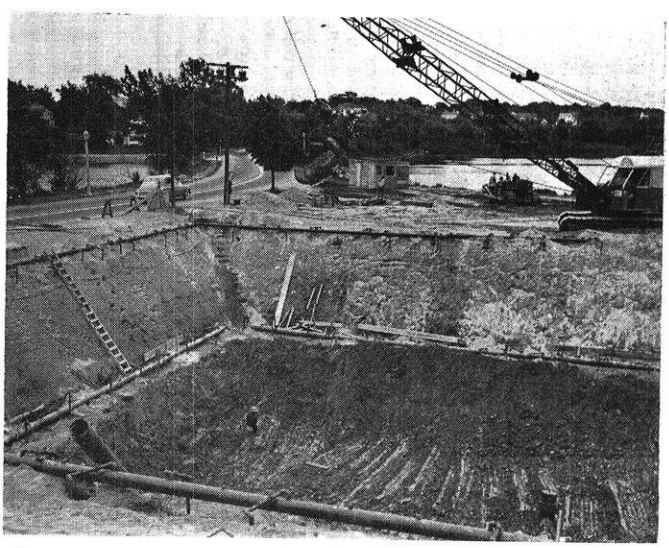


Pump station excavation dewatered by wellpoint equipment.

MOTOR OILS

Which Ones and Why

William D. Risinger m'57

This article is intended to give the average automobile owner an idea of what type of oil he should use in his automobile engine.

There are three basic types of oil, animal, vegetable, and mineral oils. The animal and vegetable oils are easily obtained and contain a certain type of molecule that has the ability to anchor itself to the surface of a metal being lubricated. This is a valuable property of a lubricating oil.

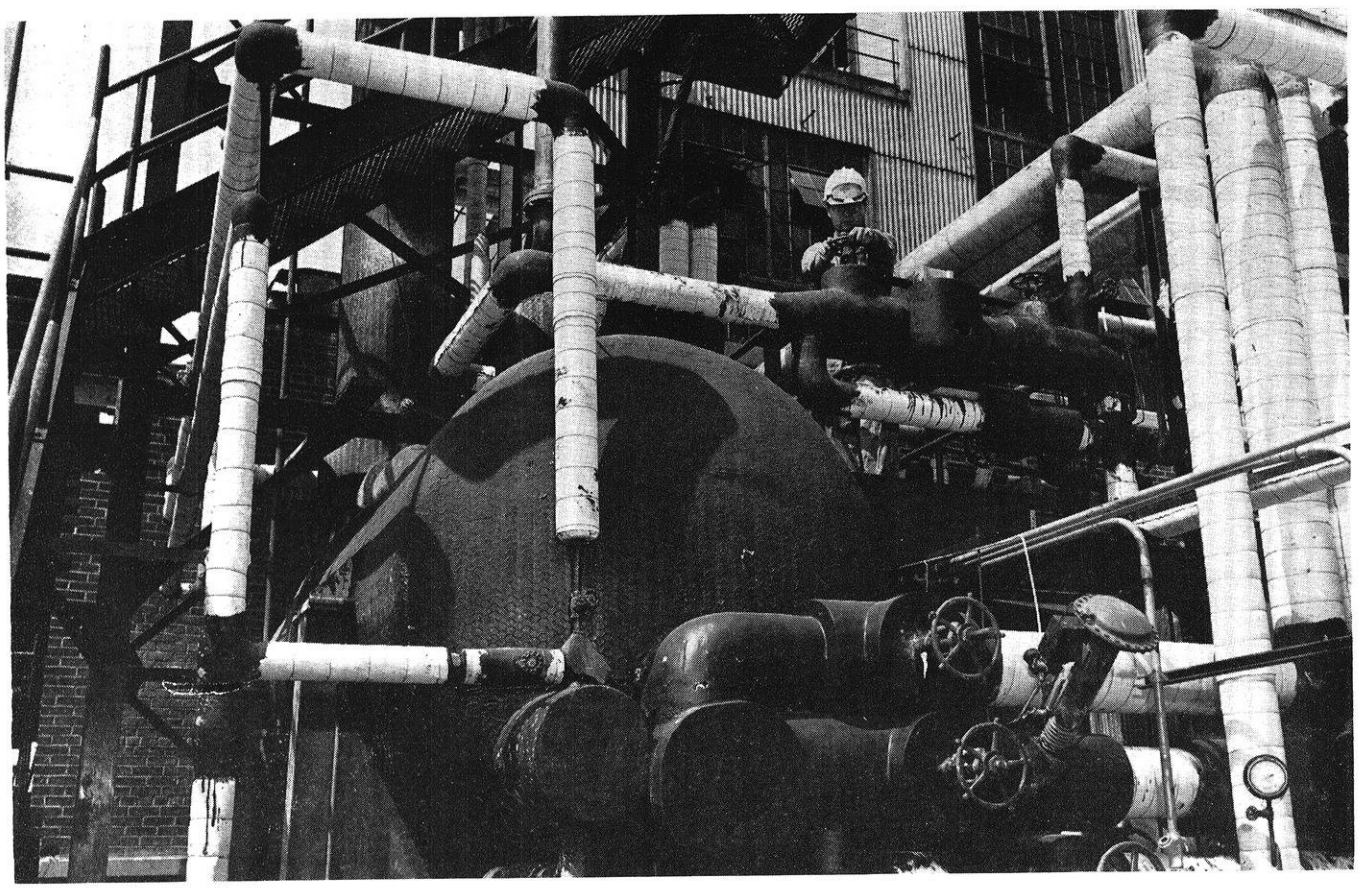
These two oils have disadvantages, however, that offset their advantages for use in an automobile engine. They are that animal and vegetable oils deteriorate rapidly at high engine temperatures and tend to form sludge more easily than mineral oils.

Mineral oils are not nearly so easily obtained as the animal and vegetable oils, but they do have more desirable characteristics of a lubricating oil. Mineral oils do not deteriorate at high temperatures so easily as other oils nor do they tend to form sludge so readily as animal or vegetable oils. Mineral oils are much easier to obtain at the viscosity required for an automobile lubricating oil.

An oil for an automobile engine has more to do than lubricate. It must do the following things in order to be called a good automobile engine oil:

1. It must minimize friction and prevent wear. There should be an oil film between all metal parts moving relative to one another.
2. The oil must dissipate the heat of the pistons and cylinders of the engine by acting as a coolant.
3. The oil must form a seal between the piston rings and the cylinder walls.

The details of how a critical engine part wears may show a clearer picture of the problem involved in engine lubrication. Take the case of the piston, rings, and cylinder wall wear. The wearing is the actual



Large stillpot for batch distillation system.

removal of particles of metal from the part being considered. There are several factors all of which will cause wear. The most obvious type of wear is that caused by the rubbing of two metal surfaces together.

When the piston of an automobile engine reaches the top dead center of its stroke, there is no movement between the piston and cylinder. This causes more wear at the top of the cylinder because the oil rings scrape the oil off the cylinder walls when they slow down and stop, rather than slide over the oil film when the piston is moving rapidly. Then too, some of the oil at the top of the cylinder wall is burned away by the high temperatures at this point or is blown away by the compression pressure.

Chemical erosion is another cause of wear. Chemically active products form from the breakdown of oils and form acids in the presence of water. These acids will cause erosion of engine parts.

Mechanical erosion is a form of wear. It is the wear caused by tiny ash, metal, and carbon particles carried around with the oil after they are worn or deposited in the engine.

The time when most wear occurs is when a cold engine is started. Several detrimental things happen at this time. First there is no oil on the engine parts until the oil pump builds up oil pressure. This lack of oil causes most of the mechanical rubbing wear.

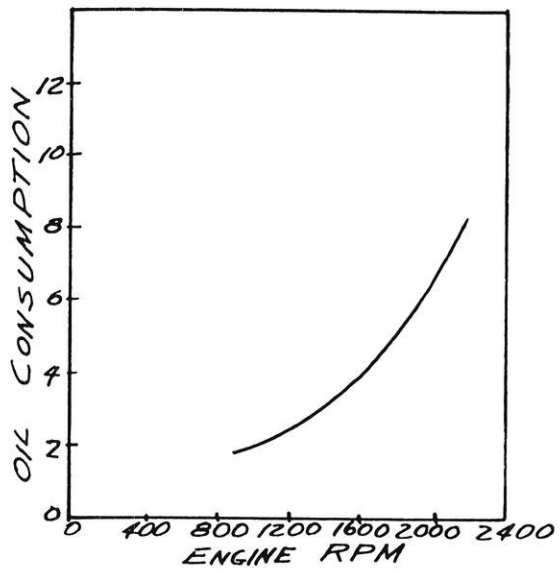
There is also a rich mixture of fuel introduced into the engine, usually by the choke operation. This excess fuel is not completely burned, and some will be blown down past the piston into the crankcase, and cause a thinning of the oil.

The fuel that does ignite is not completely burned. It forms a carbon or soot when the burning fuel comes in contact with the cold cylinder walls and heads. This causes carbon deposits and also helps contaminate the oil.

When the gasoline does burn, one of the resulting products is water. At normal engine operating temperatures this water is a vapor and passes out with the exhaust gases; but when the engine is cold, this vapor condenses on the cylinder walls and leaks down past the pistons into the crankcase where it tends to form a sludge with the impurities in the oil, and combines with the active chemicals from oil breakdown to form acids.

All of these factors cause an increase in engine wear, but most of them can be combatted by driving the car at higher speeds for a time sufficient to warm-up the engine oil. When this happens, the soot and carbon are burned out of the combustion chambers at the higher engine temperatures, and the gasoline and water evaporate from the oil and pass out the crankcase breather pipe to the atmosphere.

It can be readily seen that an automobile started and turned off before the engine really gets up to operating temperatures for any length of time is operating under severe driving conditions.



There are several reasons for an engine to "use" oil. Some of these are cited to be better able to combat oil consumption.

Oil is actually "burned" when it is exposed to the high temperatures of the combustion chambers. However, it first must be changed into a vapor before it will ignite. Therefore an oil that will not easily vaporize is desired. An oil such as this has low volatility.

A highly volatile oil (one that easily vaporizes) will evaporate when exposed to hot engine parts not exposed to the combustion chamber. This oil vapor will then pass out the crankcase breather pipe. Oil may be lost along the valve stems if they are loose fitting. This type of loss also occurs by seepage through worn bearings.

If the pistons are 'blowing" (letting gases pass from the combustion chambers into the crankcase), oil will be lost through the crankcase vent, especially at high engine speeds and temperatures. The viscosity of oil is also important in oil consumption rates. A thin oil will be used faster than a thicker oil.

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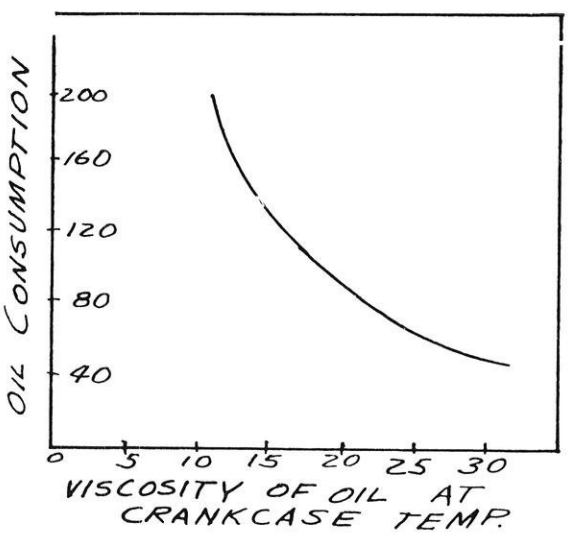
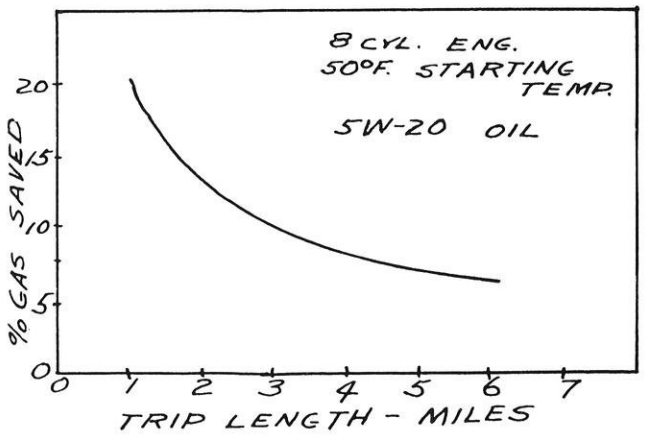


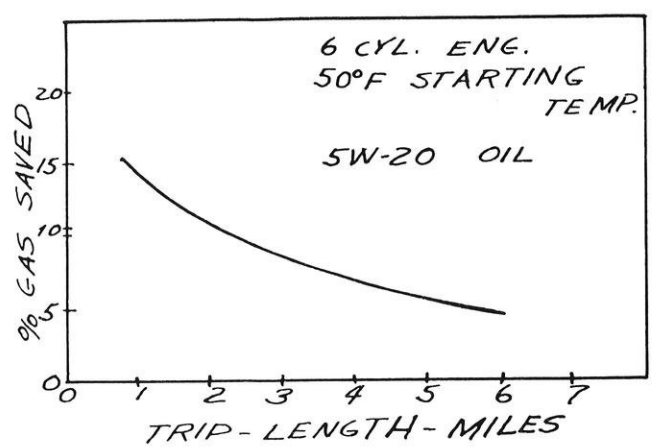


As mentioned previously, wear is basically caused by cold starting. The high operating temperatures and higher speeds will help fight the secondary causes of wear such as acid erosion and accumulation of sludge, but little can be done to remedy the lack of oil upon starting the engine.

The next best thing is to get an oil with a low viscosity at the coldest starting temperature expected, so it will get into circulation and to the spots needed as soon as possible after the starter turns the motor over. One thing wrong with low viscosity oil is that it will be consumed faster and do a less effective job of lubricating than a heavier oil after operating temperatures are reached.

Another practice in helping combat engine wear is to drain and add new oil regularly. There is no set rule for the number of miles or the time lap you should drive before you change oil. This must be determined by the severity of operating conditions encountered. It should be obvious that a car driven only on short trips of five or six miles or less in a cold climate should have its oil changed much more often than a car driven on longer trips regularly in a warm climate.

There are many types of additives put into automobile engine oils, but only a few really seem to play an important part in combating wear. The first, and probably the most common additive, is a detergent.



A detergent has the property of being able to hold dirt, sludge, and metal particles of very small size in suspension. That is, it surrounds each tiny dirt and metal particle and floats it away when the oil is drained. A detergent oil will help a great deal in cleaning out an engine and keeping it clean if it is used regularly.

One precaution to be observed is that a detergent oil should not be used in an engine that has not had the benefit of a detergent oil for a long period of time. The detergent will loosen a great deal of accumulated sludge and carbon and possibly clog up oil lines with an excess of dirt in suspension.

There are many other additives, some of which are rust inhibitors, varnish and sludge dissolvers, upper cylinder lubricants, etc. These are probably helpful, but do not serve as useful a purpose as a detergent.

Within the past few years an oil that covers several SAE (Society of Automotive Engineers) grades of oil has come into market. This type of oil is possible to make by adding an agent to the oil to thicken it at warmer temperatures. As stated previously, the majority of mechanical wear occurs at cold starting before the oil can reach the rubbing surfaces of engine parts. If a very thin oil such as an SAE–5 grade could be used for cold starting and still have the lubricating properties of a heavier oil, such as an SAE–20 or SAE–30 grade oil at higher engine temperatures, much of the problem of getting the oil to the proper places at starting would be solved. This is exactly what has been done with the creation of a multi-grade oil.

The most common multigrade oils on the market today are the SAE–5W–20 and the SAE–10W–30 grades. These have the properties of thin oil at cold starting temperatures, but, as the engine temperature rises, the oil gradually assumes the properties of the heavier oils such as an SAE–20 or SAE–30.

These oils have been manufactured by almost every major oil company, and sell at about sixty cents a quart. The question most buyers ask about the multigrade oil is, "Are the advantages in using the multigrade oils worth the extra cost?" I will try to answer this question by summarizing some recent publications on multigrade oils.

A report in the "Society of Automotive Engineers Journal" based on papers from four major manufacturing companies is summarized as follows:

The four companies conducting tests were the General Motors Corporation, Quaker State Oil Refining Corporation, the California Research Corporation, and the Union Oil Company of California. They discovered three major facts about multigrade oils. These are:

1. Very real gasoline economies during the first miles of operation from a cold start. (5–10 percent on cold starts—minimum of 3 percent on trips.)

2. At least as good antiwear characteristics as a regular heavy duty oil.

(Continued on page 72)

BIG DEAL

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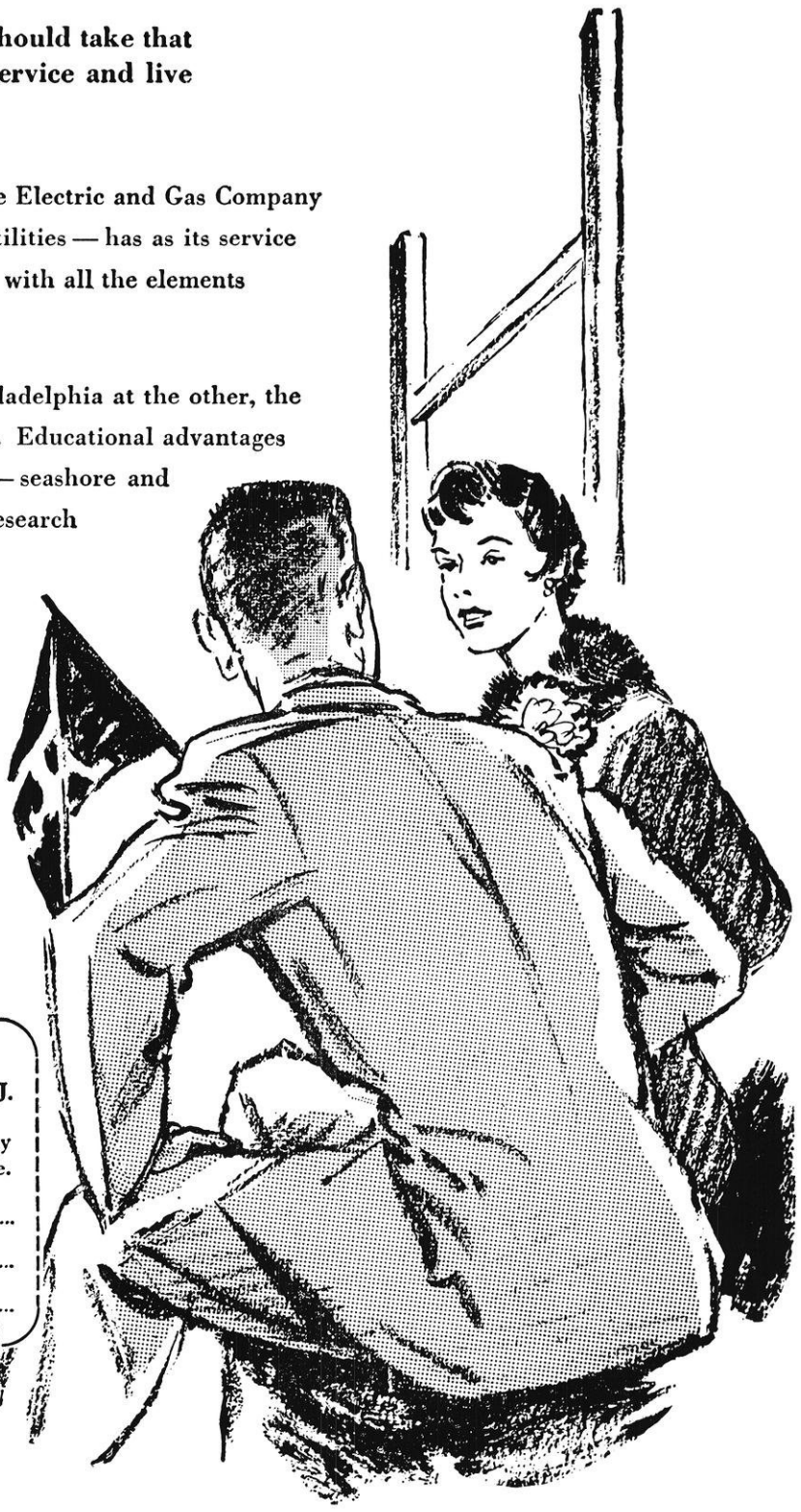

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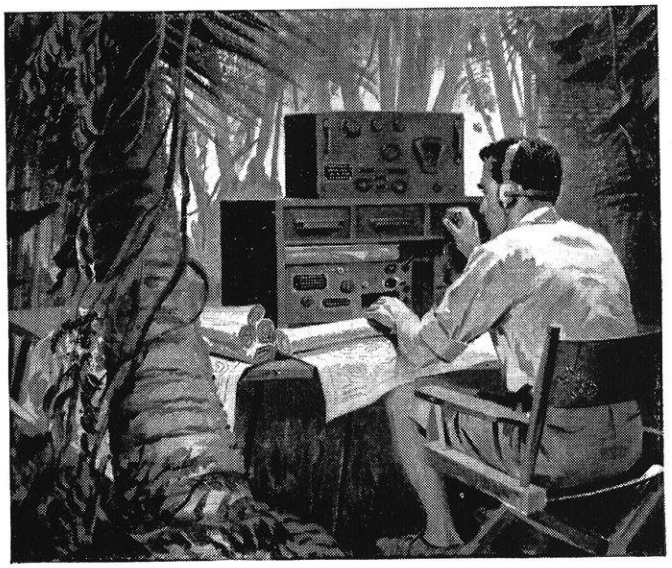

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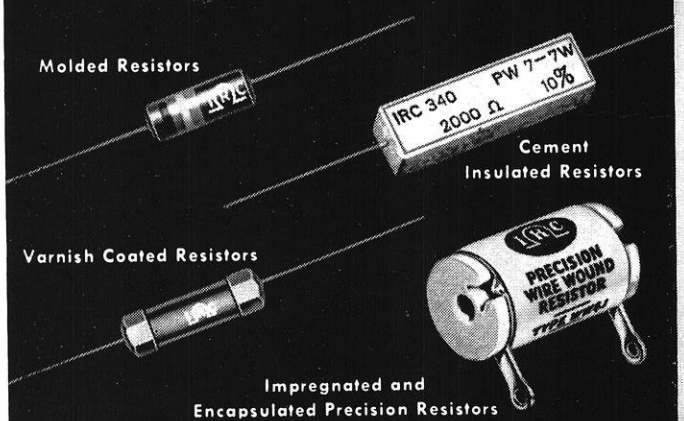

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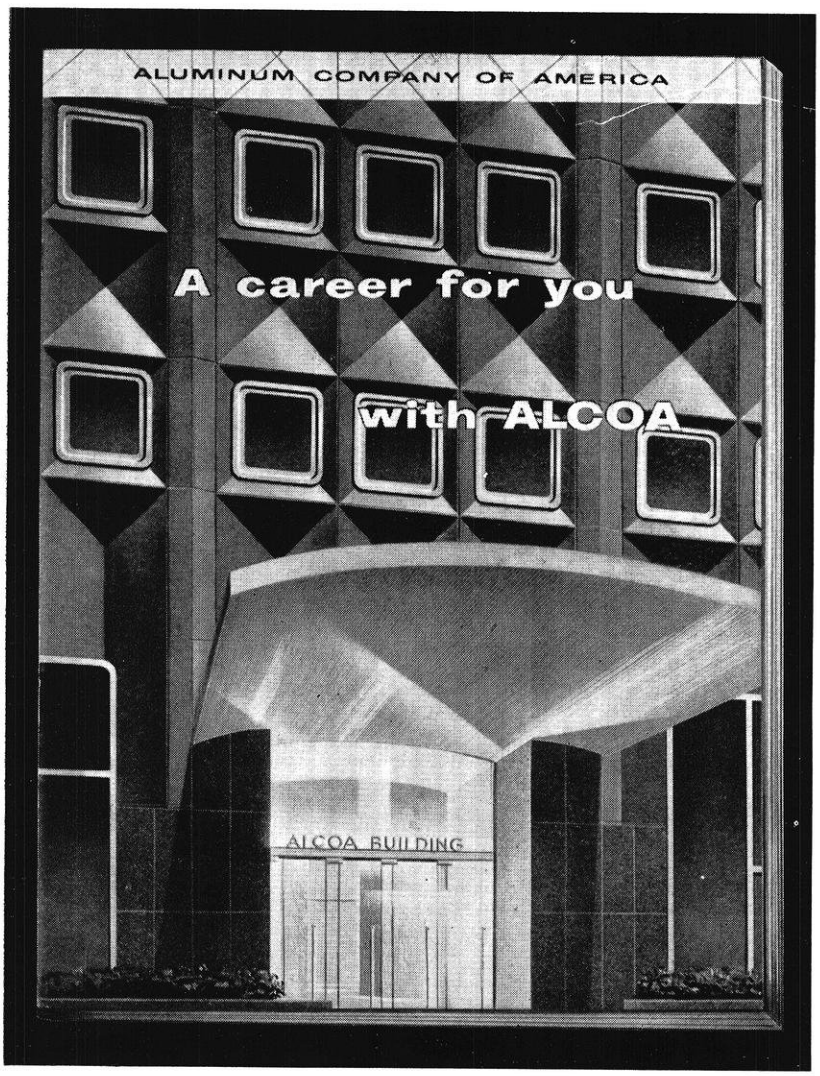

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ENGINE EARS

by Dave Rex m'57

A Wisconsin graduate who was a straight "A" scholar during his student days and a widely-known engineer from China who gained his education on three continents are among nine top-level engineers who are joining the faculty of the University of Wisconsin College of Engineering this fall.

The additions to the teaching-research staff of the College of Engineering are necessary, Dean Kurt F. Wendt said, to replace several faculty losses during the past year through retirements or resignations of staff members to take industrial jobs, and to help take care of the college's steadily increasing student enrollment.

The Wisconsin graduate who was a top scholar during his career as a student negineering on the UW cmapus, and who now returns to the University to teach chemical engineering, is **Warren E. Stewart,** research engineer with the Sinclair Research Laboratories at Harvey, Ill.

The engineer born in China and educated on three continents is **Dr. Shao-Ti Hsu,** coming to Wisconsin from the University of Dayton, Ohio, to teach mechanical engineering.

The seven other new faculty members are:

Jean Van Bladel, graduate of Brussels University in Belgium and of the University of Wisconsin, who joins the faculty of the electrical engineering department;

Herbert A. Smallwood, chief engineer with the Petrol–Structors Co., of Calgary, Alberta, Can., who will teach hydraulics and fluid mechanics in civil engineering;

L. Donovan Clark, former head of the department of mining and metallurgy at Lafayette College at Easton, Pa., who will teach mining engineering in the mining and metallurgy department;

Roger R. Nelson, formerly of the Colorado School of Mines, who also joins the staff of the mining and metallurgy department;

Werner W. Schaerff, graduate of the Technical School at Saxony, Germany, and former supervisor in the engineering department of Ohio Chemical Co., in Madison, who will teach machine design in the mechanical engineering department;

Robert R. Zenk, graduate of the UW College of Engineering in 1941 who is engineer with the Gisholt Machine Co., in Madison, and who will now teach part-time in machine design in mechanical engineering;

George A. Sievers, who this past summer obtained his Ph.D. degree in engineering from the University of Heidelberg, Germany. He is head of the Industrial Engineering Institute in Milwaukee, and will give an industrial engineering seminar in the UW Engineering Graduate program at the University of Wisconsin–Milwaukee.

Dean Wendt also announced that Profs. **Ralph Benedict** and **Gerald Pickett,** of the electrical engineering and mechanics departments, who have been on leave during the past two years to teach in India as part of the U. S. State Department's program operated by the UW College of Engineering to aid India's technical schools, returned to their teaching–research duties on the Wisconsin engineering campus this fall. Benedict served as field coordinator of the India program as well as a member of the staff of the Bengal Engineering College at Sibpur, West Bengal. Pickett has been on the staff of the mechanics department at the Bengal Engineering College and for the past few months on the staff of the Indian Institute of Sciences at Bangalore.

Prof. Herbert D. Orth retired this year after nearly half a century of work at the University of Wisconsin with all of the straight lines, curves, angles, and slants that geometric problems could throw at him.

Prof. Orth was chairman of the department of drawing and descriptive geometry of the UW College of Engineering. He had been in the department for 48 years, 33 of which he served as chairman—one of the largest periods of chairmanship ever recorded by a faculty member here.

During all those years the professor himself has wrestled, and has helped engineering students wrestle, with a mass of problems in drawing and geometric design—and he has never yet been licked.

Orth was born in Terre Haute, Ind., in 1885. His secondary education in Terre Haute public schools revealed that he had a

mathematical mind—he just loved to solve the nastiest problems of algebra and geometry.

He figured out that many of the toughest problems in mathematics would be in electrical engineering, so when he graduated from high school he decided to go into that field. He attended Rose Polytechnic Institute at Terre Haute, and received his bachelor of science degree in elecrtical engineering in 1908 with honors.

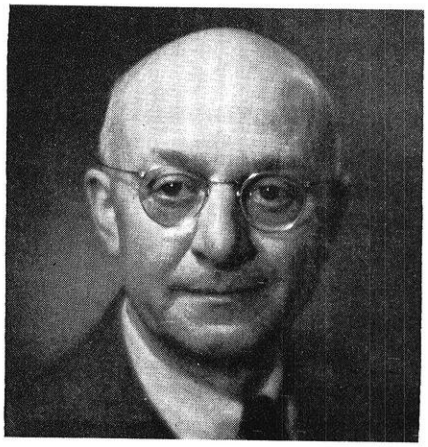
Electrical engineering jobs available to the young graduate were neither plentiful nor well-paying in 1908, but there was a job teaching engineering drawing, paying $800 for 10 months' work, waiting for a young college graduate at the University of Wisconsin. Orth was offered the instructorship and took it.

Over the years he has risen steadily through the professorial ranks, becoming a full professor in 1938.

As is usual with college and university professors, Orth's teaching and research in his field has practically filled his life—in Orth's case it has even spilled over into his hobbies, which are the making of plastic geometric models, and stereo or 3-dimensional photography. He does an excellent job at both hobbies, too. Many of his small plastic models are on display in a glass case on the wall of the hall near his engineering office. Among them are oblique and right square prisms, a plane rotation, a rotation oblique axis, and a plane landing gear—all highly technical and illustrating important engineering principles for Orth's students.

Orth has taught some 5,000 students during his years at Wisconsin. At the same time he has been the author or co-author of several basic textbooks in his field—widely used technical books including "Mechanical Drawing," "Basic Engineering Drawing," and "Problems in Mechanical Drawing."

He is an active member of the American Society for Engineering Education, the American Society



Professor H. D. Orth

of Mechanical Engineers, and Pi Tau Sigma, national honorary mechanical engineering fraternity.

Orth was married in 1909 to Effie Ann Dunlap, of Terre Haute. The Orths have three children, Mrs. Lois Wheeler, now of Lake Charles, La.; Robert M., of Madison; and Charles D., of Milwaukee, who graduated from the UW College of Engineering in 1942. In Madison the Orths live in suburban Nakoma, where the professor has found time from his busy life of teaching to take an active part in many civic activities. And on the campus he has taken time to participate in the activities of the Wesley Foundation, Methodist Church student center.

The resignation of **Joseph R. Akerman,** professor of mechanical engineering at the University of Wisconsin, was accepted by the UW Regents.

Prof. Akerman has accepted a post at the University of Michigan. He came to the University of Wisconsin in 1952 after some 15 years of experience as engineer in industry. In addition to teaching duties at Wisconsin, he supervised the Wisconsin research programs in heat transfer and on fuel burners.

The University of Wisconsin Board of Regents accepted the retirement of Reed A. Rose, associate professor of mechanical engineering.

An expert in the operation of diesel engines, Rose conducted heatpower courses in the UW School of Engineering for 35 years. In March of this year he also retired from the U. S. Navy as a captain after 39 years active and reserve service.

Rose joined the faculty of the mechanical engineering department in 1922. A native of Mankato, Minn., he received his M.S. degree in 1929 and an M.E. in 1937 from the University of Wisconsin.

He served with the U. S. Navy in both World Wars. He enlisted in the regular Navy in 1917 while an engineering undergraduate at Wisconsin. By the end of the war he had been commissioned an ensign.

Following the war he spent three years with General Electric working on the development of powdered coal experimental equipment, and other projects.

In 1923 Rose organized the 33rd Fleet Naval Reserve in Madison and participated with the organization in weekly drills and summer cruises until his recall to active duty in 1941.

A member of the American Society of Mechanical Engineers, Rose is co-author of a number of technical engineering papers.

Rose was one of the pioneers in diesel engine research. He was the first to apply electronics to the study of combustion inside of the cylinder of a diesel engine.

An important contribution to diesel research was his work on photo-electric combustion analysis. This research included the use of 28 different types of fuels. By photographing the combustion cycles, stages in combustion could be measured down to 1/100,000 of a second.

In addition to his teaching, research and naval reserve activities, in 1934, as chairman of a Technical Club committee he helped the city to establish a life saving service on Madison lakes.

Rose was recalled to active duty with the Navy on March 1, 1941 and served until March 1, 1946.

(Continued on next page)

Engine Ears

(Continued from page 41)

During the war he was assigned as chief engineering officer of a large ammunition ship and in 1943 was named commanding officer of the U. S. Naval Training Schools at Richmond, Va. This school trained diesel operators for the amphibious forces of the Navy at the rate of 500 per week during 1943 and 1944.

In 1945 he was named assistant shops superintendent of the Norfolk Navy Yard in charge of shop operations. In March 1946 he was assigned to the Sixth Naval District as redistribution officer in charge of surplus property of the Navy Department, Coast Guard and Marine Corps.

Since 1947 he has been commanding officer of the Naval Reserve Composite Company 9–4 in Madison. In July 1950 he was promoted to the rank of captain in the Naval Reserve and from 1952 to 1955 spent his summers on active duty with the Norfolk, Va., Reserve Fleet, the Charleston S. C., Reserve Fleet and at a Disaster Control Center at Port Hueneme, Calif.

ALUMNI

The appointment of **Richard J. McIntyre** to the new position of manager of sales, distributor and outdoor ballasts, at the General Electric Company's Ballast Department, Danville, Illinois, has been recently announced.

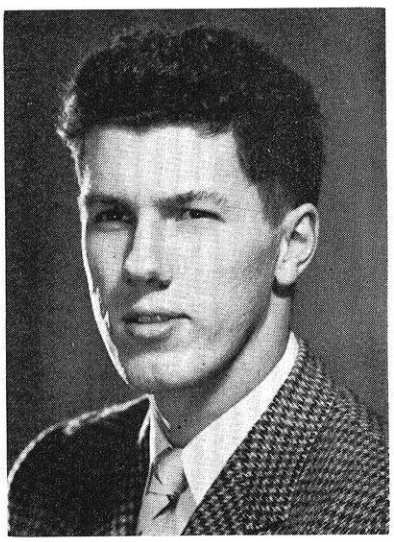
McIntyre comes to the Danville plant from Cedar Rapids, Iowa, where he was manager of equipment and specialty sales at the company's apparatus sales office there.

A native of La Crosse, Wisc., he was graduated from the University of Wisconsin in 1943 with a degree of bachelor of science in electrical engineering.

McIntyre joined General Electric after leaving the University and worked on radar and electronic control engineering for the company's Electronics Division in Syracuse and Schenectady, N. Y.

As manager of sales, distributor and outdoor ballasts, his new duties include sales of appliance, outdoor and acessory ballasts, as well as internal and distributor sales.

The Trane Company, La Crosse, Wisconsin, has announced that **Richard C. Bond,** a February, 1956 University of Wisconsin engineering and business administration graduate, recently completed an intensive six-month engineering sales training program of the firm.



Richard C. Bond

Bond has since been assigned to the Heat Transfer Sales Department at the home office of Trane in La Crosse.

Gus E. Archie, graduate from the University of Wisconsin with a Master of Science Degree in Mining Engineering is assistant Manager of the Technical Services Division of the Shell Oil Company in Houston, Texas.

Gordon W. Haddock, chemical engineer, has joined the Guided Missile Research Division, The Ramo–Wooldridge Corporation, Los Angeles.

Mr. Haddock's experience includes basic research on mechanism of combustion in flowing gas streams, turbulent mixing of fluids,

(Continued on page 70)

Left to right: Dan Palmer, Texas A&M, '54; Ted Webb, Caltech, '55; Bob Stancil, Georgia Tech, '54; Chuck Herndon, Illinois, '50.

Go with us... and you'll Grow with us!

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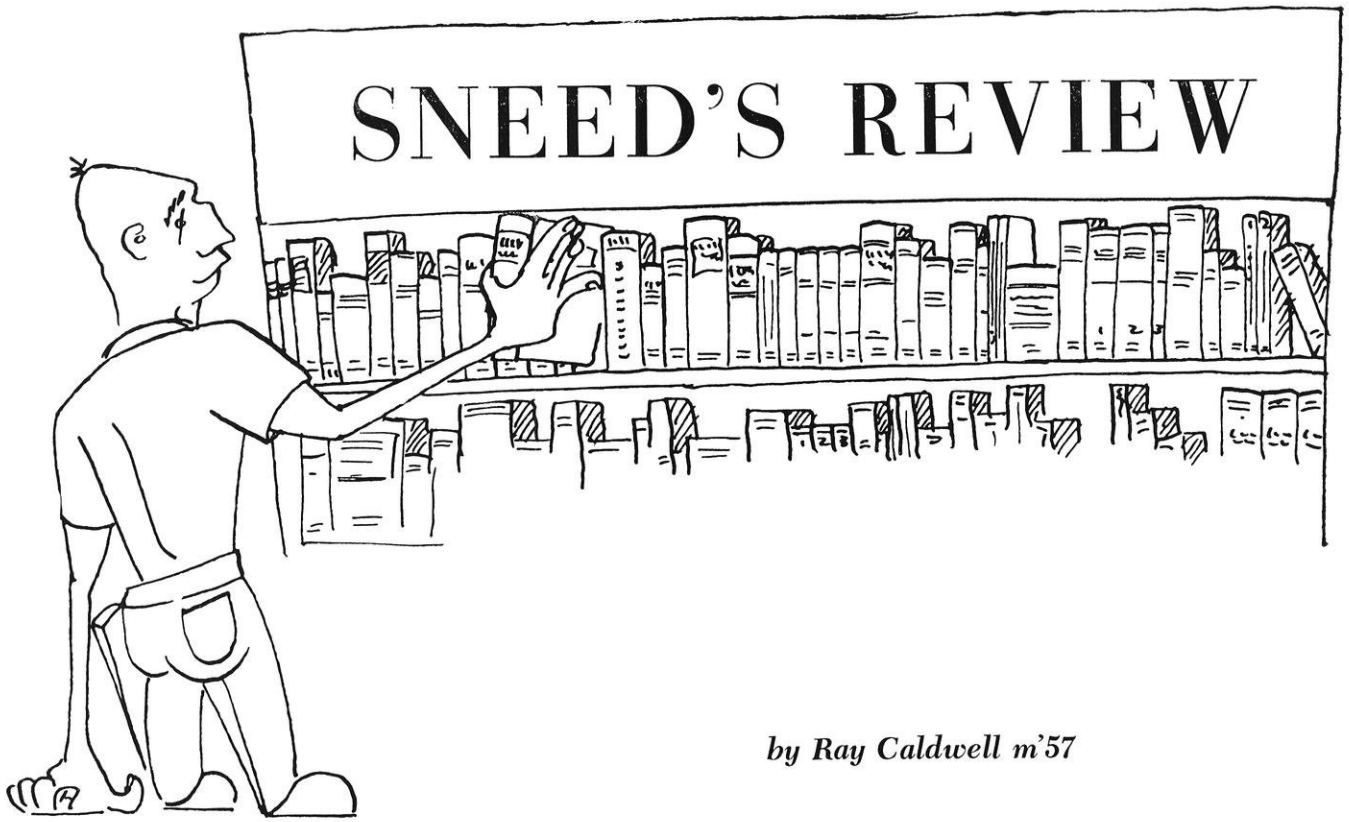
SNEED'S REVIEW



by Ray Caldwell m'57

RADIO ELECTRONICS

By Samuel Seely

A thorough and comprehensive treatment of important aspects of communication systems.

Samuel Seely was the former Professor and Chairman of the Department of Electrical Engineering at Syracuse University, and he will become Professor and Head of the Department of Electrical Engineering at Case Institute of Technology in June of 1956. Mr. Seely treats in considerable detail the essential processes and circuits which are of importance in the field of radio communications. A general discussion of the important methods of communication is followed by a detailed discussion of the more important aspects of the field.

Emphasis is on the physical and mathematical analysis, to give the reader an understanding of the fundamentals underlying the broad field of communication. Because the author employs a new approach, that of stressing the techniques of analysis, occasional alternate mathematical developments are included in order to illustrate the applicability of the different techniques of analysis.

A considerably more comprehensive discussion than is ordinarily available is included on 1) feedback in amplifiers, and 2) the ratio detector and the Bradley detector in frequency modulation detection. Among the new advances covered is Information Theory. A chapter on this subject related some of the results of this theory with different types of communication systems.—*McGraw Hill $7.00.*

STRESSES IN AIRCRAFT AND SHELL STRUCTURES

By Paul Kuhn

A distinctive new work by an internationally known authority on airplane shell stress analysis.

Paul Kuhn, Assistant Chief, Structures Research Division of the National Advisory Committee for Aeronautics, has written this book both for the practicing engineer in the field of aircraft structures and for the graduate student who wishes to use it as a reference.

The first part of the book presents methods for the analysis of stiffened-shell structures to a better accuracy than the older engineering methods could afford. The problems discussed include stresses due the bending of box beams (the so-called shear-lag problems in the general sense), stresses due to torsion with restrained warping, and stresses around cutouts. One chapter is devoted to diagonal-tension webs.

The large number of comparisons between tests and calculations presented in the second part of the book are designed to promote more intelligent application of theory to practice.—*McGraw Hill $14.00.*

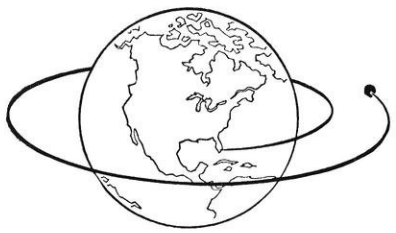
MECHANICAL ENGINEERING PRACTICE

Fifth Edition by Charles F. Shoop and George L. Tuve

Proven practical—now brought up to date.

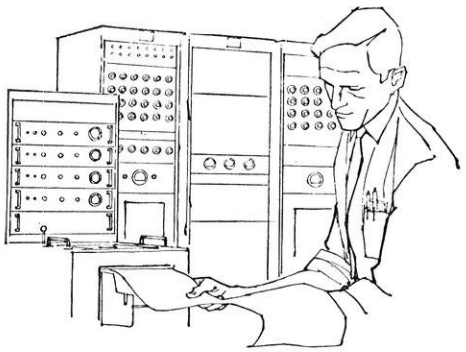
Charles F. Shoop, Emeritus Professor of Mechanical Engineering from the University of Minnesota; and George L. Tuve, Professor of

(Continued on page 74)



Challenging new projects

The first man-made satellite to be launched by the U. S. in 1957 will be directed into its orbit by an ultrasensitive missile guidance system developed and manufactured by Honeywell. And that is just one of the exciting projects in progress at Honeywell. They include new instruments basic to automation, new firing control systems for national defense and new concepts in controls for heating and air conditioning offices, homes, buses, trains and ships.



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One of the largest installations of analog computers in private industry is an example of the kind of facilities and equipment available to Honeywell engineers. This installation has 250 computer amplifiers plus extensive nonlinear components and simulator tie-ins. Equipment like this enables our engineers to tackle confidently projects that are pushing back frontiers of physical science in fields that range from automation to the conquest of space.

Inside Honeywell

A graphic review of your career advantages at the world's leading maker of automatic controls.

Outstanding associates

Dr. Finn Larsen, head of the Honeywell Research Center, directs an extremely capable staff of physical scientists in fundamental research projects dealing with semiconductors, solid state and magnetic and dielectric materials. Working with men like this in small groups at Honeywell gives you a tremendous backlog of experience to draw on for aid in developing your own ideas. It stimulates your own creativity, helps you realize your full potential.

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Honeywell's fifteen divisions are located throughout the United States with factories in Canada, Japan and Europe. And, whichever division of Honeywell you choose, you can expect a first-rate salary plus liberal benefits to insure a prosperous future. Remember this, too. Honeywell's wide diversification offers opportunities for rapid advancement in a company whose growth is not dependent on just one facet of our country's technological progress.

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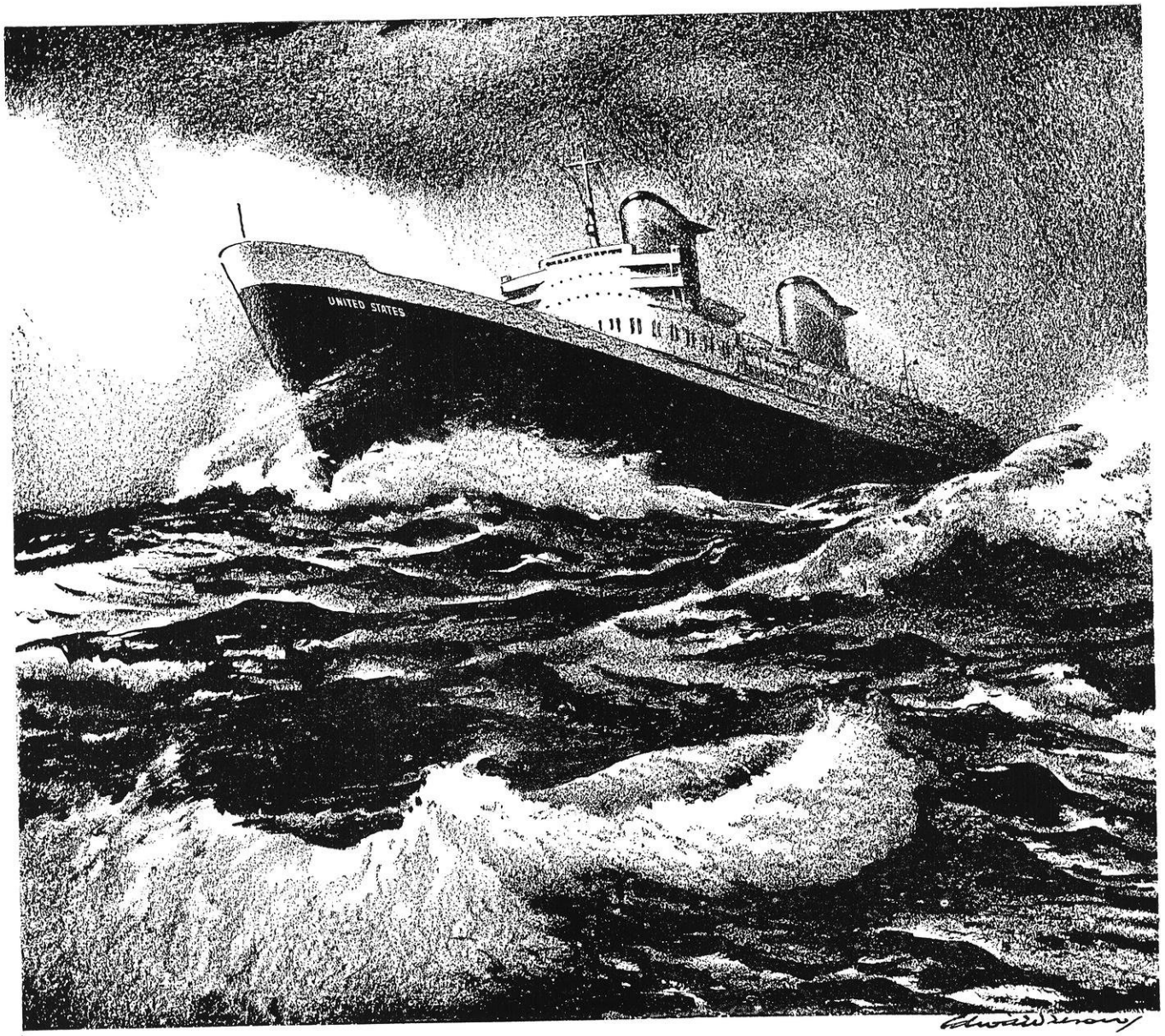

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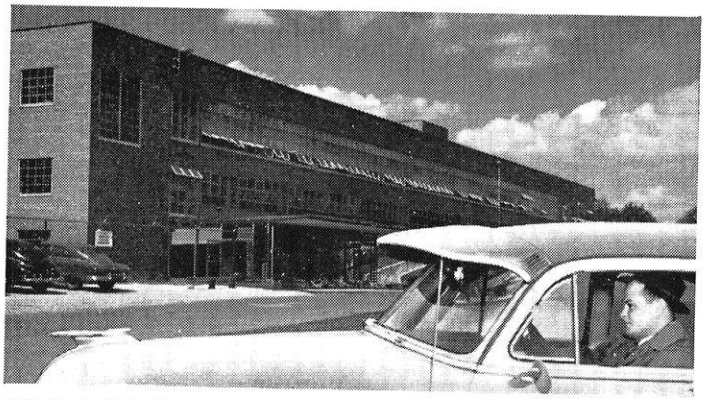
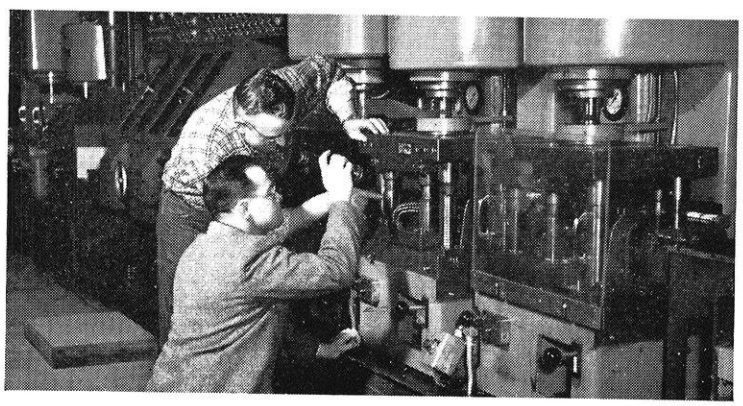
Meet Dick Foster

Western Electric development engineer



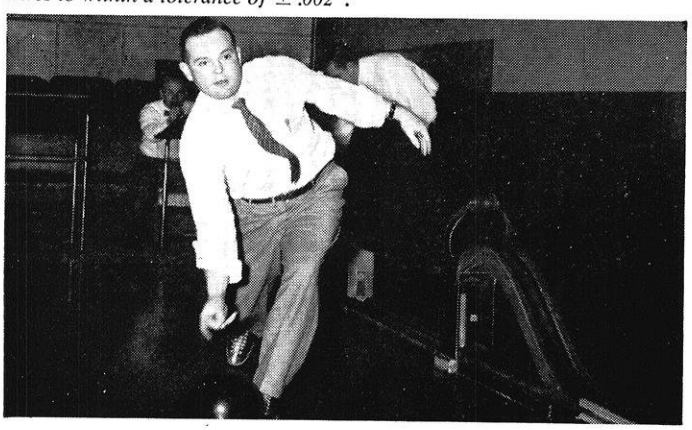
Dick Foster joined Western Electric, *the manufacturing and supply unit of the Bell System, in February 1952, shortly after earning his B. S. in mechanical engineering at the University of Illinois. As a development engineer on a new automation process Dick first worked at the Hawthorne Works in Chicago. Later, he moved to the Montgomery plant at Aurora, Illinois where he is pictured above driving into the parking area.*

Dick's day may begin *in one of several ways: an informal office chat with his boss, a department "brain session" to tackle a particularly tough engineering problem (above); working with skilled machine builders in the mechanical development laboratory; or "on the line" (below) where he checks performance and quality and looks for new ways to do things.*



Here Dick and a set-up man check over *the automatic production line used to manufacture a wire spring relay part for complex telephone switching equipment. This automatic line carries a component of the relay on a reciprocating conveyor through as many as nine different and very precise operations—such as percussive welding in which small block contacts of palladium are attached to the tips of wires to within a tolerance of ± .002".*

Examining the plastic molded "comb" *components of the wire spring relay Dick recalls his early work when he was involved in working-up forming and coining tools for the pilot model of the automation line for fabrication of wire spring sub-assemblies for relays. At present he is associated with the expansion of these automation lines at the Montgomery Plant.*



Dick finds time *for many Western Electric employee activities. Here he is scoring up a spare while tuning up for the engineers' bowling league. He is active also in the golf club, camera club, and a professional engineering society. Dick, an Army veteran, keeps bachelor quarters in suburban Chicago where he is able to enjoy the outdoor life as well as the advantages of the city.*

Western Electric offers a variety of interesting and important career opportunities for engineers in all fields of specialization in both our day-to-day job as the manufacturing and supply unit of the Bell System and in our Armed Forces job.

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SCIENCE HIGH-

by Ted Witzel e'57

A NEW USE FOR T.V.

Electronics engineers at a western aircraft company reported development of the world's tiniest television camera, only 5 inches long, as the latest scientific tool to flight test the new Electra propjet airliner.

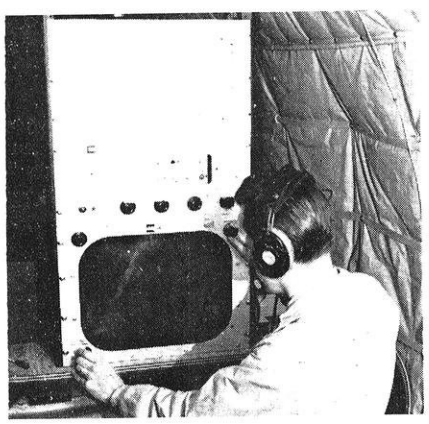
Smaller than a flashlight but rugged as a wrench, the micro-miniature camera with 8 mm. lens attached weighs only 1½ pounds. It measures 1¾ by 2 by 5 inches.

A standard box camera is eight times as large and a network-type television camera is 300 times larger.

The midget telecaster was designed for aerial televising, attached to flying test planes, as well as in laboratories on the ground.

With this remotely controlled "eye," research and flight test engineers will be able to view operations which would be impossible to see without it. The camera can see into inaccessible areas. It can give a close-up view of tests a man could not watch safely.

Extreme heat poses no problems for the "vidicon." The company has conditioned it to operate in temperatures up to 185 degrees Fahrenheit. It is also "ruggedized" to withstand severe forces imposed on it in test flights.



Inside an airborne plane, Charles Aker, electronics engineer, tunes TV monitor connected with a tiny camera mounted externally to relay a view of surfaces undergoing flight testing.

This shows how Lockheed mounts television cameras externally to permit continuous study of performance during actual test flights. Televisor relays picture of air-flow tufts attached to tail, and flight test engineers viewing receiver inside plane can evaluate air-flow pattern.

Most spectacular use for the tiny new camera—and the chief reason for its compactness and durability—is in flight testing.

It can fit inside a landing gear housing, for instance, and relay a continuous picture to a 27-inch screen inside the airplane. Observers can watch the gear being raised and lowered against the force of the slipstream. They can study gear doors to make sure they work smoothly in bumpy air, climbs or dives.

Best of all, if they detect a problem, pilots and engineers can maneuver the plane to maintain a desired test condition and explore all its characteristics immediately.

Thus, a single TV-equipped test flight will give information which would require several flights of an airplane fitted with the conventional motion picture camera. There is no need to develop film, study it on the ground, and schedule additional flights to gather follow-up information.

The micro-miniature is adapted to run on aircraft power circuits. It climaxes two years of work, in which electronics scientists developed a slightly larger ruggedized camera.

Numerous flights of the propjet C–130 military transport and of military and civilian versions of the Super Constellation showed the first camera could "take it." Next, the technicians reduced the size of all possible parts and simplified circuits. The result was the new pint-sized instrument.

NEW FLASH EVAPORATORS WILL DOUBLE KUWAIT'S SUPPLY OF DRINKING WATER FROM SEA

The Sheikhdom of Kuwait, which now operates the world's largest seawater evaporator plant, will soon double the production of drinking water for its capital city, the municipality of Kuwait.

Two new flash-type water evaporators, each capable of producing

LIGHTS

1,260,000 U. S. gallons of fresh water a day, will be installed at Shuwaikh, a suburb of the capital.

The units will convert the waters of the Persian Gulf, the world's saltiest body of seawater, into potable water containing less than 100 parts of dissolved solids per million. A small amount of even purer water will be produced for boiler operations. The Persian Gulf contains approximately 42,000 parts of dissolved solids per million, as compared with a maximum of 32,000 parts for the waters of the Atlantic and the Gulf of Mexico.

Kuwait's first drinking water from this modern source came late in 1949 from a similar installation of the Kuwait Oil Company at Mina al Ahmadi, which supplied water to the city until the government's installation took over. Prior to that time all water was obtained from brackish local wells or brought in by ship from the Tigris and Euphrates Rivers, north of Kuwait.

With the addition of the two evaporating units, the Kuwait municipality will be able to produce a minimum of nearly 5,000,000 gallons of fresh water a day by the middle of 1957.

The new four-state flash evaporator unit will require less than 25 percent of the space required by two earlier triple effect "shell and tube" units. Each of two new units will consist of two towers with four stages mounted one above the other; each measures 10 feet by 30 feet and 35 feet high. They will produce about three puonds of distilled water for each initial pound of steam.

In the new flash design, water under pressure at about 200 degrees Fahrenheit is sprayed into a chamber having a lower pressure. A portion of the water is flashed into vapor and is then condensed by means of a surface condenser which is integral with the chamber. The process is repeated through four stages at temperatures decreasing to about 120 degrees.

Steam for the new installation will be supplied by two boiler plants which also supply steam for four 7,000-kilowatt and three 700-kilowatt turbine generator units built some years ago to provide electric power for the city.

In addition to the main installation in Kuwait, a two-stage prototype will be built and operated in the United States. It will be one-sixth the size of the Kuwait evaporators and used in studying control of scaling, corrosion and erosion problems relative to the Kuwait installation.

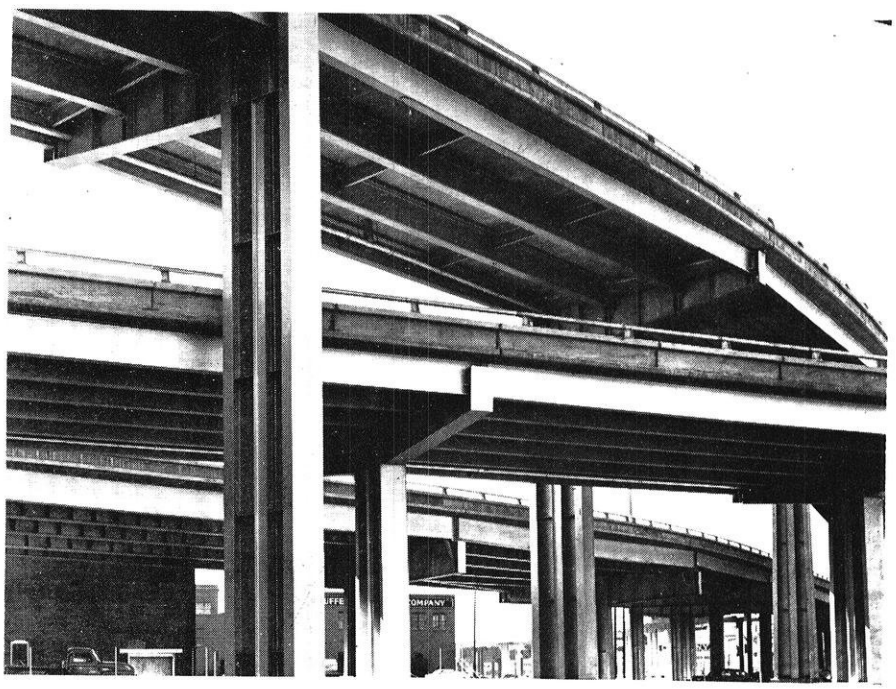
WELDED HIGHWAY BRIDGES

A recent survey of state bridge departments has revealed an increasing trend towards the use of welded bridges in the country's rapidly expanding highway system. Of the 39 state bridge departments responding to the survey, 15, or 38%, were using an increasing number of welded highway bridges. Another 13 states or a total of 72% were using welding for certain details such as coverplates, diaphrams, shoes, etc. Many of these states were considering adopting completely welded designs for more of their bridges.

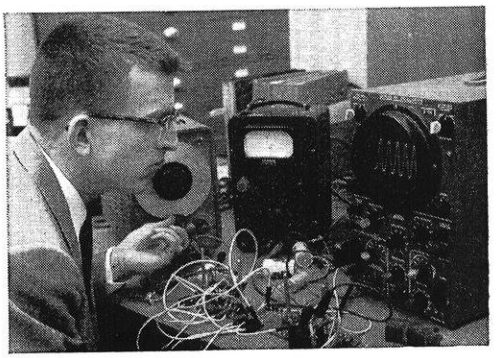
Reported savings in steel in typical bridges, resulting from welded design, ranged up to 20%. If this savings were extended to the long range road building program that has been initiated by the Federal Government, enough steel could be saved to build a typical highway girder bridge approximately 800 miles long. The projected high-

(Continued on page 62)

One of the many new welded highway bridges being constructed.



WHAT'S DOING at Pratt & Whitney Aircraft . . .



Pratt & Whitney Aircraft engineer checks a bread board model for a subminiature, encapsulated amplifier built with transistors.

A rig in one of the experimental test cells at P & W A 's Willgoos Laboratory. The six large finger-like devices are remotely controlled probe positioners used to obtain basic air flow measurements within a turbine. This is one of the techniques for obtaining scientific data vitally important to the design and development of the world's most powerful aircraft engines.

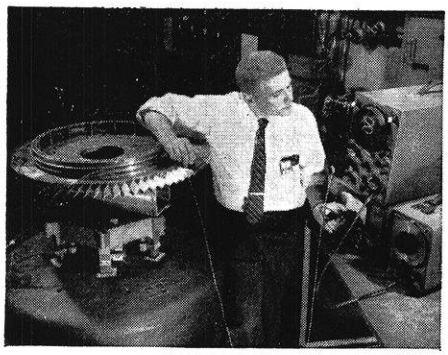
. . . in the field of INSTRUMENTATION

Among the many engineering problems relative to designing and developing today's tremendously powerful aircraft engines is the matter of accumulating data — much of it obtained from within the engines themselves — and recording it precisely. Such is the continuing assignment of those at Pratt & Whitney Aircraft who are working in the highly complex field of instrumentation.

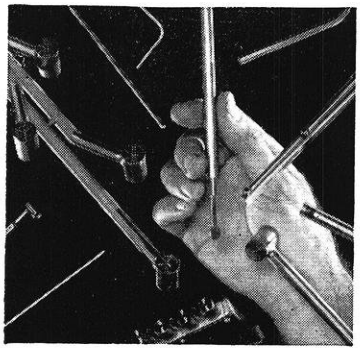
Pressure, temperature, air and fuel flow, vibration — these factors must be accurately measured at many significant points. In some cases, the measuring device employed must be associated with special data-recording equipment capable of converting readings to digital values which can, in turn, be stored on punch cards or magnetic tape for data processing.

Responsible for assembling this wealth of information so vital to the entire engineering team at Pratt & Whitney Aircraft is a special group of electronic, mechanical and aeronautical engineers and physicists. Projects embrace the entire field of instrumentation. Often involved is the need for providing unique measuring devices, transducers, recorders or data-handling equipment. Hot-wire anemometry plays an important role in the drama of instrumentation, as do various types of sonic orifice probes, high temperature strain gages, transistor amplifiers, and miniaturized tape recording equipment.

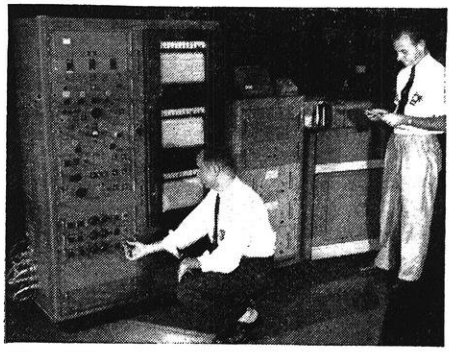
Instrumentation, of course, is only one part of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program — with other far-reaching activities in the fields of combustion, materials problems, mechanical design and aerodynamics — spells out a gratifying future for many of today's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



Instrumentation engineer at Pratt & Whitney Aircraft is shown investigating modes of vibration in a blade of a single stage of a jet engine compressor.



Special-purpose probes designed and developed by P & W A engineers for sensing temperature, pressure and air flow direction at critical internal locations.



The "Plottomat", designed by P & W A instrumentation engineers, records pressure, temperature and air flow direction. It is typical of an expanding program in automatic data recording and handling.

World's foremost designer and builder of aircraft engines

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

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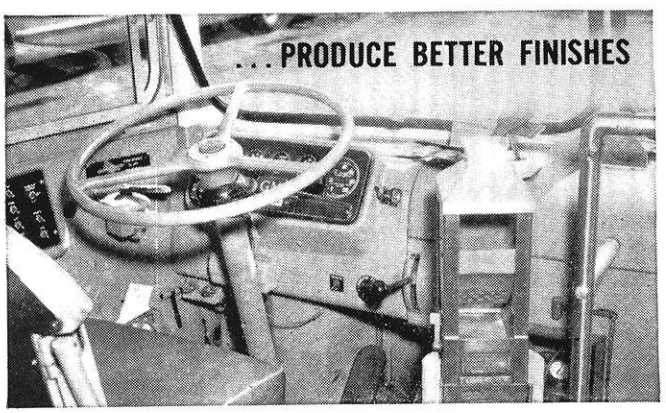
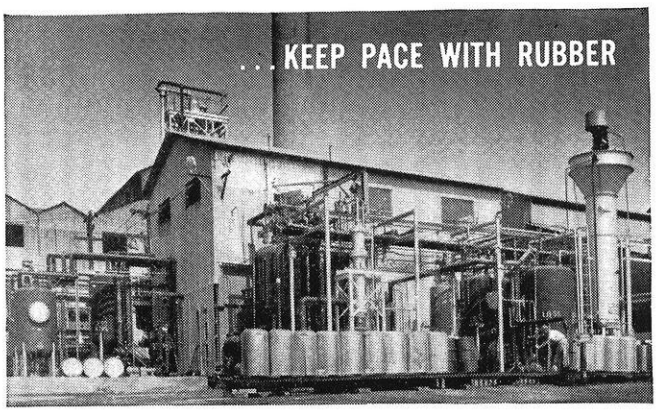
CAREER OPPORTUNITIES WITH *HERCULES*

HERCULES' CONTINUING RESEARCH offers many challenging opportunities for a career in the development and sales of processing materials for construction and other industries. New York City's Coliseum is typical of the many modern buildings and other projects where Hercules Vinsol® Resin is used as an air-entraining agent in concrete. Other Hercules products require specialized application in many industries offering more career opportunities for you.



HERCULES IS A LEADING SUPPLIER of chemical materials to the protective coatings industry, a field where there is always a future for the young man of vision. For example, multicolor lacquer, based on Hercules® nitrocellulose, was used as an interior finish on this new 48-passenger bus. Other uses are challenging.



WITH MORE THAN $20,000,000 invested in new plant facilities this year alone, Hercules will continue to be a chemical growth leader in the years ahead. This pilot plant, where new rubber chemicals are being readied for commercial production, is a part of Hercules' effort to anticipate tomorrow's needs. Technical men are needed.

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CAREER INFORMATION—Your Placement Office can tell you more about a career with Hercules. Or write directly to Personnel Department for additional information.

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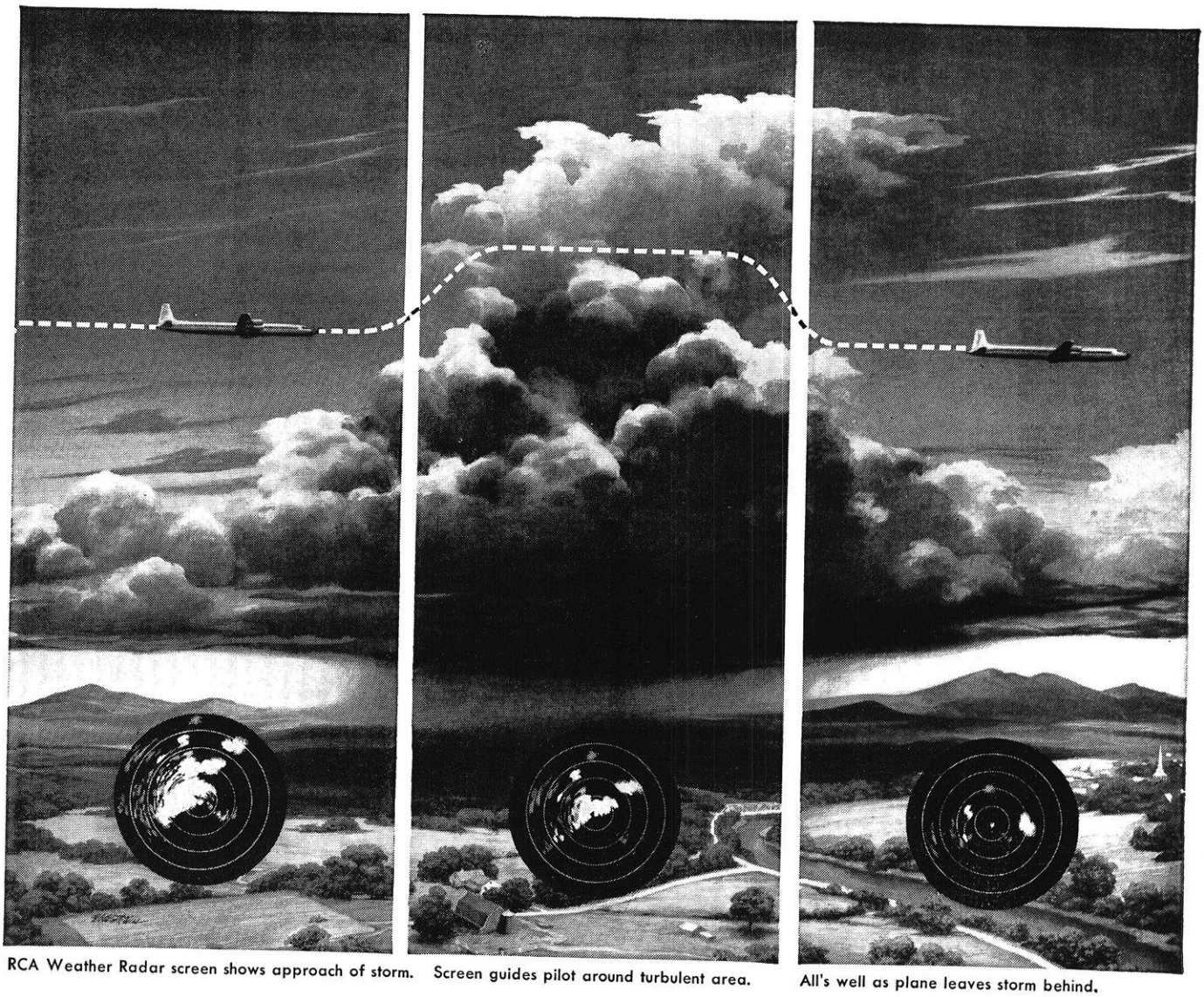

RCA Weather Radar screen shows approach of storm. Screen guides pilot around turbulent area. All's well as plane leaves storm behind.

How RCA Weather Radar adds comfort and speed to your flight

No longer need you, as a traveler of the sky, experience the discomfort of bouncing around during storms. If your plane is equipped with RCA Weather Radar, you enjoy comfort and speed throughout.

For supersensitive RCA radar peers miles ahead of the plane to give your pilot advance warning of weather disturbances. The signals on its screen then point the way to a smooth course around storm areas.

The electronic leadership behind Weather Radar is inherent in all RCA products and services. And at the David Sarnoff Research Center of RCA, Princeton, N. J., scientists continue to explore new "Electronics for Living"—electronics that make life easier, safer, happier.

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

LEADING AIR LINES installing RCA Weather Radar include American Airlines, Continental Air Lines, Pan American World Airways, Trans World Airlines Inc., United Air Lines; and these European Air Lines: Air France, BOAC, Iberia Air Lines of Spain, Sabena Belgian World Airlines, Swissair; Mexicana.

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ENGINEERS' CREED

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

I PLEDGE

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

W. S. P. E.

SPEECHES GIVEN AT W.S.P.E. SUMMER CONFERENCE

THE HOOVER COMMISSION'S LOOK AT ENGINEERING IN GOVERNMENT

CHARLES D. CURRAN

It is only natural that the recommendations of the second Hoover Commission should be more controversial than those of the first. There have been many charges by those on the receiving end of government subsidy that with the adoption of some of the recommendations of the second Commission the Federal government would be failing to carry out its responsibilities. They mean, of course, the assumed responsibility to provide subsidies to some paid for by taxes of others.

It is almost fifteen months since the final report was rendered. In that period, the Executive Branch and the Congress have put in effect a few (11 out of 314) of the recommendations. Much remains to be done if we, the American people, are to receive the full value of the work of this Commission and its Task Forces.

Ninety laws of the last session of Congress took on additional projects, functions and activities for the Federal government, all of which call for future appropriations and for future employees. This is the fruit of just seven months Congressional action. The growth of government, the Federal assumption of responsibilities can, if left unchecked, overshadow other problems of this Nation. If we are to keep from being completely subordinated to an expanding central government, we must from time to time make examinations such as that made by the Hoover Commission and then take necessary steps to get our government back more nearly to a proper relation to the people.

The adoption of a toll system whereby users would pay charges in amounts sufficient to reimburse the Government for its outlays would tend to eliminate the initiation of new projects of dubious worth or the continuation in service of economically unsound projects.

The increased productivity of the land for commercial, industrial, residential, or agricultural purposes is the real measure of value of flood damage prevention measures.

Federal public power is subsidized by:

(a) Use of interest rates which are lower than the actual cost of long-term money and risk capital;

(b) Omission of interest during construction;

(c) Omission of Federal Income Taxes or comparable contribution to the cost of the Federal Government;

(d) With two exceptions (Hoover Dam and TVA), omission of State or local taxes;

(e) Charging large parts of the initial capital costs to wholly subsidized Federal activities such as flood control, navigation, fish and wildlife, etc.;

(f) Charging administrative costs, insurance and pensions to other Government accounts.

If I were asked what items I thought should be most vigorously pressed now for improvement of the Federal water resources program, I would say, first, establish in the office of the President an independent, and I underscore independent, water resources and power board and strengthen the independent review facilities of his office; second, require that rates for the sale of vendible surplus products, particularly water

(Continued on page 56)

Meet the President

A. G. BEHLING
W.S.P.E. President

First in this year's Meet the President series is Arthur G. Behling, President of the Wisconsin Society of Professional Engineers. Mr. Behling is a consulting engineer in the steam power plant field. He formerly worked in the steam turbine department at the Allis Chalmers Mfg. Co. and on power plant design for the Wisconsin Electric Power Co. He was born on October 2, 1905 in Oshkosh, Wisconsin, where he also received his education and early training.

Mr. Behling, now a resident of Milwaukee, is an active member of the Engineering Society of Milwaukee, serving as its president in 1949–50. He has also served on several civic affairs committees in the Milwaukee area. Among these are the Citizens Lake Front Committee, Advisory Committee to the Milwaukee Department of Safety Engineering, and the advisory Committee to the Milwaukee County Air Pollution Control Engineer.

A charter member of W. S. P. E., Mr. Behling has been active in the society ever since. He served on the first nominating committee, public relations committee, and the fees and salaries committee. Mr. Behling also served as director and national representative of W. S. P. E. He was elected successively, second vice president, first vice president and is now serving W. S. P. E. as its president.

W.S.P.E.

(Continued from page 54)

for municipal supply and electric energy, be set to meet all real costs; third, establish by law basic and broad principles of a Federal water policy; and, fourth, require greater local participation in the planning, financing, and operating of water resources development projects with immediate and direct beneficiaries making substantial contribution.

SPECIAL WEAPONS EFFECTS

HAROLD L. GOODWIN

Civil Defense must plan for a number of attack combinations. A given city must have plans that assume an H–bomb burst big enough to take out the city. The plans must also assume a multiple A–bomb attack with several ground zeroes, or single A–bombs aimed at specific targets—usually critical industries—within the city.

In making assumptions about the effects of nuclear weapons on a given target, it would be a grave error to attempt to be too precise. Consider these factors:

a. We don't know the size of the bomb an enemy might use on a specific city—and we never will know, until the bomb has actually gone off and we can measure it.

b. By analysis of population and industrial concentrations within any target area, we can asumme what we believe to be a logical aiming point for enemy attack. However, we don't know how complete the enemy's information may be or whether his attack assumptions are the same as ours.

c. We don't know for what altitude an enemy might set his fuzes. Variation of the altitude of a burst of small or moderate power can modify considerably the effects-distance relationships.

d. It cannot be asummed that enemy bombing would be entirely accurate. Bombing error would be an unknown value. This error could be caused by poor or faulty equipment, the "human" element in operations, or harassment of the enemy aircraft by our own defenses.

e. It should also be a recognized that much civil defense planning is based on an assumption that we know to be inexact. This is the assumption of symmetrical behavior of a nuclear burst—that propagation of blast and other effects is equal in all directions. This assumption is demonstrated by the concentric circles commonly used in target analysis. But propagation of nuclear effects, particularly blast, would almost never be symmetrical over a target because of variations in the terrain, including the presence of built-up areas, and to some extent, the behavior of the weapon itself.

These factors necessarily restrict civil defense planning to gross effects. For that reason, it's practical to deal in round numbers.

All nuclear weapons cause damage in four ways: by blast, heat, initial radiation, and residual radioactivity.

a. Initial radiation.

At the moment of explosion, about five percent of the bomb's energy is released in the form of radiation. The components include alpha and beta particles, gamma rays, and neutrons.

The alpha and beta do not travel far; they are quickly absorbed by the air and may be discounted for Civil Defense purposes.

Gamma radiation is highly penetrating, and can produce casualties.

Neutrons can produce casualties, and in addition they interact with matter. Neutrons have the capacity for making matter radioactive, by producing radioisotopes.

Initial radiation can be shielded out. Earth is the cheapest shielding, and a few feet of earth between people and a burst will give good protection even close to a burst.

Even the smallest nuclear bomb would produce significant fallout if exploded under the proper conditions. Of principal concern is the ground burst of a device in the megaton range. The figure of several thousand square miles is commonly used for the contaminated area resulting from such a burst. It's unfortunate that persons who have described the fallout in such an area have tended to talk about uniform distribution of the radioactive material. While this is a handy way to define the problem, it is also misleading, since fallout distribution is anything but uniform.

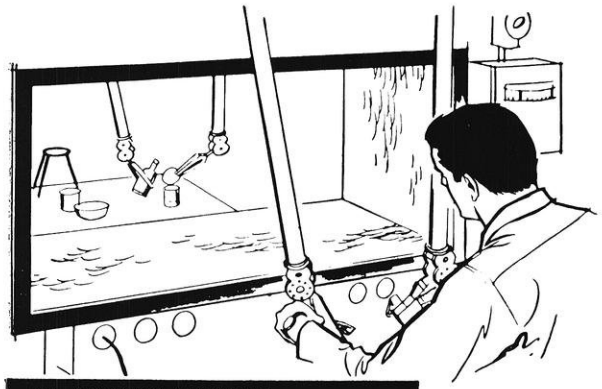
To define a fallout pattern, we may draw lines like those of a weather system. Close to the main line of fallout the lines may show rates exceeding the lethal dose by a factor of three or four. There may be iso-intensity lines enclosing an elliptical area where many hundreds of square miles are subject to a median lethal dose, or higher. But in most of the several thousand square miles, the rate will be moderate enough so that some action can be taken. This action might be shelter until the activity had decayed to safe levels, or it might, under ideal conditions, be evacuation.

Actually, fallout has no significant mysterious physical properties. It consists of radioactive particulate matter; dust, if you like. The size of the particles would depend on the nature of the ground in which the nuclear device is exploded, and there probably would be places where fallout could be seen. However, whether or not it is seen should not be used as a detection method. Only suitable detection devices would be reliable for that.

Decontamination procedures are the same as those for removing ordinary dust. It can be picked up and carried away, by vacuum cleaner, for example; it can be hosed away if water is available, or it can be scraped away. The fallout will not involve more than the top few centimeters of soil, a fact that may offer possibilities for area decontamination.

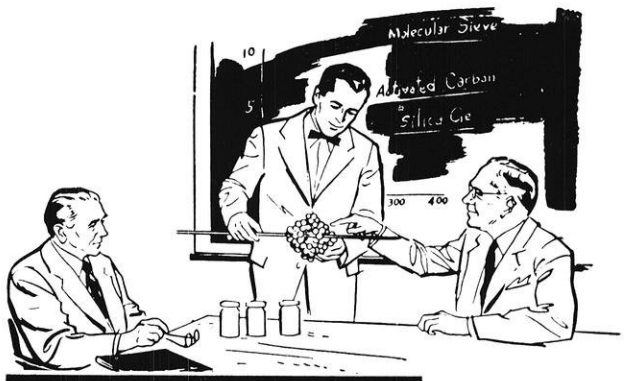
(Continued on page 60)

College graduates in growing fields...
growing with UNION CARBIDE



IN ATOMIC ENERGY...

"I'm Class of '52, with a B.S. in chemistry. I wanted to do research in the atomic energy field, so I went to work at Oak Ridge National Laboratory, which Union Carbide Nuclear Company operates for the AEC. After two promotions I'm an Associate Chemist, doing research in special materials important to the atomic energy program."



IN CHEMICAL ADSORBENTS...

"I'm a chemical engineer, Class of '53. Two years after I joined Linde Air Products Company I was in charge of a group of engineers and technicians synthesizing Molecular Sieve adsorbents. I recently transferred to a Development group exploring applications of these new adsorbents, and have many opportunities to help LINDE customers with their problems."

IN AUTOMATIC PRODUCTION...

"I'm an electrical engineer, Class of '53. I joined National Carbon Company, and after a short orientation worked on problems of instrumentation of automatic equipment for the production of batteries. Now I'm assistant head of the Product and Process Control Lab., working in product development with full responsibility for inspection and quality control."

IN PURCHASING...

"I received my B.S. in Chemical Engineering in '51 and my Masters in Business Administration in '54. I went to work for Union Carbide, and after a year of training at plants all over the country, I transferred to New York as a Purchasing Agent, responsible for contract negotiations and cost reduction in the purchase of heavy chemicals."

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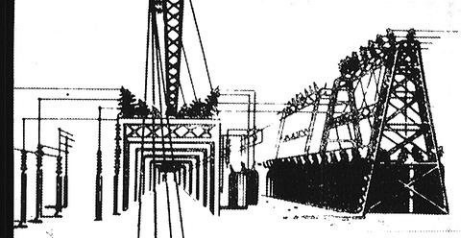
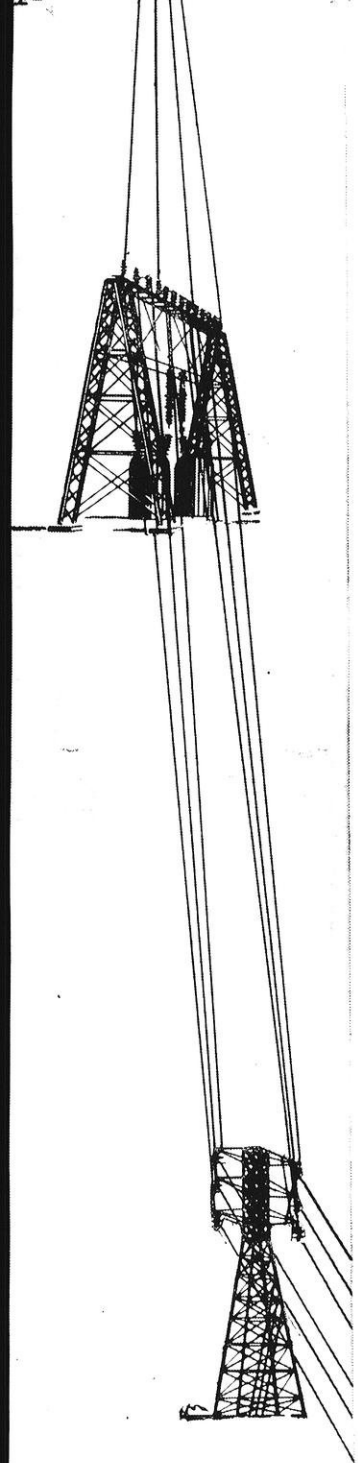




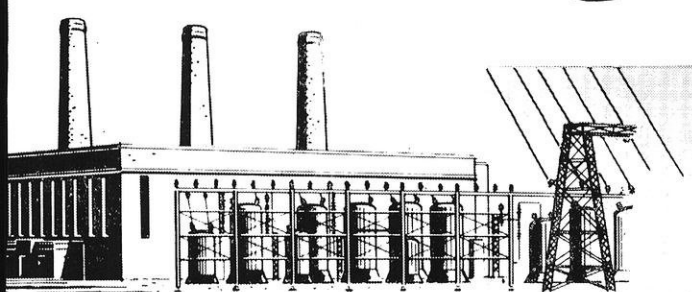
The importance of insulations for

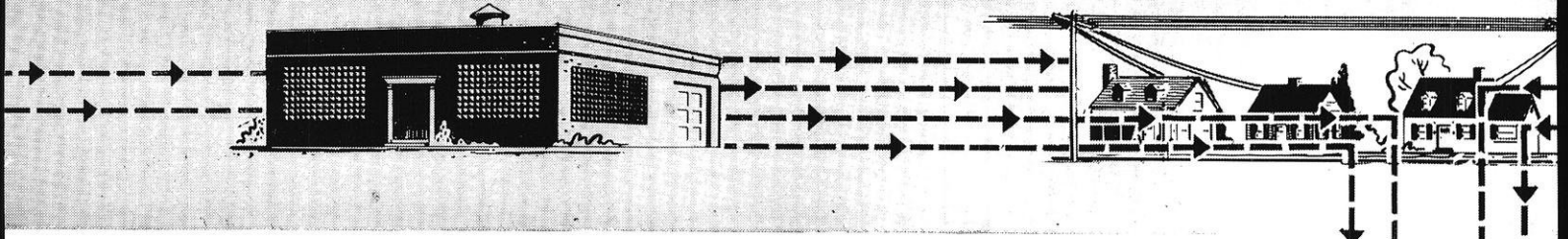
THE PURPOSE of electrical insulation is to offer resistance to the flow of electricity and thus to confine electrical potential to the conductor material throughout its length. An ideal insulating material would have infinite insulation resistance and voltage breakdown, a specific inductive capacity of 1 and zero power factor. In addition it would be flexible, physically strong and unaffected by abrading, cutting and impact forces, oxygen, ozone, acids, alkalies and water throughout a temperature range from minus 80 C. to the maximum operating temperature of copper. A conductor insulated with a thin wall of such a material would occupy minimum space and would operate indefinitely even at high voltages in the presence of any or all of the above destructive materials with no energy loss within the insulation. All available insulating materails fail to comply with the above ideal in practically every respect.

Insulations for use on electrical wires and cables which are subject to bending during manufacture, installation or use must have adequate flexibility. Flexible insulations for such uses are of two general classes, depending chiefly on the extent that they absorb or are affected by moisture. In one group are included the homogeneous rubber and rubber-like insulations, made from natural rubber or the synthetic rubbers, GR-S, butyl and silicone and thermoplastic insulations such as polyvinyl chloride compounds and polyethylene. Most of these are highly resistant to moisture. The other group consists of insulations built up of one or more layers of fibrous materials such as asbestos, cotton, varnished cambric, various synthetic fibers and paper. Even though these fibrous materials are impregnated with moisture-proofing materials such as paraffin, asphalts and oils, they readily absorb sufficient moisture in wet locations to completely lose their insulating properties. Such insulations must therefore be protected by a moisture-proof sheath such as lead when used in moist locations.

The insulations made from materials appearing in the first group fall into two general classes depending on whether or not they are vulcanized after application to the conductor, namely, (1) thermosetting insulations, those which are vulcanized and, (2) thermoplastic, those that are not vulcanized. Thermosetting insulations are those made from natural rubber, GR-S, butyl and silicone synthetic rubbers. Such insulations are applied to the conductor in a soft plastic condition and attain their ultimate physical properties as a result of a heat treatment (vulcanization) during which the sulfur or vulcanizing agents combine with the rubber. Thermoplastic insulations become plastic enough for application to the conductor simply by raising their temperature. They acquire their toughness again on cooling. From this it follows that thermosetting insulations are less subject to softening at elevated temperatures than

US RUBBER **United States Rubber**





electrical wires and cables

thermoplastic insulations.

Natural rubber, including Laytex®, GR-S synthetic rubber and thermoplastic insulations are available in two classes, depending on whether they are designed for use in dry or wet locations. Standard insulations, Type R and Laytex Type RU (made from rubber) and Type T (made from thermoplastic) are for use in dry locations while moisture-resistant insulations Types RW, RUW, and TW are for use in wet locations. There are many installations, particularly in buildings, where the less costly standard compounds give entirely satisfactory service.

Natural rubber and GR-S synthetic rubber insulations are also available in two classes depending on the operating temperature for which they are designed, namely, Type R and RW for 60 C. operation and Type RH and RUH for 75 C. operation. Conductors insulated with RH insulation carry more current, that is, use the conductor more efficiently than those insulated with Type R insulation. There is also available a combination insulation capable of operating at 60 C. in wet locations and 75 C. in dry locations. Butyl rubber insulation is suitable for operation at 85 C. and silicone rubber for even higher temperatures.

The thermoplastic insulations described above are limited to 600 volts for general power distribution. The rubber and rubber-like insulations are limited to a maximum operating voltage of 5000. For operation at higher voltages where ozone is produced in quantity, resistance to ozone in the insulation must be provided.

Acceptable ozone resistance in rubber and GR-S synthetic rubber insulations is provided by incorporating in them relatively high percentages of an inert chemically saturated compound such as vulcanized vegetable oil. These are the so-called oil base compounds. Compounds made from butyl rubber are inherently ozone resistant. Oil base and butyl compounds are suitable for operation at a maximum voltage of about 28 KV, grounded neutral, when properly shielded.

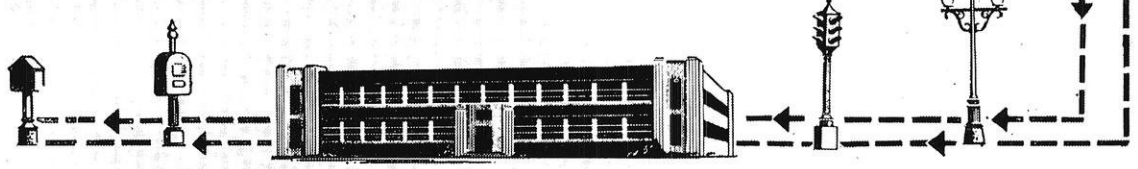
Varnished cambric insulated cables are generally used in the same voltage range as ozone resistant rubber, that is, at a maximum of 28 KV, grounded neutral, and at a maximum conductor temperature of 85 C. For use in wet locations varnished cambric cables must be covered with a lead sheath.

Impregnated paper-insulated, lead-covered cables are suitable for operation at voltages up to 69 KV at a maximum temperature of 85 C. Gas or oil filled paper insulated cables are suitable for higher voltage services at somewhat reduced temperatures.

Insulation thicknesses for all insulations depend on the rated voltage, the conductor size and type of insulation. Minimum insulation resistance and test voltages have been established for all classifications.

For reprints of these pages write to address below.

Electrical Wire & Cable Department
Rockefeller Center • New York 20, N.Y



W.S.P.E.

(Continued from page 56)

However, it must be remembered that removing the contamination is not all of the problem. It must be disposed of. Usually, this would mean only placing it at a safe distance. Further, some of the dust is hard to remove, particularly from cracks and surfaces that trap dust.

Personnel decontamination is pretty easy, if sufficient water is available, and if means for disposing of the water are also in operation.

b. Thermal Radiation.

Roughly one-third of the energy of an atomic burst may be released in the form of thermal radiation. Most of this radiation is released within a very short period of time, with the result that impact of the radiation on objects or persons is in the form of a transient "heat flash."

Experiences show, however, that where readily ignitable materials exist, fires set by the thermal flash may continue to burn and may develop into large fires.

The main lesson for civil defense is that fire vulnerability from thermal radiation can be reduced in direct proportion to good housekeeping within a city. Good housekeeping includes keeping streets and alleys clean. It means keeping wooden structures, including fences, painted to prevent weathering.

Chapter News

FOX RIVER VALLEY CHAPTER

A joint meeting of the Fox River Valley Board of Directors and Chairmen of all Committees was held on October 5 at the Van Camps Club, Appleton. This was the kickoff for the Committee activities. An extensive program is now underway for the year ahead.

ETHICS AND PRACTICES COMMITTEE

KURT ROTH, Chairman

A procedure has been set up by the Ethics and Practices Committee for investigating and handling of complaints of violations. The procedure has been approved by the Board of Directors of W. S. P. E. It is intended to make the Chapter Ethics and Practices Committees a live and functioning unit with co-ordination at the state level and a means for action by Board direction.

ETHICS AND PRACTICE PROCEDURE

Step #1

If a complaint about Ethics & Practice is in order, as felt by any member of the society or non-member professional engineers or interested party, a complaint shall be placed in writing to any chapter committee man of that area.

Step #2

Each chapter committee member receiving a written complaint shall consult his chapter chairman either at the next meeting of the committee or, if time is of an essence, shall call said chairman for proper disposition. It shall be the duty of each chapter to investigate all complaints and file a report with the chairman of the state committee. If after investigation it is decided that the complaint is non-existent, it shall be so stated to the complaining member or non-member with a copy to the State Chairman. If the chapter chairman feels that State action should be taken the case shall be referred to the chairman of the State committee with a copy of such letter to the chapter board.

Step #3

The chairman of the State committee will be responsible for conducting the further investigations and when necessary checking with Legal Counsel whether further action is advised.

Step #4

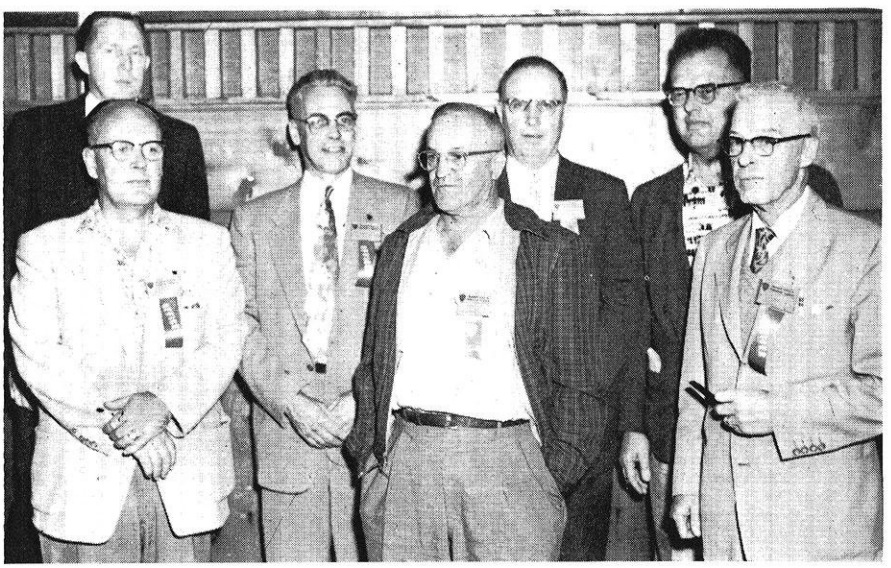
It shall be the duty of the State Chairman, if further action is required than normal procedure, to present the case to the state board for a decision.

Step #5

If the State Board's decision is such that a case should not be carried any further. It shall be the duty of the State Chairman to inform all parties concerned.

Step #6

If it is the decision of the board to carry the case to completion. It shall be the duty of the State Chairman to contact the Registration Board or Legal Counsel for further action. **END**



Officers of W. S. P. E. attending the Summer Conference at Genoa City. Left to right, Frank L. Carlson, Director; Clifford J. Nelson, 2nd Vice President; Arthur G. Behling, President; A. L. Genisot, 1st Vice President; W. E. Dick, Director; Harold N. Kingsbury, Secretary-Treasurer; A. Owen Ayres, Past President.

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MARTIN

Science Highlights

(Continued from page 49)

way program of 51 billion dollars will require an estimated 23 million tons of steel. Approximately half of this will go into bridges and overpasses. If welded design were able to save 20% of this requirement, we would save, on bridges alone, more than three times as much steel as was used for all highway purposes in 1954.

LEAD METANIOBATE

Pilot production of limited quantities of lead metaniobate, an unusual new high-temperature material with numerous possible defense applications in guided missiles and jet engines, was announced recently.

The lead metaniobate is a piezoelectric material, which gives off small voltages when acted upon by outside physical forces such as vibration. It retains most of its properties up to 500 degrees, Centigrade.

Earlier piezoelectric materials, such as barium titanate and lead zirconate, lost their properties at lower temperatures.

One application of the material is in missile accelerometers where high temperatures would be encountered from the "thermal barrier" of air particles at extremely high speeds.

The "push" of the missile's acceleration, acting upon the material, would produce a voltage which in turn could indicate the rate of acceleration or could be used in a control for the missile's motor.

Another possible application is in a safety device to detect and control excessive vibration which could damage jet engines. The device would be mounted directly on the engine, and the vibration acting on the lead metaniobate would produce the voltage to trigger a warning indicator or, through another control, to throttle back the engine.

The "Cat Eye", as announced recently by the Air Force, is approximately a thousand times more sensitive than the standard television camera, and permits pilots to "see in the dark with daylight clarity."

SULPHUR HEXAFLUORIDE —AN ELECTRON 'SPONGE'

Why is sulphur hexafluoride such a good insulating gas? Present studies of this and other gases to determine their insulating properties are finding the answer.

Sulphur hexafluoride is much like a "sponge" for low-energy electrons, soaking them up by forming negative ions of low mobility and velocity, so that no further ioniation can result. This electron attachment process has been studied by means of a mass spectrometer. Monoenergetic electrons, or electrons of a single energy, are projected into the gas and the resulting negative ions measured. This yields much more exact information than could be obtained in previous studies where the incident electrons possessed a wide range of energies.

From the studies, the cross section (probability of the atom being hit) of sulphur hexafluoride was found to be much greater than that which had previously been measured. This large cross section of the sulphur hexafluoride molecule makes it at least 10 times more efficient than any other attachment process yet discovered.

POWDER METALLURGY

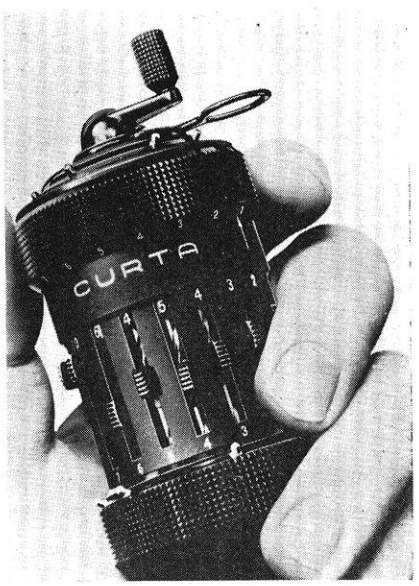
New applications of powder metallurgy will permit the "breaking" of heretofore unsolvable engineering problems in the design of aircraft.

The trend toward higher powered aircraft engines has created a demand for improved materials that can take higher operating temperatures.

Conventionally produced metals formerly used for certain aircraft engine parts do not contain the combination of characteristics needed in the new high-temperature gas turbine and jet propelled engines. In answer to the challenge, powder metallurgy has developed "new" materials during the last few years.

These materials consist of combinations of metals and non-metals which cannot be produced by any other presently known engineering method. The new materials made by powder metallurgy methods will permit the operation of aircraft engines at higher temperatures and, with considerably greater efficiency.

The automobile industry in the United States produced more than 500,000,000 parts made by powder metallurgy methods for automobiles and trucks during 1954. The powder metallurgy industry worked up more than 35,000,000 pounds of iron powder during that year. **END**

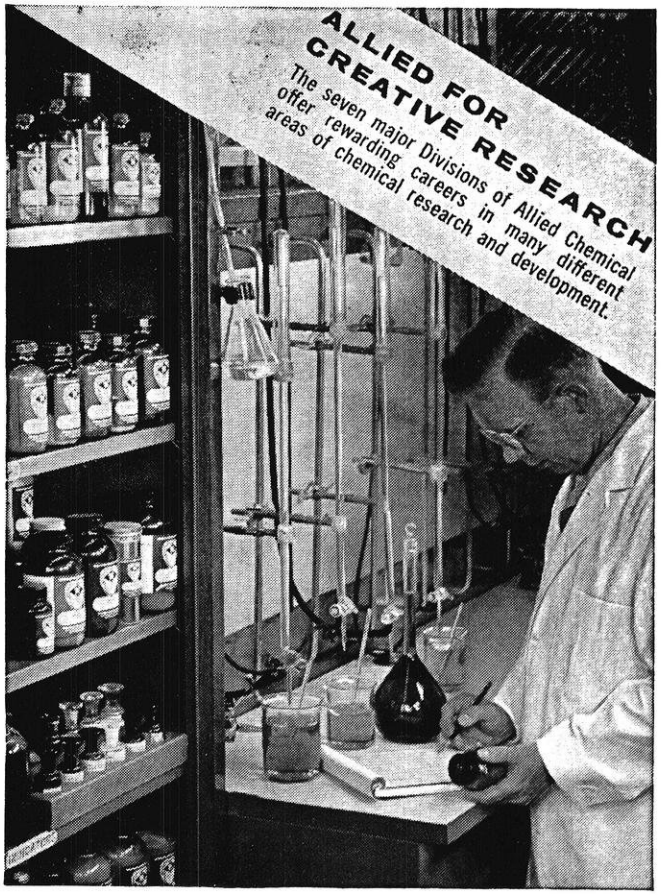


The uniqueness of the Curta Calculator lies in the fact that it performs calculations in much the same manner as large desk calculators, yet is small enough to be carried in one's pocket or brief case.

SOFT, SPRINGY FOAMS
and
FACT-FINDING CHEMICALS

HERE'S HOW THEY'RE

ALLIED



New urethane plastic foams have a mushrooming future. You'll find them everywhere — in your home as durable furniture upholstery, resilient carpet underlays, warm quilts and washable toys.

In laboratories, researchers rely on the purest chemical reagents to develop products like urethane for modern living.

Allied Chemical is in both laboratory and home. Allied's General Chemical Division markets over 1000 BAKER & ADAMSON reagents and fine chemicals, while National Aniline Division makes NACCONATE isocyanates, the key ingredient of urethane.

Another example of how the Company's seven producing divisions are allied to serve you better.

TRADEMARK PRODUCTS INCLUDE:

Baker & Adamson Reagents • Solvay Hydrogen Peroxide • Barrett Pipeline Enamels
Arcadian Fertilizers • A-C Polyethylene • Nacconate Isocyanates • Mutual Chromates

Allied Chemical

61 BROADWAY, NEW YORK 6, N. Y.

Turntables

(Continued from page 28)

The arm is supported by a needle-point pivot which is covered with a special silicone fluid. This fluid serves to absorb and dissipate any vibrations transmitted by the arm. Short, light arms will usually have resonant peaks at low frequencies unless some method is used to eliminate this effect.

During the recording operation, the stylus follows a radial, straight-line path. With a conventional pickup arm, it is inevitable that the line along which the stylus pivots will not be tangent to the record groove. Any discrepancy at any point is called tracking error.

Long arms help to reduce any tracking error. One method of eliminating this error has been employed in a relatively new arm on the market.

The arm is constructed of two rods of equal length. The cartridge is mounted between the rods. As the arm travels across the record, one arm becomes effectively shorter than the other, thereby turning the cartridge so that it is always tangent to the record grooves.

Every tone arm should have some means for adjusting the stylus pressure. This is usually accomplished with a system of sliding counterweights or springs. In view of present stylus pressures being on the order of a few grams, a change in pressure of two or three grams is very significant.

In summary then, the final selection of a high fidelity turntable or pickup can be made only after operation and construction of these components are understood.

A synchronous motor of the two-pole, four-pole, or hysteresis type must rotate the record at a constant speed. Because a hysteresis motor does not have hum problems or speed fluctuation, as do the others, its cost is much larger. The two-pole motor is the least desirable. A four-pole motor is found in most medium-priced turntables.

In order to provide a choice in turntable speeds, several methods have been developed. The direct-drive system, although the best, is too costly. The simplest and most dependable method is through the use of an idler wheel. For continuously variable speeds, a conical pulley is mounted on the motor shaft.

The best turntables are cast of a non-magnetic metal, and they are machined and balanced for smooth rotation. Coverings of rubber or rubber impregnated cork reduce electrostatic charges and dust collection.

Turntables should be at least as large as the record they must support. Overhang will result in excessive slip-page and uneven record wear.

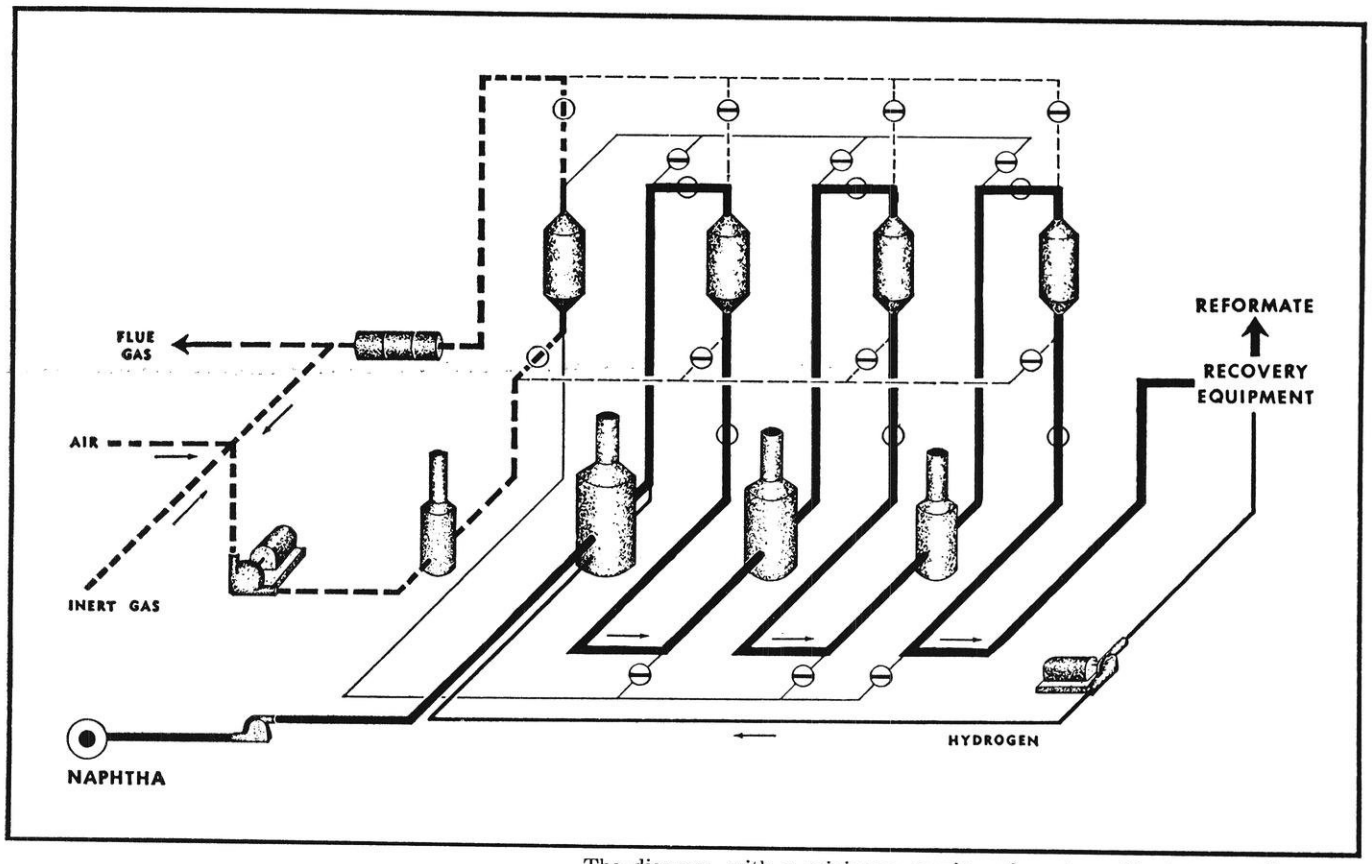
A record changer serves only one purpose: to provide uninterrupted music for several hours. There are so many disadvantages that a serious listener should not buy a record changer. Better turntables can be purchased for the same amount of money.

The stylus, which converts the record striations into mechanical motion, must be made of suitable material. Steel is very unsatisfactory because of its effects toward poor reproduction and record wear. Yet the better reproduction and longer record life through the use of osmium are not good enough for high fidelity reproduction. A sapphire stylus is better than osmium, but it doesn't last. The best stylus now available is made from diamonds. Besides its excellent reproduction and longer life, it will outlast sapphire by at least twenty times.

The cartridge, which generates an electric current, must reproduce every lateral movement of the stylus. Ceramics have been developed which will reproduce all audible frequencies. Crystal cartridges do not have the frequency response for true high fidelity sound systems. Magnetic cartridges are used almost exclusively because of their low distortion and wide response.

Tone arms carry the cartridge and maintain the stylus in the correct relation to the record. Manufacturers have taken great precautions to eliminate resonant effects which impair reproduction. Tracking error has been corrected in most expensive tone arms, but most inexpensive arms are not corrected in any way. The pressure of the stylus on the record has much to do with the sound reproduction. Almost all tone arms are capable of being adjusted, either through the use of sliding counterweights or springs.

END



The diagram, with a minimum number of reactors, illustrates cyclic regeneration. Piping arrangement permits the swing reactor to substitute for any other reactor in the system. High activity of catalyst is maintained —without interrupting production—in the ULTRAFORMING process.

HOW TO KEEP $1,000,000 WORTH OF CATALYST ON THE JOB

When you have a million dollars' worth of platinum catalyst in a single refinery unit, you hope you can keep it steadily on the job. That's too much money to be standing around idle. Also, you'd like to keep the catalyst working at high efficiency.

Most catalysts lose activity with use. The platinum that "reforms" 40-octane gasoline to 100-octane gasoline is no exception. And the higher the octane number, the faster the catalyst loses activity.

For years activity could be restored only by taking the catalyst out of the unit and sending it away for special treatment. To keep from having too many of these shutdowns, refiners had to operate at relatively low octane numbers.

Standard Oil research scientists came up with a better answer. They developed a new type of platinum catalyst, and they learned how to regenerate it repeatedly—while it is still in the unit. When a swing reactor is provided, the unit need not even be shut down. The new process is called ULTRAFORMING.

During a year of ULTRAFORMING at Texas City, one reactor was regenerated 53 times. The unit is still producing 100-octane gasoline.

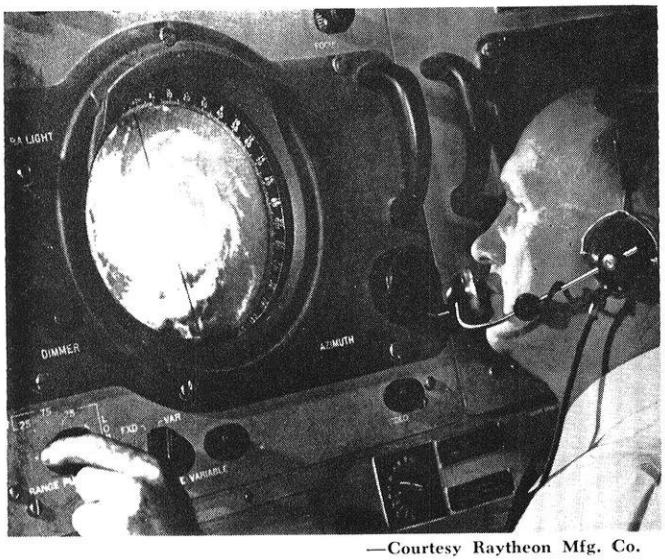
ULTRAFORMING also gives high yields of by-product hydrogen. The hydrogen can be used in upgrading other oil products. Or, it can be reacted with nitrogen from the air to make ammonia.

ULTRAFORMING is only one of the many major achievements credited to the scientists who have made careers at Standard Oil.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD



—Courtesy Raytheon Mfg. Co.

Storm detector radar sets such as these provide a powerful tool for meteorologists.

Radar

(Continued from page 22)

activity, which is often a hazard and always a discomfort in airline operations, can be avoided by the use of radar.

The development of microwave radar has given meteorologists a new tool with which to do their work. Weather echoes were first discovered in the early operational use of microwave radar and were called "weather clutter", because they tended to obscure aircraft targets.

A few progressive military meteorologists used radar to track showers during the war, but little was known of the full potentialities and limitations of this new weather instrument. In using radar to track the weather, the targets are raindrops and snowflakes—cloud drops are usually too small to be "seen".

Almost at once it was apparent that radar could be used to track convective showers, approaching cold fronts, and the like and so yield a fairly precise, very short-range forecast of the arrival of such storms. This can be important at an airport where a half-hour warning of a violent local storm is often sufficient.

Radar gives a nearly continuous picture with excellent detail. On the other hand its range is limited by the curvature of the earth to the order of 200 miles and it "sees" only precipitation. The later limitations are not too serious because precipitation accompanies almost all interesting weather phenomena,

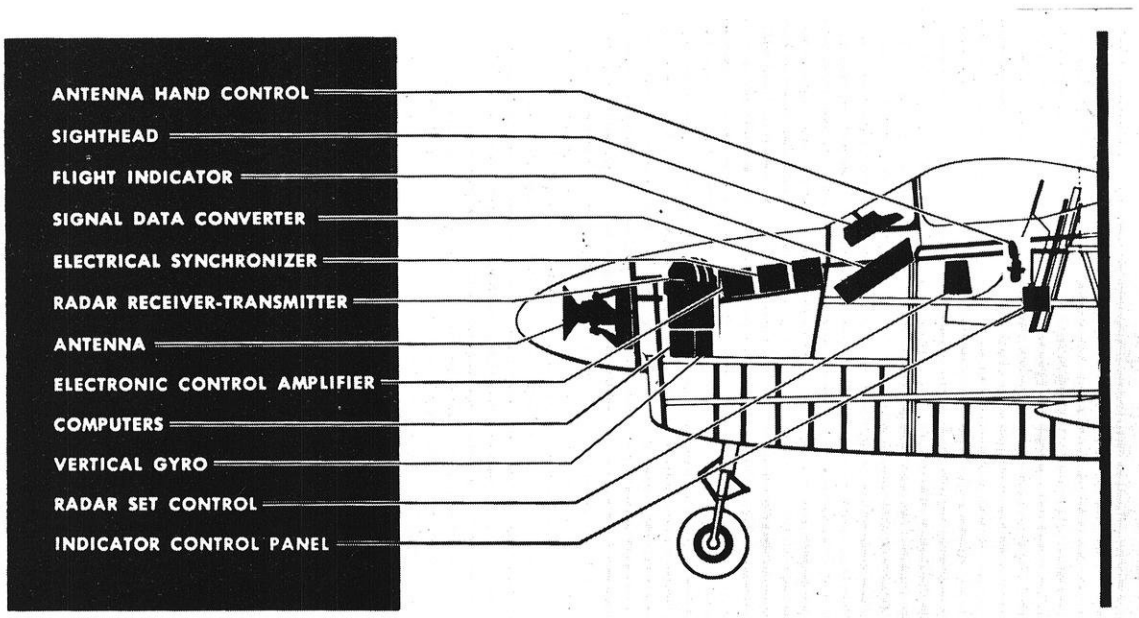
As with any new instrument, new concepts and methods must be developed to use it effectively. As previously stated, radar is most valuable for very short-range forecasting. This means that it will be most immediately useful for giving warnings of tornadoes and severe thunder storms. Along the East Coast radar offers a useful supplementary means for tracking hurricanes.

Airborne radar is now being used in commercial planes since designers have been able to get the weight down to 200 pounds. A picture screen is provided for both the pilot and navigator. Each screen shows azimuth and range information.

The scanning antenna mounted in the nose of the plane, emits either a fan or pencil shaped beam. Used primarily for mapping purposes, the fan beam scans the area below and in front of the plane at selected ranges up to 100 miles. The scanned area appears on the picture screen as a relief map showing cities, lake, mountains, and other terrain data. The pictures can be related readily to maps of the area under the plane.

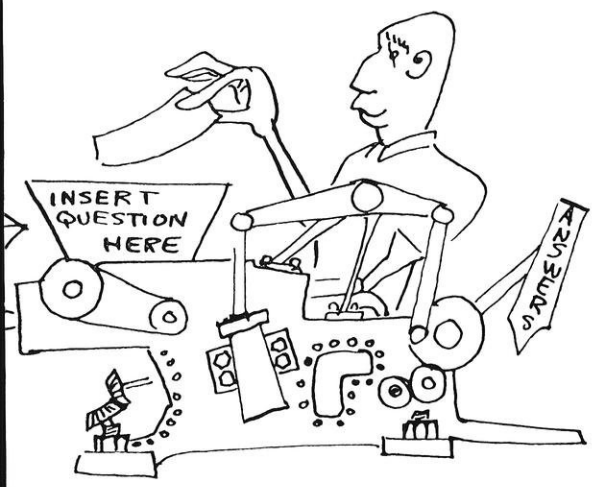
For navigation at long or short ranges the pencil beam is used. The picture screens display coded identification signals from a ground radar station. Navi-

(Continued on page 68)



—Courtesy North American Aviation, Inc.

A typical aircraft radar system installation.



FINAGLE FACTORS

Ed. Note: This feature will be carried each month. You may find this page helpful in the future so why not save the whole series.

Multiply	*By*	*To Get*
Abamperes	10	amperes
Abamperes	$3x10^{10}$	statamperes
abamperes per sq cm	64.52	amperes per sq inch
abampere-turns	10	ampere-turns
abampere-turns	12.57	gilberts
abampere-turns per cm	25.40	ampere-turns per inch
abcoulombs	10	coulombs
abcoulombs	$3x10^{10}$	statcoulombs
abcoulombs per sq cm	64.52	coulombs per sq in
abfarads	10^9	farads
abfarads	10^{15}	microfarads
abfarads	$9x10^{20}$	statfarads
abhenries	10^{-9}	henries
abhenries	10^{-6}	millihenries
abhenries	$1/9x10^{-20}$	stathenries
abmhos per cm cube	$1.662x10^2$	mhos per mil foot
abmhos per cm cube	10^5	megmhos per cm cube
abohms	10^{-15}	megohms
abohms	10^{-6}	microhoms
abohms	10^{-9}	ohms
abohms	$1/9x10^{-20}$	statohms
abohms per cm cube	10^{-5}	microhms per cm cube
abohms per cm cube	$6.015x10^{-6}$	ohms per mil foot
abvolts	$1/3x10^{-10}$	statvolts
abvolts	10^{-8}	volts
acres	43.560	square feet
acres	4047	square meters
acres	$1.562x10^{-3}$	square miles
acres	5645.38	square yards
acres	4840	square varas
acre-feet	43.560	cubic feet
acre-feet	$3.259x10^5$	gallons
amperes	1/10	abamperes
amperes	$3x10^9$	statamperes
amperes per sq cm	6.453	amperes per sq inch
amperes per sq inch	0.01550	abamperes per sq cm
amperes per sq inch	0.1550	amperes per sq cm
amperes per sq inch	$4.650x10^8$	statamperes per sq cm
ampere-turns	1/10	abampere-turns
ampere-turns	1.257	gilberts
ampere-turns per cm	2.540	ampere-turns per in
ampere-turns per inch	0.03937	abampere-turns per cm
ampere-turns per inch	0.3937	ampere-turns per cm
ampere-turns per inch	0.4950	gilberts per cm
ares	0.02471	acres
ares	100	square meters
atmospheres	76.0	cms of mercury
atmospheres	29.92	inches of mercury
atmospheres	33.90	feet of water
atmospheres	10,333	kg per sq meter
atmospheres	14.70	pounds per sq inch
atmospheres	1.058	tons per sq foot
Bars	$9.870x10^{-7}$	atmospheres
Bars	1	dynes per sq cm
Bars	0.01020	kg per square meter
Bars	$2.089x10^{-3}$	pounds per sq foot
Bars	$1.450x10^{-5}$	pounds per sq inch
board-feet	144	cubic inches
British thermal units	0.2530	kilogram-calories
British thermal units	777.5	foot-pounds
British thermal units	$3.927x10^{-4}$	harsepower-hours
British thermal units	1054	joules
British thermal units	107.5	kilogram-meters
British thermal units	$2.928x10^{-4}$	kilowatt-hours
Btu per min	12.96	foot-pounds per sec
Btu per min	0.02356	horsepower
Btu per min	0.01757	kilowatts
Btu per min	17.57	watts
Btu per sq ft per min	0.1220	watts per square inch
bushels	1.244	cubic feet
bushels	2150	cubic inches
bushels	0.03524	cubic meters
bushels	4	pecks
bushels	64	pints (dry)
bushels	32	quarts (dry)
Centares	1	square meters
centigrams	0.01	grams
centiliters	0.01	liters

Multiply	*By*	*To Get*
centimeters	0.3937	inches
centimeters	0.01	meters
centimeters	393.7	mils
centimeters	10	millimeters
centimeter-dynes	$1.020x10^{-3}$	centimeter-grams
centimeter-dynes	$1.020x10^{-8}$	meter-kilograms
centimeter-dynes	$7.376x10^{-8}$	pound-feet
centimeter-grams	980.7	centimeter-dynes
centimeter-grams	10^{-5}	meter-kilograms
centimeter-grams	$7.233x10^{-5}$	pound-feet
centimeters of mercury	0.01316	atmospheres
centimeters of mercury	0.4461	feet of water
centimeters of mercury	136.0	kg per square meter
centimeters of mercury	27.85	pounds per sq foot
centimeters of mercury	0.1934	pounds per sq inch
centimeters per second	1.969	feet per minute
centimeters per second	0.03281	feet per second
centimeters per second	0.036	kilometers per hour
centimeters per second	0.6	meters per minute
centimeters per second	0.02237	miles per hour
centimeters per second	$3.728x10^{-4}$	miles per minute
cm per sec per sec	0.03281	feet per sec per sec
cm per sec per sec	0.036	km per hour per sec
cm per sec per sec	0.02237	miles per hour per sec
circular mils	$5.067x10^{-6}$	square centimeters
circular mils	$7.854x10^{-7}$	square inches
circular mils	0.7854	square mils
cords	128	cubic feet
coulombs	1/10	abcoulombs
coulombs	$3x10^9$	statcoulombs
coulombs per sq inch	0.01550	abcoulombs per sq cm
coulombs per sq inch	0.1550	coulombs per sq cm
coulombs per sq inch	$4.650x10^8$	statcoulombs per sq cm
coulombs per sq inch	$3.531x10^{-5}$	cubic feet
cubic centimeters	$6.10x10^{-2}$	cubic inches
cubic centimeters	10^{-6}	cubic meters
cubic centimeters	$1.308x10^{-6}$	cubic yards
cubic centimeters	$2.642x10^{-4}$	gallons
cubic centimeters	10^{-3}	liters
cubic centimeters	$2.113x10^{-3}$	pints (liq)
cubic centimeters	$1.057x10^{-3}$	quarts (liq)
cubic feet	$2.832x10^4$	cubic cms
cubic feet	1728	cubic inches
cubic feet	0.02832	cubic meters
cubic feet	0.03704	cubic yards
cubic feet	7.481	gallons
cubic feet	28.32	liters
cubic feet	59.84	pints (liq)
cubic feet	29.92	quarts (liq)
cubic feet per minute	472.0	cubic cm per sec
cubic feet per minute	0.1247	gallons per sec
cubic feet per minute	0.4720	liters per second
cubic feet per minute	62.4	lb of water per min
cubic inches	16.39	cubic centimeters
cubic inches	$5.787x10^{-4}$	cubic feet
cubic inches	$1.639x10^{-5}$	cubic meters
cubic inches	$2.143x10^{-5}$	cubic yards
cubic inches	$4.329x10^{-3}$	gallons
cubic inches	$1.639x10^{-2}$	liters
cubic inches	0.03463	pints (liq)
cubic inches	0.01732	quarts (liq)
cubic meters	10^6	cubic centimeter
cubic meters	35.31	cubic feet
cubic meters	61.023	cubic inches
cubic meters	1.308	cubic yards
cubic meters	264.2	gallons
cubic meters	10^3	liters
cubic meters	2113	pints (liq)
cubic meters	1057	quarts (liq)
cubic yards	$7.646x10^5$	cubic centimeters
cubic yards	27	cubic feet
cubic yards	46,656	cubic inches
cubic yards	0.7646	cubic meters
cubic yards	202.0	gallons
cubic yards	764.6	liters
cubic yards	1616	pints (liq)
cubic yards	807.9	quarts (liq)
cubic yards per minute	0.45	cubic feet per second
cubic yards per minute	3.367	gallons per second
cubic yards per minute	12.74	liters per second

Radar

(Continued from page 66)

gators can, therefore, obtain a "fix" of the aircraft's position. When crossing large bodies of water where ground aids to navigation are not present, navigators may "zero" on distant radar beacons by using the long range sensitivity of the equipment.

Radar has been used as a tool in locating faults on overhead lines, underground power cables, and multi-conductor control and communication cables.

It works like this: a pulse of energy is sent over a line or cable and a portion of the energy is reflected by the discontinuity back to the receiver, where it is detected. The transmitted and received pulses are displayed on a cathode ray tube and a ranging device is provided to measure the time interval between the transmitted and received pulses.

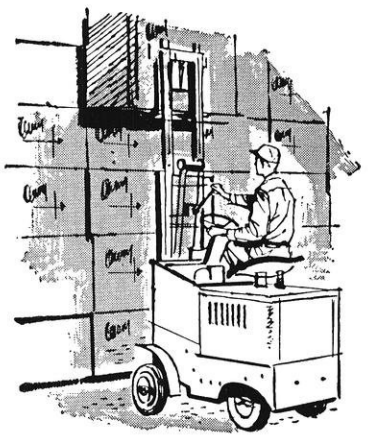
Ever since radar has been used for clocking automobiles, the question "How accurate is it?" has been raised. According to J. Q. Brantley, Jr., Consultant, Traffic Department, City of Buffalo, Buffalo, New York, speed errors made by the radar were almost always in a direction which favored the passing vehicle. The one exception occurred when observations were made with the engine in the radar car idling. Radar then consistently overestimated actual speed.

Thus radar and its magic sounds like "the things that dreams are made of." In 1911 it sounded fantastic, but in 1956 it is a reality. This truly is a great tribute to man's scientific development. From the meager beginning as a freak phenomenon of radio transmitting to the exacting science it is today, radar has been developed by the brains, work, and sweat of many scientists.

With radar no longer can enemy planes or ships move in to strike when visibility is poor. The ever-searching radar eye spots them and soon our radar aimed guns will find the mark. **END**

NEW DEPARTURES OF TOMORROW

TOMORROW: Use no hands! For in this magic warehouse, orders fill themselves in seconds—electronically.



TODAY: Leading lift truck manufacturers rely on New Departure "sealed and lubricated-for-life" ball bearings to carry rugged loads without "downtime" or adjustments for wear.

Here's tomorrow's "look" in warehousing! **Electronically, orders are received, checked against inventory, assembled, packed, wrapped, labeled, and whisked to shipping—untouched by human hands!**

When this futuristic "stock-chaser" takes shape, its intricate moving parts will turn on New Departure ball bearings . . . preferred throughout industry for their accuracy, dependability, and service-free performance.

As every engineer knows, New Departure can be relied upon to look to the future while serving dependably today.

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

GM GENERAL MOTORS

NEW DEPARTURE

BALL BEARINGS

NOTHING ROLLS LIKE A BALL

Engine Ears

(Continued from page 42)

combustion stability studies, flame stabilization and physical measurement instrumentation development.

Mr. Haddock received his B.S. degree in chemical engineering from the University of Wisconsin. His professional affiliations include membership in the American Institute of Chemical Engineers, the California association of professional engineers, Tau Beta Pi, and Sigma Xi.

POLYGON BOARD PROJECTS

Polygon, the engineering campus coordinating body for all engineering societies is proud to announce that $2970 profit was made at the highly successful Engineering Exposition this past spring.

Of this amount $500 will be used for improvement of the facilities of the Engineering campus. The remainder will be divided among the Engineering Societies for use in defraying operating expenses until the next Exposition in 1959.

We are open to suggestions as to the best use of the $500 as noted above. Please contact your Society officers or drop suggestion in Polygon mail box in the M. E. building.

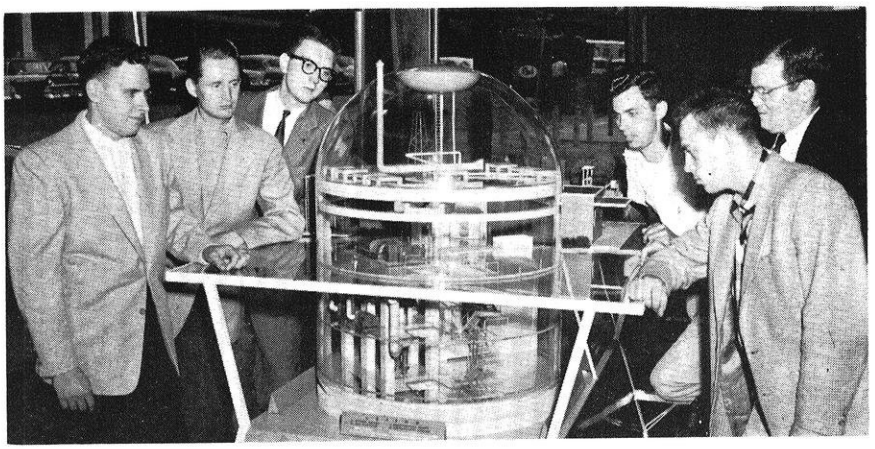
Other projects presently being considered are:

1. Outstanding Student Award: A scholarship and leadership award to be presented to the outstanding Senior each year by Polygon.
2. Coordination of meeting nights to avoid conflicts between Engineering societies and fraternities. A workable schedule was proposed and accepted at the first meeting by the presidents of societies and fraternities concerned. Watch the bulletin boards for further word.
3. A suggestion that Polygon expand its membership to include representatives of Engineering fraternities has been tendered and will be discussed at the next meeting of the Board.

We expect to continue this column in future editions with news about progress on the Engineering campus.

All engineers are welcome to attend our meetings which have been scheduled per new schedule every other Tueesday evening at 7:00 p.m. in Room 353 of the M. E. building.

Welcome to all the new freshmen.



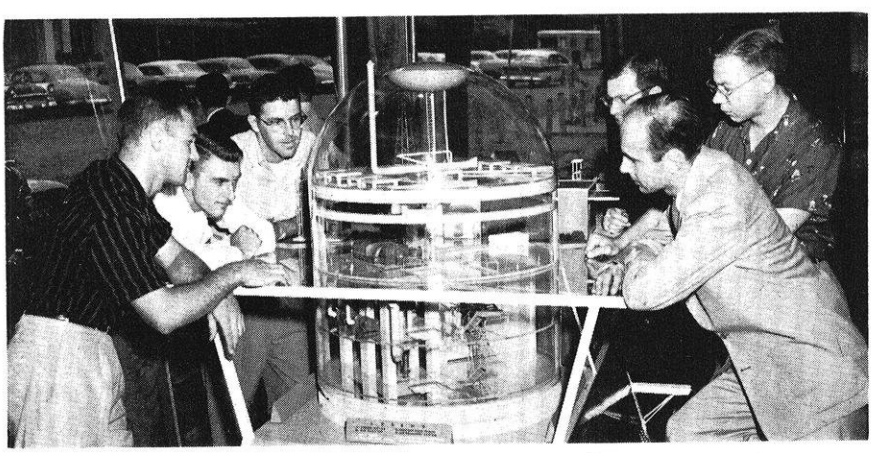
Participants in Allis-Chalmers' first engineering summer training program are: John Hren, Richard Gregory, James Wert, James Cockroft, and Arol Sherwin.

U.W. TRAINEES

Almost 50 undergraduate engineering students from 19 colleges and universities around the nation spent the summer at the Allis-Chalmers Manufacturing Co., in Milwaukee, Wis. They were participants in a special short-course project which is associated with the regular two-year graduate training program.

Participants in Allis Chalmers' first engineering summer training program from the University of Wisconsin were: John Hren, James Wert, James Cockcroft, Arol Sherwin, Richard Gregory, Richard Sobocinski, Reinhold Braun, Richard Kraemer, Russel Eckman, Raymond Riche, Paul Kitze, and Janis Pukite.

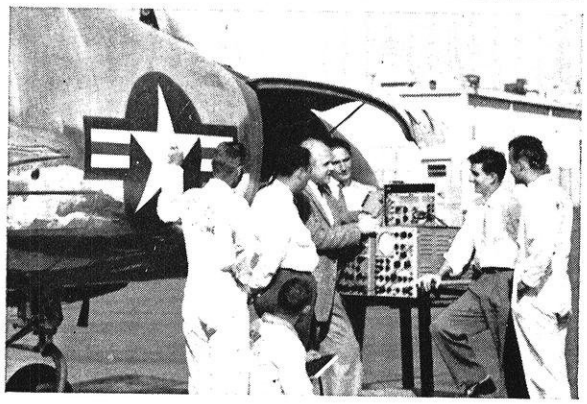
Much like the graduate trainees, who are preparing for permanent assignment within the big A–C organization, the summer trainees participated in choosing training locations that would help them in their fields. There were locations available in applied thermodynamics (steam turbines, condensers); fluid mechanisms (pumps, blowers); metallurgy (research); safety and sales. **END**



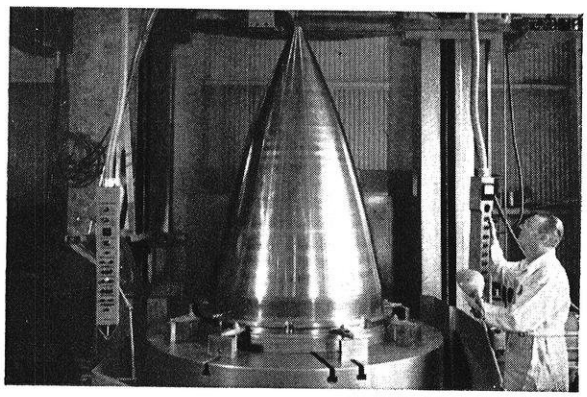
Richard Sobocinski, Reinhold Braun, Richard Kraemer, Russell Eckman, and Raymond Riche (from left) are pictured.

In which of these 3 activities does **YOUR FUTURE** *lie?*

RESEARCH AND DEVELOPMENT.
Projects of the engineers and scientists in this area at Hughes encompass practically every known field of electronics—and often border on the unknown. It is this team which is responsible for the Falcon air-to-air guided missile and the Automatic Armament Control System. Some of the projects include Microwave Tubes and Antennas, Digital and Analog Computers, Ground and Airborne Radar systems, long-range highly miniaturized communications equipment, and missile systems.



FIELD SERVICE AND SUPPORT.
Engineers in the Field Service and Support activity are responsible for the maximum field performance of Hughes-produced military equipment. Theirs is essentially liaison work with the company, airframe manufacturers, and the armed forces. Their recommendations are often the basis for important modifications. Openings exist for Engineers assigned to airbases and airframe manufacturers, Engineering Writers, Laboratory and Classroom Instructors, and Equipment Modification Engineers.



MANUFACTURING AND PRODUCTION.
In this area at Hughes technical experts are responsible for the development of production techniques for the manufacture of advanced electronic equipment from the Research and Development Laboratories. Some of the open areas include Engineers for Test Equipment Design; Quality Control; and Manufacturing Processes for semiconductors, automatic controls and miniaturized electronic systems.

You will find Hughes to be unsurpassed as a firm in which to begin a successful career. Last year, in fact, 327 June and February graduates joined the Hughes staff. Since then they have been working directly with the nation's finest scientists and engineers.

Hughes is the West's leading center for advanced electronics. The company's interest in electronics spans both the military and commercial fields. Whether you choose Research and Development, Field Service and Support, or Manufacturing and Production, you will be rewarded with a top salary, a challenging future, and the ideal climate of Southern California.

If you are interested in the long-range opportunities available at Hughes, contact your college or university placement office or mail a resume to us today.

Scientific Staff Relations

HUGHES

Research and Development Laboratories
HUGHES AIRCRAFT COMPANY
Culver City, California

Motoroils

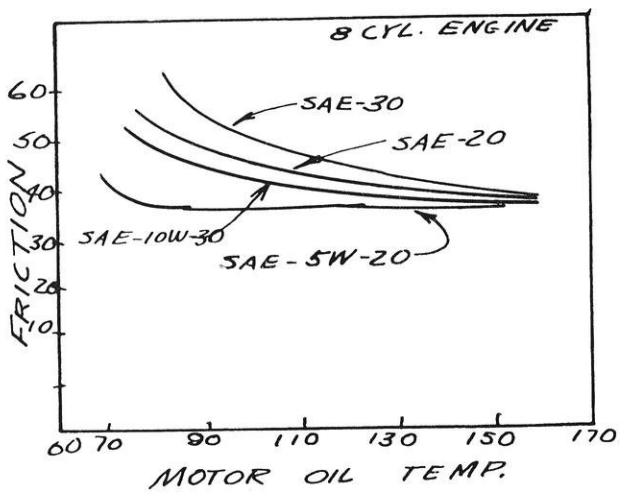
(Continued from page 36)

3. Less combustion chamber deposits and octane requirement increase.

All three companies found that multigrade oils could improve the fuel economy of cars driven short distances at a time, but as the distance traveled went up, gas savings went down. This is because multigrade oils reduce engine friction during the warmup period. On short trips the engine does not get really warm, resulting in greater friction than when driving on a long trip.

The tests performed by the Union Oil Corp. showed that gas savings up to 10 percent could be expected for typical passenger-car driving at moderate temperatures. Larger savings up to 25 percent could be expected on very short trips in cold weather. Gasoline savings appeared to have a minimum value of about 3 percent even for long trips with a hot engine.

The wear shown on the critical engine parts of some cars using multigrade oils showed about the same as



with conventional oils, while some other tests showed that in engines using multigrade oils, the wear on engine parts was as little as one fourth that on engines using conventional oils.

California Research, in both laboratory tests and field experience, found that an SAE–10W–30 multigrade oil operated with leaded commercial gasoline reduced the "no noise" octane needed by four numbers as compared with conventional SAE–30 oil. General Motors researchers found that multigrade oils gave an engine operation exceptionally clean as to varnish and sludge.

In a report by Mr. C. A. Hall from the Ethyl Corp. in Detroit, Michigan, more evidence was presented in favor of multigrade oils. A part of Mr. Hall's report follows:

". . . These new oils take advantage of the beneficial effect of increased oil volatility on both octane-requirement increase and surface ignition. (The higher volatility of the oils lowers the octane number of the gasoline used to prevent knocking and erratic firing.) Besides reducing the "noise" effects of deposits, these multigraded oils provide additional benefits to the motorist through easier cold weather starting and improved fuel economy. The latter benefit results from a reduction in friction losses, particularly during periods of engine warm-up. These beneficial characteristics are achieved without sacrificing oil consumption properties.

"The multigraded oils are made by blending distillate oils which boil within relatively narrow ranges. The high-boiling fractions, which increase deposit formation in conventional oils, and the low-boiling fractions, which promote high oil consumption, are eliminated. Viscosity index improvers are added to these low viscosity oils in order to raise their viscosity at engine operating temperatures. The high viscosity index of the final blend often permits the oil to meet the viscosity specifications of several different SAE grades. These new oils also contain large amounts of other additives, such as oxidation inhibitors and detergents which provide good engine cleanliness characteristics.

"These new oils are also effective when used in engines which already contain stabilized combustion-chamber deposits accumulated with conventional engine oils. A modern new V–8 passenger car was first operated on a conventional straight-mineral oil until the octane requirement for ordinary knock had stabilized at 185 hours. An SAE–10W–30 oil was then put into the automobile. After 50 more hours of operation, the ordinary knock requirements had decreased three octane numbers, and the audible surface ignition requirements had dropped about eight octane numbers. Similar results have been obtained by other tests."

From these reports, it can be seen that the answer to the question given previously is "yes, the multigrade oils are worth the extra added investment".

In summary then, it can be seen that the greatest problem of lubrication of automobile engines is presented in cold weather starting. At such times the greatest wear occurs. The solution to this problem is to get oil circulating in the engine as soon as possible. This is not possible with a heavy oil needed to stand up under severe operating conditions at high engine temperatures.

The second most important cause of wear is the mechanical and chemical erosion that takes place in an engine that does not get warmed up very often.

To correct the lack of oil at cold starting, use an SAE–5W–20 oil in cold weather and an SAE–10W–30 oil in warm weather.

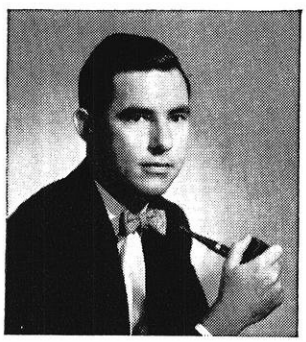
To prevent the erosion from acid and particles of dirt and carbon in the oil, give the automobile a periodic long, hot run in all seasons. Also, drain and change the oil frequently.

END

George Lincoln asks:

What do metallurgists do in a chemical company?

GEORGE M. LINCOLN, JR., expects to receive his B.S. in metallurgical engineering from Lehigh University in 1957. George was vice president of his junior class, is active in sports, and a participant in many other campus activities. He's starting his employment investigations early, for he feels that the selection of an employer is one of the most important decisions in a man's career.



CHARLES I. SMITH, JR., received his B.S. Ch.E. from V.P.I. in 1943, served in the Navy as an engineer officer, and joined Du Pont's Engineering Department in 1946. Since then, he has advanced steadily through a number of interesting assignments at various Du Pont plants. He was recently promoted to manager of the Technical Section of Du Pont's Pigments Department.

Charlie Smith answers:

They have an almost endless variety of interesting problems to face, George. As a student of metallurgy, you know that about two-thirds of all known chemical elements are metals. Many of them are revealing valuable new applications, when highly purified on a commercial scale. Du Pont is greatly interested in several metallic and semi-metallic elements.

My own experience at Du Pont ranges from work on titanium pigments, to metallic titanium production, and to the ultra-pure silicon used in transistors. You can appreciate some of our metallurgical problems when I point out that impurities in transistor silicon have to be below one part in 100 million. That's equivalent to one pound of impurities distributed through a train of ore cars twenty miles long!

Some of our metallurgists carry out fundamental research on new metals, and, in the development stage, they frequently operate pilot plants for producing them. Other metallurgists study problems relating to engineering materials used in construction, carry out research on intergranular corrosion, or investigate fatigue relationships encountered in dynamic, high-pressure operations.

You'll find many challenging opportunities in every phase of metallurgy at Du Pont, George.

Metallurgists and Metallurgical Engineers can find some of Charlie Smith's challenging new problems described in "Engineers at Du Pont." For a free copy of this booklet write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington 98, Delaware.

DU PONT
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BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*
WATCH "DU PONT CAVALCADE THEATER" ON TV

Sneed's Review

(Continued from page 44)

Mechanical Engineering, Case Institute of Technology, have improved what previously was an excellent laboratory reference text for engineering students as well as a sound reference book for the practicing engineer. Measurement of technical and economic performance of machines and equipment is presented as a major engineering assignment, and attention is called to precise requirements of the codes and standards sponsored by various professional groups.

To keep this Fifth Edition within a convenient size, material of lesser current value has been deleted and new information of current importance added.

Recent trends, such as the greater use of electrical instruments and transducers and the study of the dynamics of the processes of flow and heat transfer, are reflected. Special emphasis is placed on the latest techniques for mechanical measurements, dynamic characteristics of processes, and automatic control. A new chapter deals with electro-mechanical instrumentation and another with the characteristics of automatic controls.—*McGraw Hill $7.00.*

CHEMICAL PROCESS INDUSTRIES

Second Edition by R. Norris Shreve

A one-volume "mine of information" for anyone interested in chemical and related industries.

This book by R. Norris Shreve, Consulting Chemical Engineer and Professor of Chemical Engineering at Purdue University, presents, in one volume, the modern methods used in the manufacturing of chemicals and chemical products—broken down into unit processes and operations by convenient flow sheets. Such important factors as data on chemical and physical changes and reactions, economic statistics and costs, energy and power required, etc., are covered. Where figures were available, quantities of materials required to produce the finished product are given.

Wide in scope, the book covers the manufacture of chemicals themselves, and includes full description of many manufacturing industries based on important chemical changes, such as the making of plastics, synthetic fibers, ceramics, paints, explosives, and pesticides.

Flow sheets are emphasized—this parallels the practice of the various chemical and allied factories where the flow sheet is considered the best method for studying and presenting a given process. Many new illustrations, as well as hundreds of tables, have been added. Copious up-to-date references are included—in these references the titles of the articles have been stated so that the reader can judge whether the reference meets his requirements.—*McGraw Hill $11.50.*

DYNAMICS OF MACHINERY

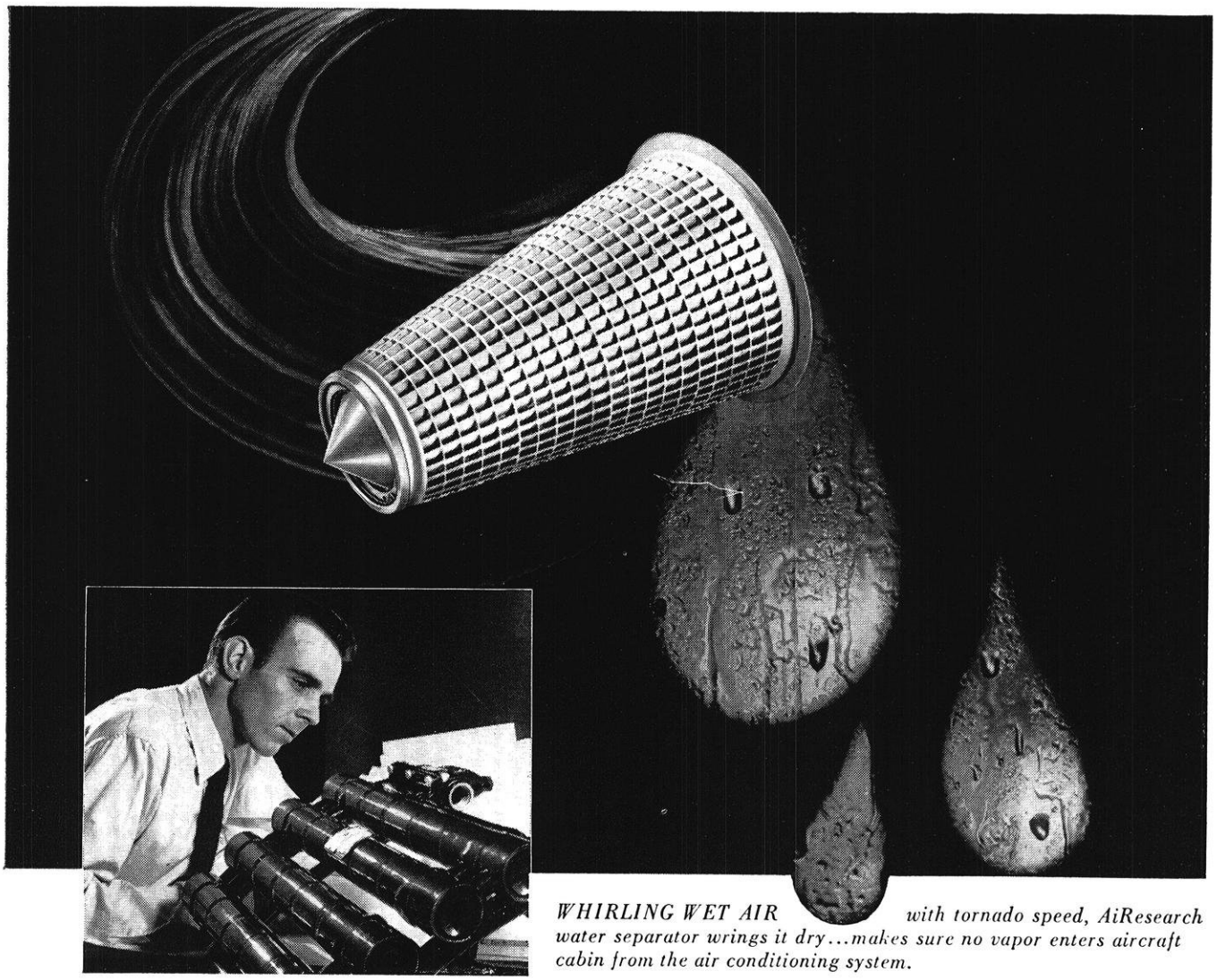
By James B. Hartman

Originality of view point and arrangement—Creative, as well as analytical thinking is encouraged.

James B. Hartman, Professor and Chairman of the Department of Mechanical Engineering at Lehigh University has written his book so that through the discussion of pertinate topics in dynamics, the reader is helped to acquire some of the techniques required for the design and control of modern high speed machinery and the analysis of its performance.

Some of the author's objectives are: 1) to extend two-dimensional consideration of kinematics and dynamics to the three-dimensional case, by means of vector notation; 2) to provide a transition from basic work in mechanics to more advanced work in dynamics; 3) to show the current practical applications of mathematics and dynamics; 4) to introduce the mechanical engineer to certain mathematical techniques now becoming widely used in the literature of automatic controls and servomechanisms.—*McGraw Hill $7.50.* **END**

To the engineer with a bent for research...



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All modern U.S. and many foreign aircraft are Garrett equipped. We have pioneered such fields as refrigeration systems, pneumatic valves and controls, temperature controls, cabin air compressors, turbine motors, gas turbine engines, cabin pressure controls, heat transfer equipment, electro-mechanical equipment, electronic computers and controls.

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AIRESEARCH INDUSTRIAL • REX • AERO ENGINEERING • AIR CRUISERS • AIRESEARCH AVIATION SERVICE

AIR CONDITIONING INSTITUTE

Wednesday, November 14, 1956

A. M.

8:30 Registration and first days sessions will be held in room 205, Babcock Hall located at corner of Linden and Babcock Drives on the Campus. Second and third days sessions will be held in room 6 of Temporary Building, T-16, located at the same intersection. Park cars in Area 60, Walnut Street lot. No permits needed. Bus service from lot every ten minutes.

9:10 Welcome and Introduction to Subject
Paul J. Grogan, Chairman, Engineering Extension Department, The University of Wisconsin

9:35 High Temperature Hot Water as a Heating Medium
Sam Sachs, Chief Mechanical Engineers, Skidmore, Owings, and Merrill, Chicago, Illinois

10:35 Break

10:15 Basic Types of Refrigeration for Production of Chilled Water
E. C. Decker, Machinery and Systems Division, Carrier Corporation, Milwaukee, Wisconsin

12:00 Lunch

P. M.

1:30 Meeting Load Requirements with Adsorption Equipment
James Yund, Chief Application Engineer, Servel, Inc., Evansville, Indiana

2:30 Break

2:45 Meeting Load Requirements with Centrifugal and Reciprocating Equipment
W. G. Wassmandorf, Manager, Reciprocating Compressor Department, The Trane Company, La Crosse, Wisconsin

4:15 Adjourn until 6:30 p. m.

6:30 Dinner Meeting—$3.50 per person, Hoffman House, 514 East Wilson Street, Madison, Wisconsin
Movie of 1956 Wisconsin football game.

Thursday, November 15, 1956

A. M.

8:45 Coils—Performance and Selection
Frank W. Loebl, Sales Engineer, Young Radiator Company, Racine, Wisconsin

9:40 Break

9:15 Hot and Cold Water Distribution Systems
John Lofte, Lofte and Fredericksen, Milwaukee, Wisconsin

10:15 Break

11:00 Factors Influencing the Design and Performance of Modern Centrifugal Pumps for Hot and Cold Liquid Application
G. W. Anderson, Division Sales Manager, Aurora Pump Division, New York Air Brake Company, Aurora, Illinois

12:00 Lunch

P. M.

1:20 Control of Water Systems
W. G. Young, Automatic Controls, Barber–Colman Company, Rockford, Illinois

2:20 Break

2:30 Panel Discussion on Water Systems
Chairman: N. J. Janisse, Assistant Chief Field Engineer, Johnson Service Company, Milwaukee, Wisconsin
Panel Members: Mr. Anderson, Mr. Decker, Mr. Flagg, Mr. Lofte, Mr. Wassmandorf, Mr. Young

4:30 Adjourn for Day

Friday, November 16, 1956

A. M.

8:45 Air Cooled Equipment and Evaporative Condensers
Herbert Wolf, Chief Engineer, Research and Development Section, Worthington Corporation, East Orange, New Jersey

9:45 Break

10:00 Cooling Towers for Air Conditioning
R. L. McFadin, Regional Manager, The Marley Company, Chicago, Illinois

10:50 Break

11:00 Water Treatment—As Related to Evaporators and Cooling Towers
....., Dearborn Chemical Company, Chicago, Illinois

11:50 Lunch

P. M.

1:20 Design Coordination
L. F. Flagg, Supervisor—Field Training, Minneapolis–Honeywell Regulator Company, Minneapolis, Minnesota

2:45 Award Certificates
Ralph D. Smith, Institute Coordinator

3:00 Final Adjournment

GENERAL INFORMATION

The general theme of this institute will be a study of water systems and their application in the field of air conditioning. This program will be of interest to architects, designers, contractors, mechanical engineers, operating engineers, and to other engineering personnel representing manufacturers of air conditioning equipment and accessories. This program is being put on in cooperation with the Wisconsin Chapter of the American Society of Heating and Air Conditioning Engineers.

A fee of $25.00 should accompany each application for enrollment. This fee will cover the cost of the course and materials but not the cost of room or meals.

Housing will be the responsibility of the enrollee. Reservations may be made directly with any of the following:

Hotel/Motel	Phone	Address
°Belmont	AL 5–7221	31 North Pinckney
°Edgewater	AL 6–9071	666 Wisconsin Avenue
Hamacher	CE 3–5357	5101 University Avenue
°Loraine	AL 6–0231	123 West Washington
Mayflower	AL 5–1333	South Park and Beltline
°Park	AL 5–6711	22 South Carroll
Vikingtown	CE 3–9733	4354 West Beltline Hy.

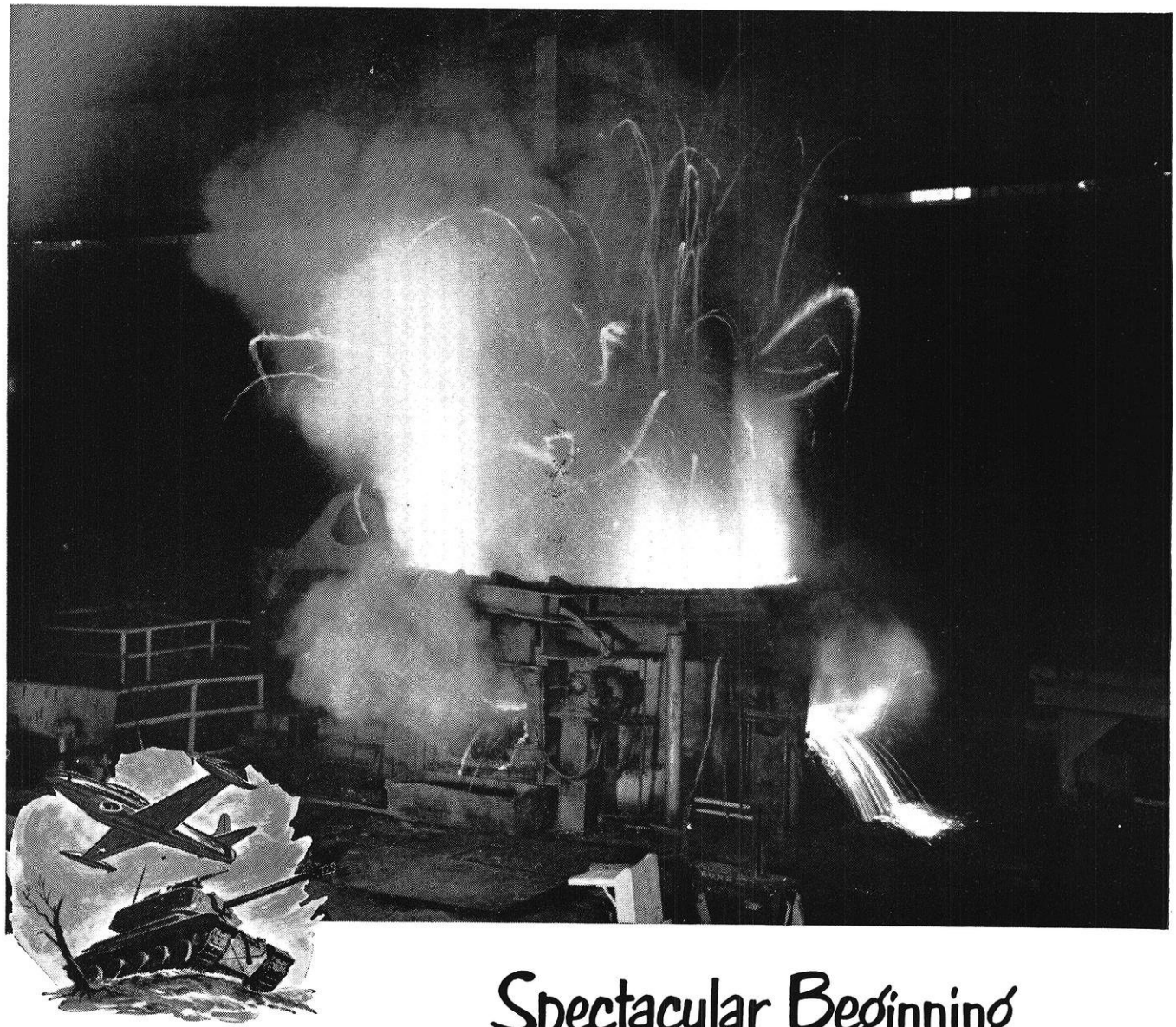
° Hotel

The meeting will convene in Room 205 of Babcock Hall, located at the corner of Babcock and Linden Drives on the Campus in Madison. The second and third days sessions will be held in Room 6 of Temporary Building, T-16, located at the same intersection.

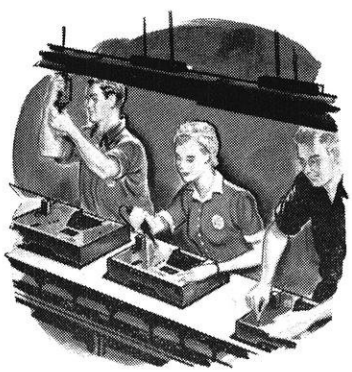
A certificate will be awarded to each person regularly enrolled who attends all sessions and satisfactorily completes the course.

Parking near the meeting room is not possible; however, there will be ample space in University lot 60 located at the intersection of Walnut Street and Willow and Linden Drives. There will be bus service from the lot past Babcock and T-16 every 10 minutes.

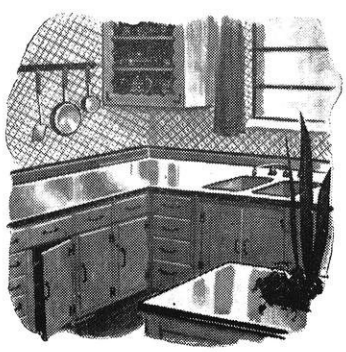
RALPH D. SMITH, *Institute Coordinator*



Spectacular Beginning of a SPECTACULAR STEEL



Special Steels for Armament for Industry for the Home



An electric furnace puts on a terrific show when we drop in a charge (as above) but it's only indicative of the great performance the steel will give later in service. For these are the high-alloy steels, stars of the metal world . . . the steels that give you so much more than they cost in resisting corrosion, heat, wear or great stress—or in providing special electrical properties. • That may be the field you'd like to enter in your business life. In any case, remember that whenever a finer steel is needed to cut costs, improve quality, or add sales appeal, we're the people to see. *Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pa.*

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POLYGON BOARD

September 30, 1955 to September 30, 1956

Cash Balance

Sept. 1, 1955		719.41

Cash Receipts

Dividends on Anchor Shares	30.00	
St. Pats—Ticket Sale	459.50	
Engineering Exposition Profits	2970.14	
Triangle Refund	10.00	
Remington Rand Refund	10.08	3479.72
Total cash Receipts		4199.13

Cash Disbursements

Keys		62.25	
Reynolds Award Fund		25.00	
Initial Contribution Exposition		100.00	
Badger Page		25.00	
Photo Service		4.00	
Button Design		15.00	
Scholarship Plaque		31.44	
Financial Service		15.00	
Polygon Folders		18.72	
Banquet		91.25	
Petty Cash		23.19	
Stationery		23.50	
St. Pat's Dance			
Band	90.00		
Refreshments	14.75		
Trophies	35.37		
M.C.	10.00		
Triangle & Prog.	10.00		
Tickets	41.00		
Advertising	19.76		
Decorations	10.16		
Rent	68.93		
Engraving	30.26		
Pictures	9.05	339.28	
Total cash Disbursements			733.63

Cash Balance

Sept. 30, 1956		3425.50

Also on Hand

Anchor Savings & Loan Assoc. Shares	1000.00

Ford

(Continued from page 13)

with even less tendency for front-end dive on quick stops and rear end dip on rapid starts, has been accomplished by increasing the length of the spring leaves ahead of the rear axle.

New live rubber mounts developed by Ford engineers are installed at 20 places between the body and the frame. The result is that the body rides on rubber, insulated from road vibration and noise.

For the first time, a high performance V–8 is available as an optional engine on any Ford car. This engine, the Thunderbird Special V–8, features a 9.7 to 1 compression ratio, and develops 245 horsepower. The high performance engine has a special four-barrel carburetor and displaces 312 cubic inches.

A 212 h.p. 292 cu. in. Thunderbird V–8 with 9.1 to 1 compression ratio is the standard engine for Fairlane, Fairlane 500 and station wagon models.

The standard V–8 for Custom and Custom 300 models is the 190 h.p. 272 cu. in. engine. Its compression ratio is 8.6 to 1.

The 144 h.p. 223 cu. in. six is available on all Ford cars.

All Ford engines can be ordered with Fordomatic, standard or overdrive transmission.

Major engineering changes which have brought improved performance include a new dry-type air filter which is more efficient than the former oil bath type; new low silhouette carburetors; new and larger intake manifold; bigger and higher lifting intake valves; recontoured compression chambers and camshafts; a new centrifugal-vacuum distributor; new rotor oil pump, and completely new exhaust system.

Ford's new styling starts with wide hooded headlights and a forward slanting grille, and includes streamlined wheel openings, a windshield that wraps further around the sides for better visibility, distinctive fins at the rear, and contoured sides that give the car a sculptured look.

"Hardtop" styling is the trademark of the conventional two door and four door sedans in the Fairlane and Fairlane 500 series. The effect is achieved with thin side pillars. Ford's true pillarless "hardtops," the four door and two door Victorias, also are offered in these series.

Station wagons have flatter roof lines, with a contoured step-down midway back from the windshield. At the back, the rear window and liftgate wrap around the sides to provide 20 per cent more opening for bulky loads. A new latch opens the entire tailgate with one pull, and the liftgate swings up automatically on concealed torsion bar springs.

Special side mouldings and ornamentation distinguish each of Ford's five series, which are available in 19 two-tone paint combinations or 12 solid colors. Inside, upholstery is color-matched to the body's paint.

(Continued on page 82)

"A new era is beginning...

"As I review the progress in aeronautics within so short a span, and marvel at the complex aircraft of today, I call it an achievement little short of miraculous.

"Today, electronically-guided planes take off and land without human touch. Lethal sky missiles seek and destroy invisible targets with uncanny precision. And still other fantastic achievements in both man-controlled and pilotless flight are now in the offing.

"When men go to the moon and planets, electronically-controlled skycraft will take them there. Aviation maps will be studded with stars as well as with cities. New developments in aeronautics will go on and on. Success opportunities and careers will continue to develop for ambitious young men in this exciting field where a new era is beginning."*

LEE De FOREST

Appropriately qualified to speak for aeronautics and other fields in which his own scientific achievements play an important part, Dr. Lee de Forest gives helpful counsel to young graduates headed for successful, rewarding careers.

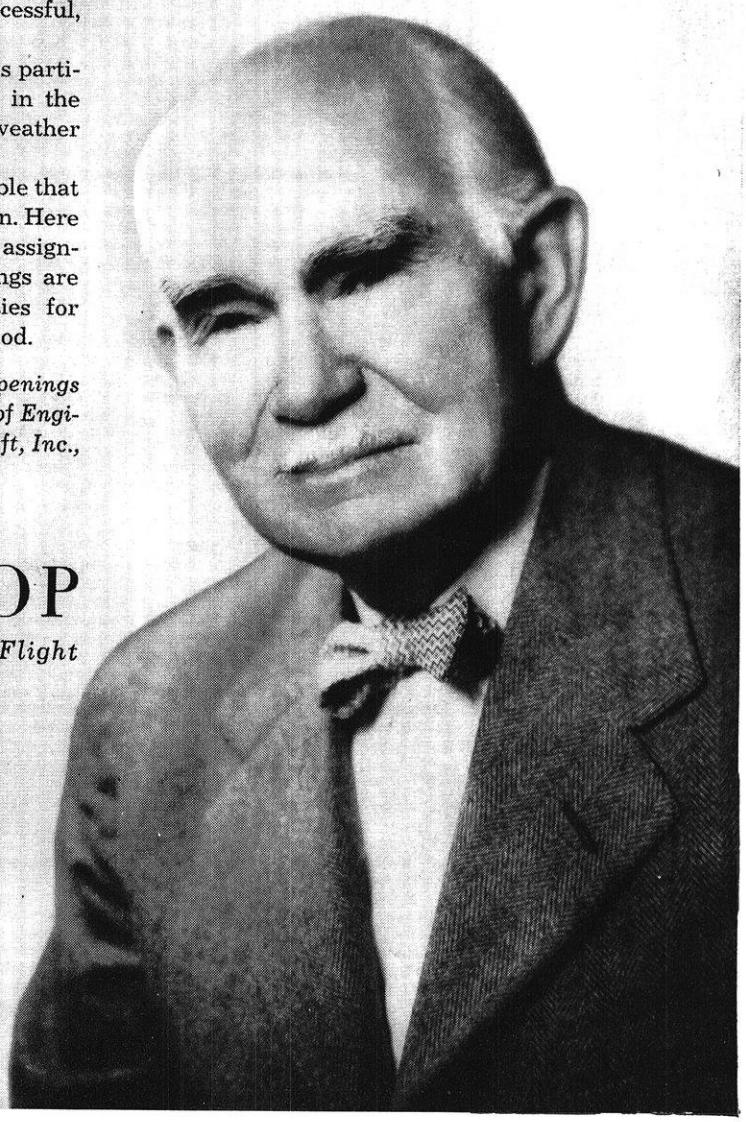
His expression, "a new era is beginning," has particular significance at Northrop, world leader in the design, development and production of all-weather and pilotless aircraft.

At Northrop, permanent positions are available that offer full play for individual talent and ambition. Here the graduate engineer will find interesting assignments for which he is best fitted. Surroundings are attractive, co-workers congenial, opportunities for advancement unceasing, the compensation good.

For detailed information regarding specific openings in your field of specialization, write Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., 1001 East Broadway, Hawthorne, California.

NORTHROP

Pioneers in All Weather and Pilotless Flight



*A statement by Dr. Lee de Forest, pioneer in radio.

Chevrolet

(Continued from page 11)

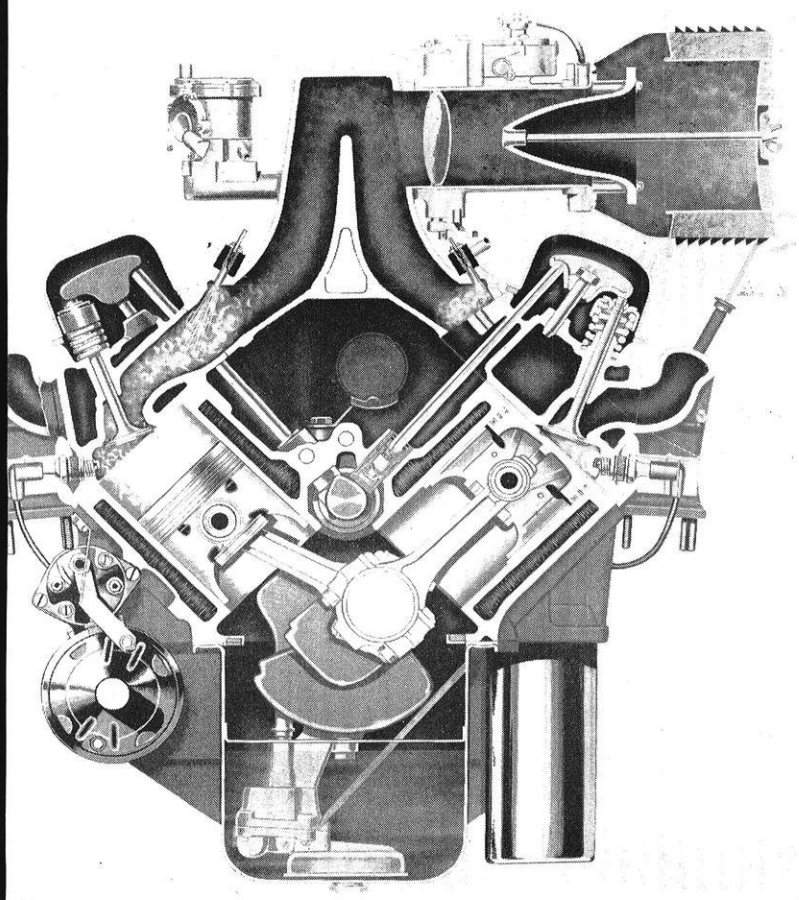
To power its 1957 line, Chevrolet will build one six and four new V8s ranging in output from 140-horsepower for the six to a sensational one-horsepower per cubic inch of displacement for the "Corvette V8." The Corvette engine develops 283-horsepower with the RAMJET fuel injection system.

Several instances of engineering progress are evident in the new chassis. "Ram's horn" exhaust manifolds aid engine breathing. Fourteen-inch wheels and lower pressure tires (22 pounds) further riding comfort and safety through greater traction. Crankshaft bearings are wider, longer wearing. Front suspensions and shock absorbers benefit from modifications.

Vehicle braking improves with a finer facing material that is less sensitive to temperature changes. The repositioning of rear outrigger springs promises better handling. Added bracing increases front-end rigidity and bumper strength. Batteries have been moved forward for convenient servicing. Axle ratios have been changed to provide top performance with the smaller wheels.

Powerglide, power brakes and power steering, and electric window lifts are again optional. The company also makes available the gas-saving overdrive and a close ratio manual transmission that assures lightning down-and-up-shifts.

While Chevrolet makes no extravagant claims for its fuel injection system, research with fuel injectors indicates an increase in economy, readier firing at low speeds, faster warm-up and elimination of carburetor icing. Another advantage is that a fuel injector requires less height than the carburetor. This could lead to an important reduction in hood lines.



Injector Requires Precise Mechanism

While the goal is well-known, the mechanics of fuel injection are complex and exacting. The system must not only deliver the correct proportions of air and gasoline to each of the eight cylinders in the Chevrolet engine, but requires a series of diaphragms and controls to cover the varied demands on a passenger car engine. Extremely precise parts and bearings of jewel-like consistency are reminiscent of the works of a finely built watch.

In the Chevrolet application, two separate castings replace the regular production intake manifold. The lower casting, made of iron, serves as the top cover of the engine while the upper aluminum casting mounts the air induction and fuel metering systems.

In operation, the accelerator pedal controls the volume of air and the air volume in turn determines the amount of gas delivered through the nozzles. A high-pressure pump, submerged in a fuel reservoir and driven by the distributor, supplies the force behind the gasoline.

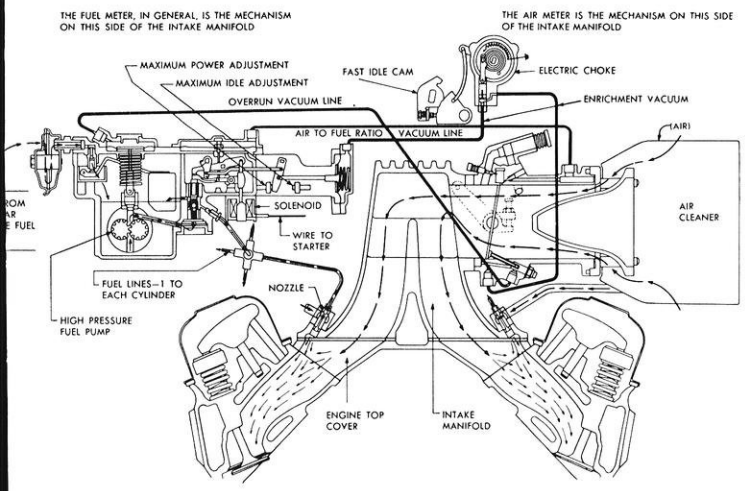
The gas pump delivers fuel to a metering chamber from which there are two outlets. The lower outlet leads to the nozzles and the upper to an overflow line. A plunger, sensitive to the flow of air in the system, meters the volume of gas directed toward the cylinders. Pressures at the .011-inch orifices of the nozzles measure up to 200 pounds per square inch, inducing a spray into the intake parts so fine that it could not be detected by the eye. The explosion driving the piston is from this point accomplished in conventional fashion.

An over-run feature provides for the cut-out of fuel pressure when the car is going down-hill or decelerating. A vacuum-operated diaphragm located over the high-pressure fuel pump opens a valve, thus releasing the pressure and preventing the injection of fuel into the intake ports.

Augmenting the basic system, Chevrolet's fuel injector covers provisions for fast engine starting in cold weather through a solenoid check on the fuel plunger and an electric choke. An oil-wetted air cleaner is used. The distributor is designed to permit timing adjustments without interference with the pump-driving mechanism.

New Automatic Transmission Promises Smoothness

Chevrolet's new Turboglide transmission heads a list of 1957 power train features that extend from the three-speed manual shift through an improved Powerglide automatic transmission and the gas-saving overdrive. Introducing a new design of the torque con-



verter type, the Turboglide is supplied only with the 283-cubic inch engine.

Superlative responsiveness, elimination of all automatic shifting and a newly developed "hill retarder" are a few of the innovations. According to Chevrolet, Turboglide gives nearly twice the torque multiplication delivered by standard torque converters, assuring a high brand of performance.

Differing from the usual automatic transmission, too, is the single forward driving position on the quadrant. This is possible, says the company, because the infinitely graduated torque multiplications from a standing start to highway cruising speed makes a step in the transmission unnecessary.

Mechanically, Turboglide consists of three turbines and two planetary gearsets combined with a variable pitch stator and the conventional torque converter pump enclosed in a die-cast aluminum housing. Drive of the transmission output shaft results from an ingenious coupling of the turbines and the gears. As the turning force of one of the turbines lessens, another takes over to maintain a constant positive drive.

In the hill retarder position, a turbulence is created in the oil in the converter to impart a drag on the rear wheels. This safety factor, patterned after a similar device developed for the automatic truck transmission by Chevrolet, is reputedly an exclusive feature.

Turboglide has several other design advantages. Important is the coaxial distribution of torque loads which decreases the chance of wear, and a reduction in the possibilities of leaks through elimination of many external attachments.

Although the 1957 Chevrolet boasts a number of improvements that will enhance the comfort and safety of driving, major interest of the chassis story is found in the greatest variety of power plants ever produced by a low price car builder. Offered in the Chevrolet passenger car line are one six- and four eight-cylinder engines, ranging in horsepower from 140 to 283. The six develops 140-horsepower. The eights range in horsepower from 283, 270, 250 and 245 for the "Corvette V8" to 220 for the Super Turbo-Fire "283", 185 for the Turbo-Fire "283" and 162 horsepower for the Turbo-Fire "265."

Each of the engines is improved mechanically, but the gain in power—up from a peak of 225 horses in the 1956 line—is primarily due to larger bore, higher lift camshafts and fuel injection.

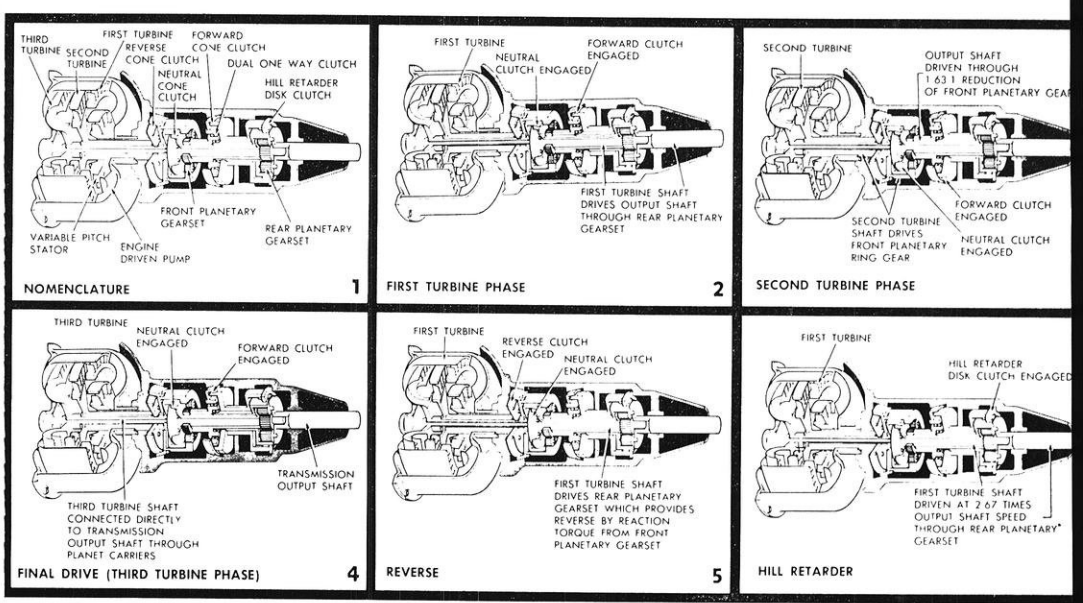
Displacements of the six-cylinder and lowest cost V8 remain unchanged at 235 and 265 cubic inches respectively. In the 283 cubic inch engine, the bore has been increased one-eighth of an inch over the highest powered 1956 V8 to a new 3.875 inches. Piston stroke in all Chevrolet eights stands at 3 inches, one of the shortest in the industry and a contributing factor in effortless power output.

All high performance engines are based on the 283 cubic inch block, while varying in fuel induction, compression ratio, camshafts and valving. Mechanical type valve lifters are used in the special high performance engines with compression up to 10.5 to 1 with fuel injection. Full pressure lubrication to the valve lifter galleries replaces the former metered system on all V8s. Full flow oil filters continue as an option, except on engines equipped with two four-barrel carburetors or fuel injection. Here filters are standard.

There are numerous other refinements. Spark plug electrodes protrude one-eighth inch farther into the combustion chamber, resulting in shorter flame travel. New metal heat deflection shields between spark plugs and exhaust manifold protect the spark plug wires and boots from heat. Starting motors of both six and V8 have been modified to increase the efficiency of the solenoid.

Improved engine breathing and higher volumetric efficiency are claimed for new "ram's horn" exhaust

(Continued on next page)



Ford

(Continued from page 78)

Ford's pioneering safety features introduced in 1956 have been improved. There is a new safety instrument panel with recessed control knobs clustered under the redesigned deep center steering wheel. Instrument panel and sun visor crash cushions are available, and the safety rear view mirror is continued. Safety door latches have been reinforced to withstand greater impacts. A three and one-half inch shock absorbing area is provided over the steering column by the new safety steering wheel, which is one inch smaller in diameter. It is mounted lower in the car for the best driving position.

Roofs have been strengthened with steel center bows. Hoods are hinged at the front so air will hold them down if they open accidentally. The hood release has been moved to the instrument panel, making the engine compartment tamper-proof when the car is locked. The fresh air intake has been moved to the cowling in front of the windshield so exhaust fumes are not drawn into the car.

For 1957, Ford offers a broad range of optional features including power-operated steering, brakes, seats and windows, as well as air conditioning, tinted glass, 6 and 8-tube radios, and heaters. **END**

Chevrolet

(Continued from page 81)

manifolds on the V8s. The new design provides larger gas passages which gradually increase in cross-sectional area from the inlet port at the cylinder head to the outlet. The manifolds are designed to rush spent gases from each cylinder with equal freedom from back pressures.

A new distributor of advanced design is used on V8 engines equipped with the two-barrel or four-barrel carburetors. This places the breaker points directly above the shaft bearing, reducing fluctuations in the gap setting. An access door in the distributor cap provides for the setting of the breaker gap while the engine is running.

Front and intermediate main bearings of V8 engines are one-sixteenth inch wider, while connecting rod bearings and the front and intermediate main bearings of all Corvette V8 engines are of premium material, an alloy which is said to triple average bearing life.

Notched pistons and dual exhausts are also characteristic of the high performance cars. In all V8s piston rings have been revised for better compression and oil control

Corvette Offers H.P. Choice

In addition to the 283 cubic inch V8 engine equipped with RAM-JET fuel injection, the 1957 Corvette offers sport car owners a choice of the standard four-barrel carburetor or dual four-barrel carburetors.

A wide range of transmissions complements the choice of engine. They include the regular production axle ration of 3.70–to–1 and an optional 4.11–to–1 axle for use with the close ratio 3-speed transmission. The 3.55 rear axle is retained for use with Powerglide.

Hydraulic valve lifters will be used on all Corvette engines excepting the high performance, competition engine. Modified mechanical lifters in this instance are designed to improve oil metering to the upper valve train.

Hult's Capital Garage invites Madison residents to see the 1957 Chevrolet at their 608 East Washington Avenue Show Room.

END

Well Points

(Continued from page 33)

lines are installed one below the other in terrace-like steps. This application could be continued indefinitely if pumps were available to raise the water to discharge level. Efficient wellpoint systems have operated as low as 120 feet.

When a series type wellpoint system is used, the excavation is usually made down to the water table. A wellpoint system is installed with a depth of 15 to 18 feet. This area is dewatered, and the excavation again made to the new water table. Then the next wellpoint system of the series is installed and the water table is lowered another 15 to 18 feet.

This sequence is followed until the subgrade of the project is above the final water table line.

Wellpoint systems in use provide many economical advantages. A construction job can be done much faster in dry working conditions than in wet conditions. The short time required to set up and install a wellpoint systems pays big dividends in faster completion of the job.

Wellpoint systems are available both for rent and for sale. If the system is to be put in permanently, it can be purchased, although many temporary projects are completed with rented equipment.

A well known process for removing excess water from an excavation is the sheeting and suction pumping method. In many cases, the cost of installing sheeting and pumping water with ordinary suction pumps would exceed the cost of installing a wellpoint system. With a sheeting and suction pumping method, the bottom of the excavation is always wet, making working conditions difficult.

In some locations, construction would be impossible without the use of wellpoints. In an excavation at the edge of a lake, for example, sheeting and suction pumping would be useless. A wellpoint system or series of wellpoint lines could efficiently remove the water before it reached the point of excavation.

Work can be done better under dry conditions. No contractor can do a good job when he is up to his knees in mud. If the job is performed without hinderance of mud, water, etc., the job will be better looking and will have a higher precision of installation.

When an excavation requires a subgrade below the water table a wellpoint system will make the job easier, safer and better. The material to be handled can be moved more efficiently and the job can be done more quickly.

After the job is completed, the wellpoint system can be removed and used on another job. A wellpoint system can be installed with less labor than sheeting and shoring, and the system can be operated as cheaply as a suction pumping set up. A wellpointing system will allow a contractor to do his work better and more economically.

END

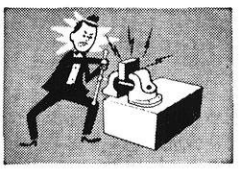
A combination...for relaxation at Home

Laminated plastics... a combination of properties at work

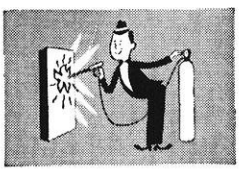
It takes a combination of properties to satisfy many of your basic material requirements. Synthane laminated plastics provide a unique combination of mechanical, electrical and chemical properties plus ease of machining.

High-speed reversing clutch cone made of Synthane molded-macerated laminated plastic increases productivity of automatic screw machines. Synthane meets all the demands of high-speed clutch operation . . . *light weight, great strength* and *excellent heat resistance* for split-second reversing of a positive spindle drive operating as high as 3025 rpm and with operating temperature of cone going up to 250°F. This Synthane clutch cone provides smooth, positive clutch action, is long wearing, and is not distorted or deteriorated by the high heat.

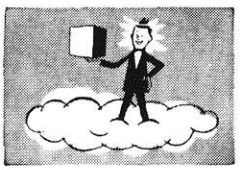
Property combinations! Synthane has them... in over 30 individual grades... sheets, rods, tubes, moldings and completely fabricated parts. Send for free illustrated catalog today.



COMPRESSIVE STRENGTH



HEAT RESISTANCE

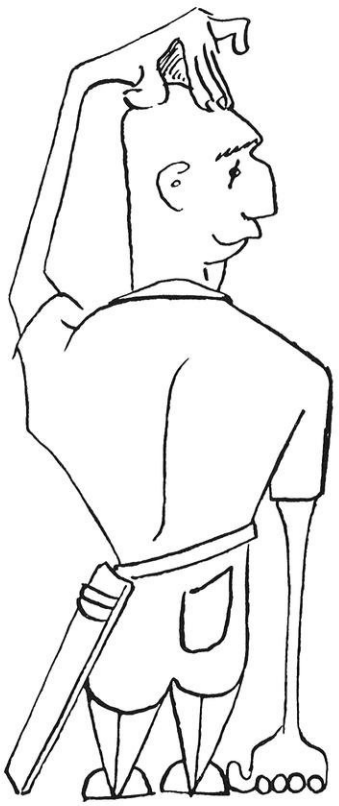


LIGHT WEIGHT

WEAR RESISTANCE

SYNTHANE

SYNTHANE CORPORATION, 13 RIVER ROAD, OAKS, PA.



So You Think You're SMART!

by Sneedly bs'60

First of all, Sneedly would like to say hello to all the new readers and to welcome back all his old friends. He promises that you'll all find some interesting problems in his column during the next year.

Next Sneedly will give you the correct answers for the problems that appeared in the last issue (May 1956).

In the problem about flys and the hog trough, the answer is given in the problem itself; it says that there were "half as many yesterday." So if the hog trough is full of flys in 57 days, it is half-full in 56 days.

* * *

To solve the one about the taximen imagine that 100 people pass Ole walking North at 4 miles an hour, and 100 pass him walking South at 4 miles an hour.

Then Pierre, if driving North at 4 miles an hour, *wouldn't pass any* walking North at the same rate, but he would pass 200 walking South; or the same number in all. What he said was wrong.

Juan, if driving North at 8 miles an hour, would pass 100 people walking North and 300 walking South. Hence he'd pass 400 in all. What he said was right.

Fred, driving North at 12 miles an hour, would pass 200 walking North and 400 walking South. That is, 600 in all, or 50% more than Juan. What he said was wrong, but he has the right idea about cruising.

As three are cruising *up and down,* while the fourth is standing still, it doesn't matter a bit about the numbers walking in each direction or the rate at which they are walking. Both these average up, between the trip up the boulevard and the trip down, and the above facts hold true just the same.

* * *

To turn a glass of water upside down without spilling it: covering it first with the palm of your hand; placing a sheet of paper over it, and letting atmospheric pressure do the rest; freezing it, so that a layer of ice holds it in; swinging it at arm's length over your head, so that the water is kept in by centrifugal force; inverting it over another glass of water, done by holding both glasses under water at once; lowering the glass into a basin of water and turning it upside down below the surface.

* * *

Gertrude was wearing a green dress when she ran away. She sold a blue dress today after buying a green one yesterday. The oldest dress Gertrude referred to in her notes was also green. The first dress she mentioned having *bought* was brown.

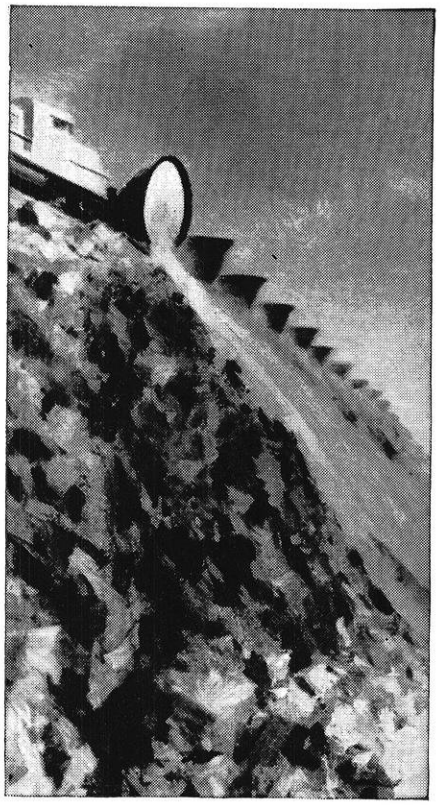
* * *

Now Sneedly has a real problem; he's nearly run out of problems! He's decided to ask you to send in your problems. Surely many of you run into some perplexing problems and situations in your classes or on your job. So send in your problems and how you solved them. Let your fellow engineers match their wits against you. The only requirement is that neither problem nor solution be too long as space is limited. Send them to:

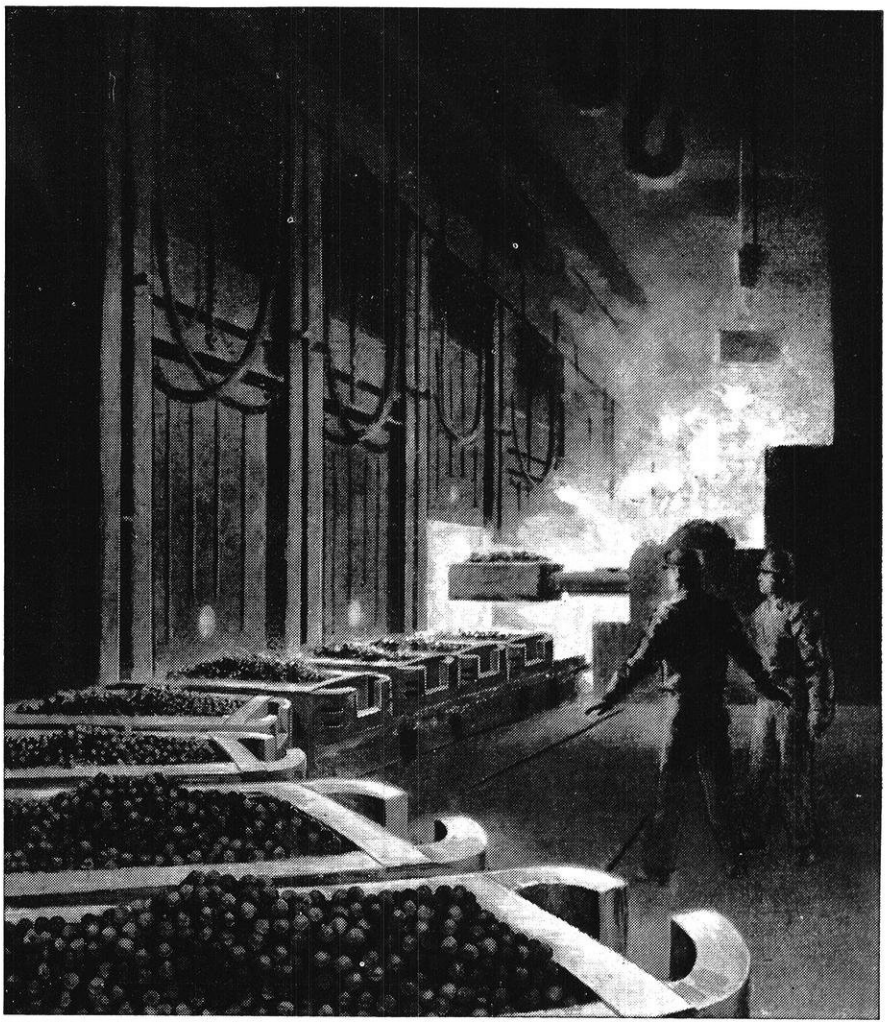
(Continued on page 90)

Inco Nickel Progress Report

How Inco's more-from-the-ore research program is expanding North America's natural resources



Once the iron in Nickel-containing pyrrhotite went to slag heaps.



Now this high-grade iron ore—product of Inco research—goes to steel mills. Here you see it being fed into open hearth furnaces.

Now Inco saves iron in Nickel ore from the slag heap

ALSO RECOVERS NICKEL

There's iron in Nickel ore.

But for years, this iron was of no commercial value. No one could find a way to recover it.

Recently, after years of research, International Nickel pioneered a new extraction process.

Saves the iron—

Nickel is recovered, too!

This new Inco process not only recovers iron ore from pyrrhotite *economically;* it is the highest grade iron ore (68% iron) now produced in quantity in North America. It also recovers the Nickel in the ore.

For its pioneering new process, International Nickel has built a $19,000,000 recovery plant. Modern and streamlined, this plant is only the first unit of the new Inco Iron Ore operation. It is expected to add hundreds of thousands of tons a year to this continent's high-grade iron resources.

More from the ore

That's one of the prime objectives of International Nickel's expansion program. As in the case of iron ore, this has enabled Inco to expand the free world's natural resources. Today, International Nickel gets fourteen different elements from its Nickel ores.

• • •

"Mining For Nickel"

Inco's new full-color, sound film! 16mm prints loaned to engineering classes and student technical societies. The International Nickel Co., Inc., Dept. 127e, New York 5, N. Y.

INCO TRADE MARK

International Nickel

Producers of Inco Nickel, Nickel Alloys, Copper, Cobalt, Iron Ore, Tellurium, Selenium and Platinum, Palladium and Other Precious Metals

So Smart

(Continued from page 88)

Sneedly, *The Wisconsin Engineer*, 333 Mechanical Engineering Bldg., Madison 6, Wisconsin.

* * *

Sneedly leaves you with this problem to mull over. The great engineering student Shane Earlwetter was given the task, by one of his teachers, Professor Rollout, of designing two containers for a gift to the University of Outward Slavovia. They were to be made to the Slavovian scale of measurement in which one dufi equals one plup (linear). One container was to be called a quiddal and the other a dalquid. Now here are the specifications; a quiddal is just one dufi deep; a dalquid is just one plup deep; the top of a quiddal is one square plup; the top of a dalquid is one square dufi; no matter how you stand one of them in the corner of a rectangular room, if any two sides are pushed flat against adjacent walls a third side lies flat upon the floor.

Shane Earlwetter was asked to find which would hold more if both were filled with blumph, and how many more times it would hold (better check this answer). Now that part was pretty easy Sneedly thought, but here's the last part of the problem: find a 16 letter word which describes the shape of each of them (better review your geometry). Send your answers to Sneedly. **END**

Lincoln

(Continued from page 10)

rates both vacuum and centrifugal spark advance systems.

Completely new for 1957 is the Lincoln Paper-Pak air cleaner which offers the driver increased efficiency over the previously used oil-bath air cleaner, and makes possible much easier servicing. Utilizing a replacement element composed of a pleated, cellulose fiber material, the air cleaner is 99.5 per cent efficient, compared with 98 per cent efficiency for the oil-bath air cleaner.

A regular production option for the 1957 Lincoln, the new power-directed differential gives the driver sure traction and control over low-tractive surfaces such as ice, snow, mud and sand. The limited-slip differential allows the axle to transmit the major driving force to the wheel having the better traction.

A new, smaller diameter 12-inch steel torque converter replaces the one used in previous years. This stronger new converter is the result of an effort to provide maximum torque multiplication and strength in a unit of reduced size.

Eliminating the bothersome servicing of conventional oil filters, the 1957 Lincoln throw-away unit is composed of five parts, sealed in one neat shell. Featuring "light bulb" ease of installation and removal, the new oil filter is screwed into a filter-mounting fitting, installed in the lower left side of the engine block.

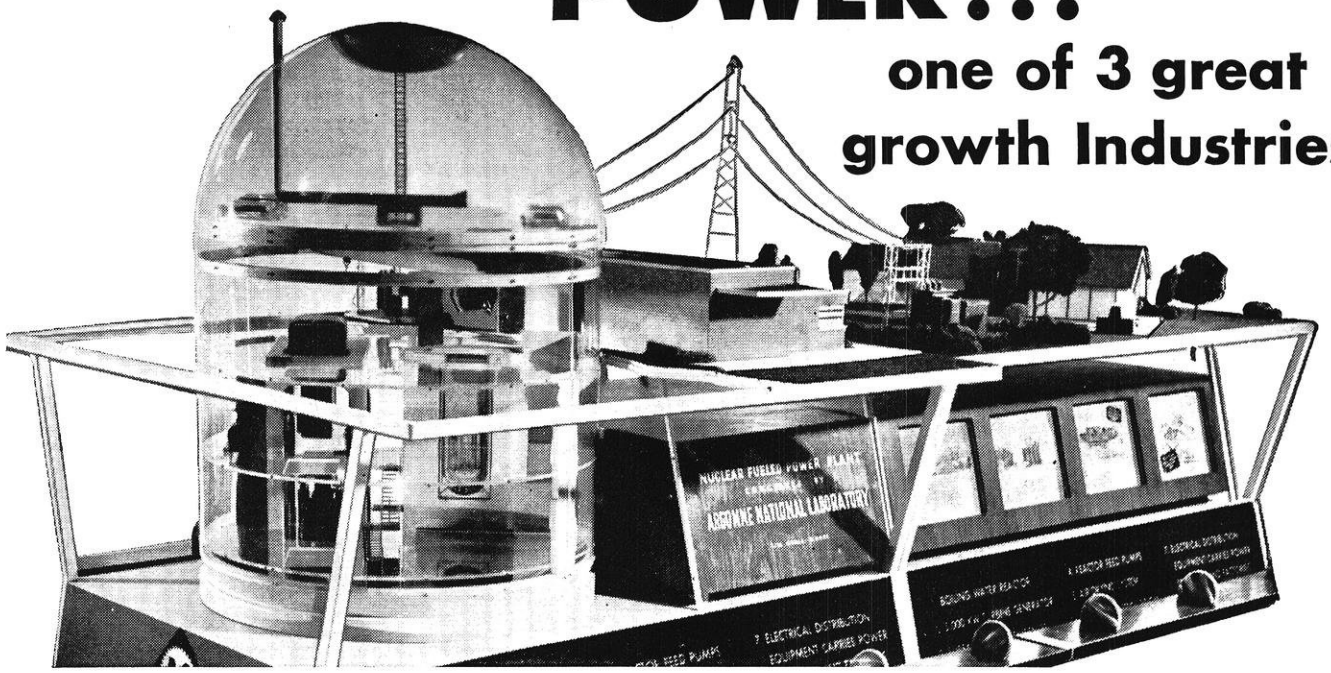
New three-piece oil control rings for better oil control and longer engine life are used on the pistons of the 1957 Lincoln engine. The three pieces of the new rings are: two chromium-plated segments which wipe excess oil from the cylinder walls and one expander which holds the segments against the cylinder wall. With the new rings, friction is reduced and longer engine life is made possible than with cast-iron rings used in previous years.

The 1957 Lincoln engine features self-locking tappet adjustment screws, where a lock nut had to be tightened after a screwdriver was used for adjustment, the self-locking screws make possible one-wrench adjustment. In addition, the new tappet adjustment screws tighten under load, maintaining the adjustment for a longer time.

In Madison the 1957 Lincoln may be seen at Stadium Motors, located at 1501 Monroe.

END

POWER...
one of 3 great growth Industries



ATOMIC POWER—Allis-Chalmers model of Argonne National Laboratory's experimental boiling water reactor power plant. Allis-Chalmers is supplying specialized equipment for the power cycle: generation, heat transfer, transmission, controls.

GO with the company that's strong in all three!

Hitch your future in engineering to the growth of the U. S. A.—and to a company that supplies the basic needs of growth!

This nation is growing at the rate of 50,000 people every *week!* To supply the needs of these people:

Electric power generation will double by 1965.

A multi-billion dollar program of new highway construction is planned within the next ten years.

Manufacturing output will have to increase by $3.5 billion by this time next year.

And Allis-Chalmers builds major equipment for all of these growth industries! Some examples are pictured here.

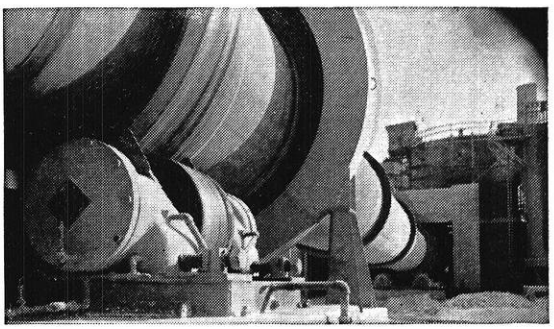
Here's what Allis-Chalmers offers to Young Engineers:

A graduate training course that has been a model for industry since 1904. You have access to many fields of engineering: electric power, hydraulics, atomic energy, ore processing.

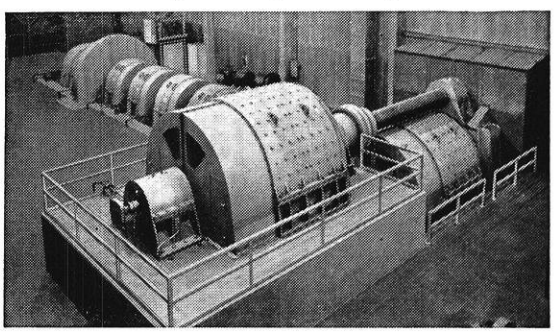
There are many *kinds* of work to try: design engineering, application, research, manufacturing, sales. Over 90 training stations are available, with expert guidance when you want it. Your future is as big as your ability can make it.

Or, if you have decided your field of interest and are well qualified, opportunities exist for direct assignments on our engineering staff.

In any case—learn more about Allis-Chalmers. Ask the A-C manager in your territory, or write direct to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.



CONSTRUCTION demands the vast tonnages of cement produced with Allis-Chalmers rotary kilns and other processing machinery.



MANUFACTURING depends upon the reliable power of electric motors—like these 5000 hp Allis-Chalmers giants powering a rolling mill.

ALLIS-CHALMERS

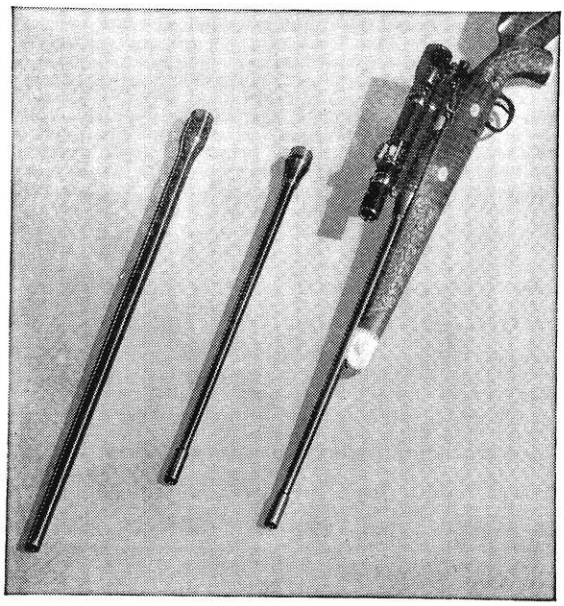
A-C ALLIS-CHALMERS 4977

○ *Another page for* **YOUR STEEL NOTEBOOK**

The rifle barrel steel that makes hunting more fun

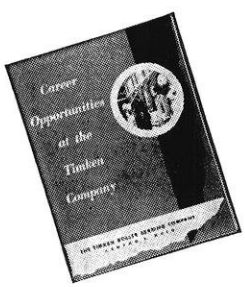
A .30/06 rifle can get heavier toward nightfall! That's why a prominent gunsmith never gave up looking for a new steel—one that would be lighter, would machine readily, and yet would take the enormous firing stresses of even heavier calibers.

Steels normally used for lightweight barrels gave all kinds of trouble to the gunsmith: distortion, poor finish, high tool costs, trouble with drilling, reaming, rifling. They took this problem to Timken Company metallurgists—and got the perfect solution.



This TIMKEN® rifle barrel steel is free from internal stresses

Developed by the Timken Company, this new steel (center barrel, in picture) made possible a rifle barrel 6″ shorter, 2 lbs. lighter than the previous barrel of the same caliber (left). It withstands the wear of thousands of rounds of firing. Machines to highest accuracy—and to high finish beauty. Machines without distortion. Drills, reams and rifles perfectly. Proof tests to 70,000 lbs. per sq. inch for safety in a .30/06. Has handled overloads up to 100,000 lbs. per sq. inch. Timken Company metallurgists are leading specialists in fine alloy steels . . . as this remarkable new steel will testify.



Want to learn more about steel or job opportunities?

Some of the engineering problems you'll face after graduation will involve steel. "The Story of Timken Alloy Steel Quality" will help you learn more about steel. And you might be interested, too, in the excellent job opportunities described in "Career Opportunities at the Timken Company". Drop us a card, ask for one or both booklets. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN *Fine Alloy* STEEL

TRADE-MARK REG. U. S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

STA  TIC

ENGINEERS

With clouding wits the draftsman sits
And pushes pens and pencils
While day by day the years slide away
Among his inks and stencils.
He works and works and never shirks
(He couldn't do without it)
And if he stops, asleep he drops,
And then he dreams about it.
With head that sinks and frame that shrinks
He does his toilsome duties
Without a glance at gay romance
Or a blink at all her beauties.
Oh, when at last his life is past
There comes no chance to show it
For engineers are dead for years
Before they even know it.

* * *

The story is told of a Ch.E. professor who arrived at one of his classes on a particular day, left his hat and departed to chat with a colleague.

His students arrived for the class hour but, after waiting the customary ten minutes, left. When the professor returned to find his class gone, he was highly irritated and gave them a stern lecture the next period, concluding: "If my hat's here, I'm as good as here."

When the professor arrived for the next class meeting, there was nary a student present, but a hat had been neatly placed on each seat.

* * *

"John, John," whispered an alarmed wife, poking her sleeping husband in the ribs. "Wake up, John; there are burglars in the pantry and they're eating all my pies."

"Well, what do we care," mumbled John, rolling over, "so long as they don't die in the house!"

The ferocious lion ate a bull. Afterward he felt so wonderful he roared and roared. A hunter heard him roar and shot him.

Moral: When you're full of bull, you had better keep your mouth shut!

* * *

The old engineer pulled his favorite steam engine up to the water tank and briefed the new fireman. The fireman got up on the tender and brought the spout down all right, but somehow his foot caught in the chain and he stepped into the tank.

As he floundered in the water, the engineer watched him with a jaundiced eye.

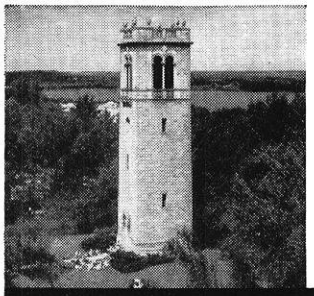
"Just fill the tank with water, Sonny," he drawled. "No need to stamp the stuff down."

* * *

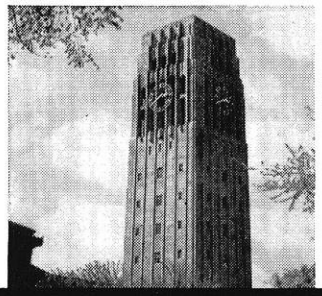
ODE TO A LAB REPORT

When I grow old and even older,
I'll never forget that manilla folder,
Bane of existence, object of hate
And never less than three weeks late.
Title, object, method, theory,
The clock strikes one, my eyes are bleary.
If I could have my preference
I'd never write a reference,
Never compute efficiency
For readings numbering eighty-three,
But many like that I have done,
At least infinity plus one,
Many to tell the dullest dullard
That graphs are labeled and curves are colored.
Engineers Arise—storm the fort;
And abolish forever the lab report.

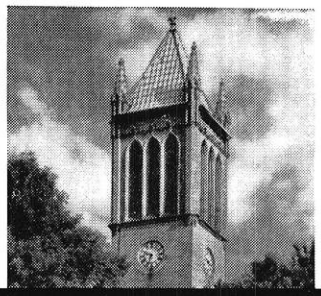
—Unanimous



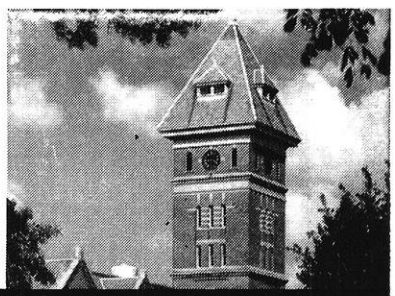
WISCONSIN



MICHIGAN



IOWA STATE

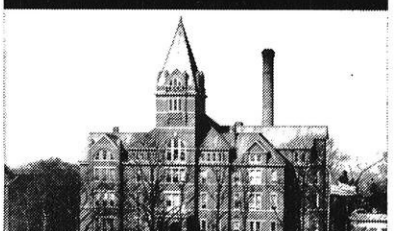


PURDUE

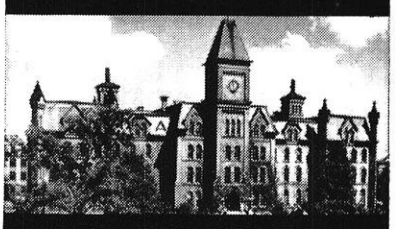
TEXAS A&M

ILLINOIS

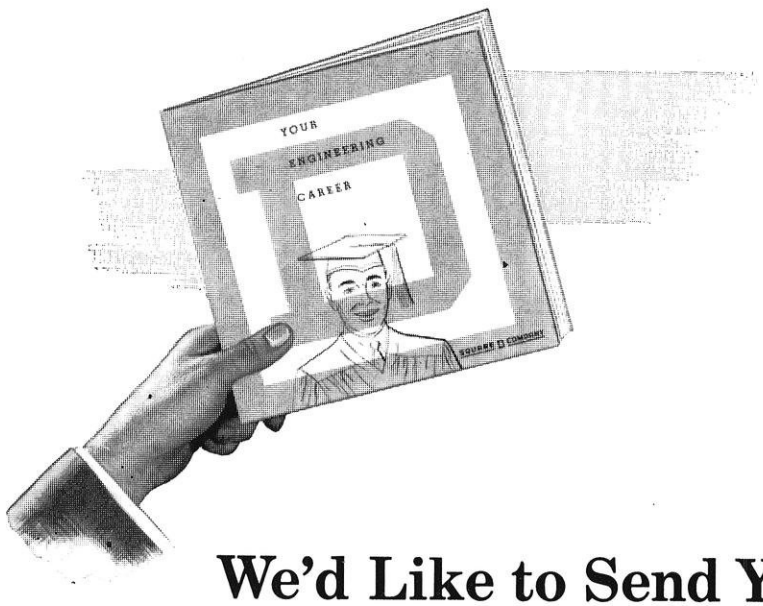
PENN STATE



GEORGIA TECH



OHIO STATE



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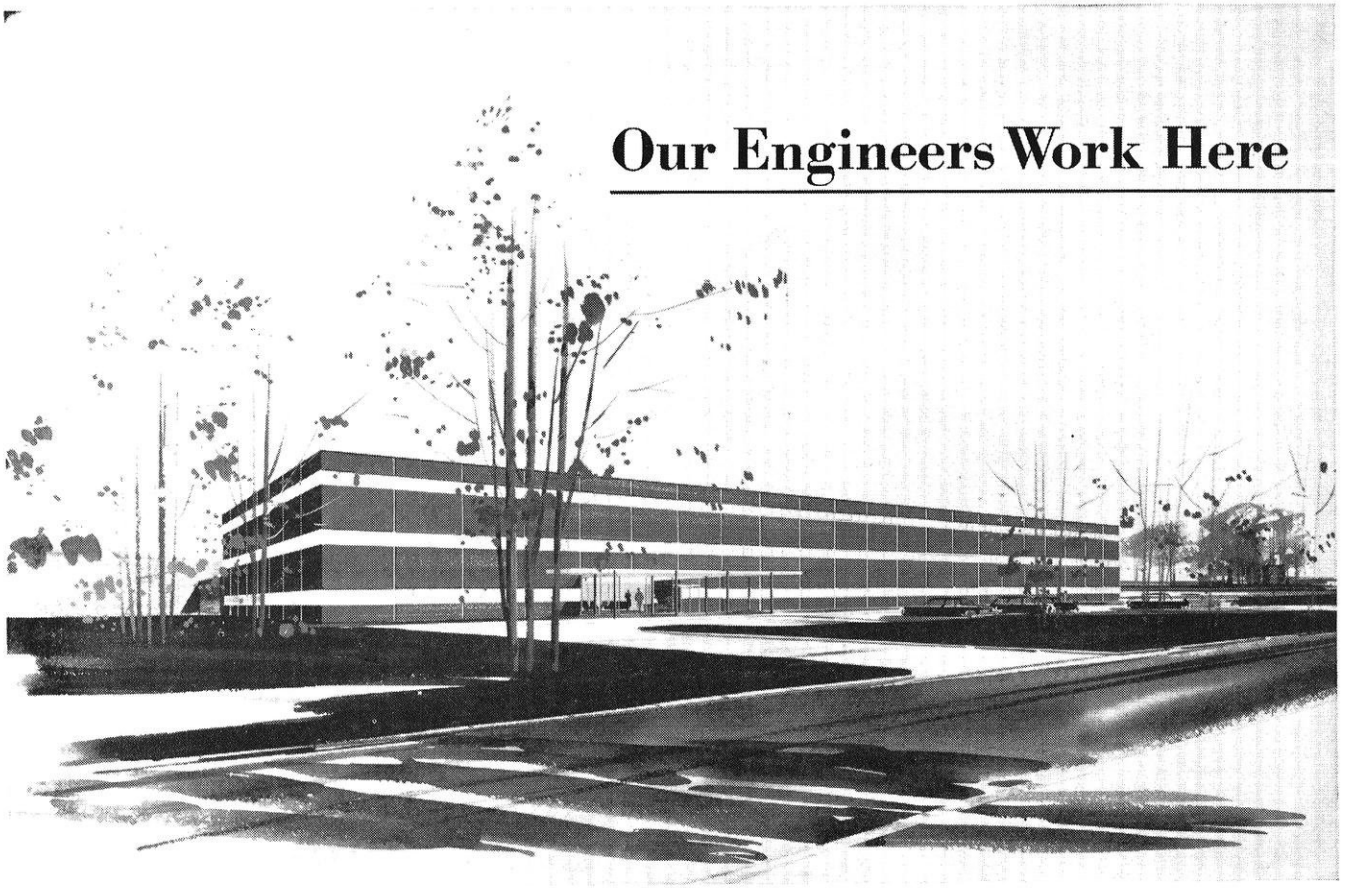

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