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MAY
1958

The Wisconsin

25¢

engineer

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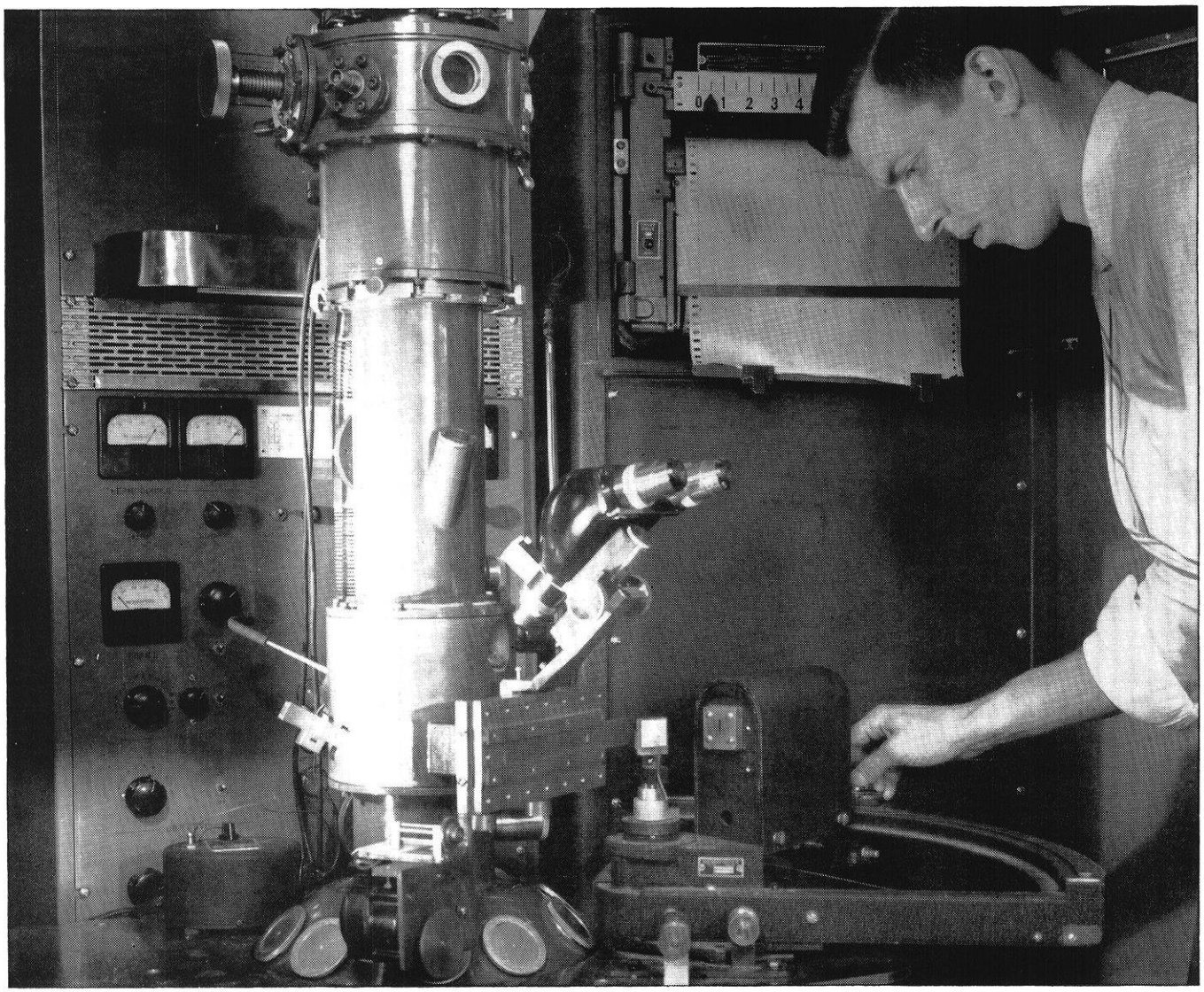

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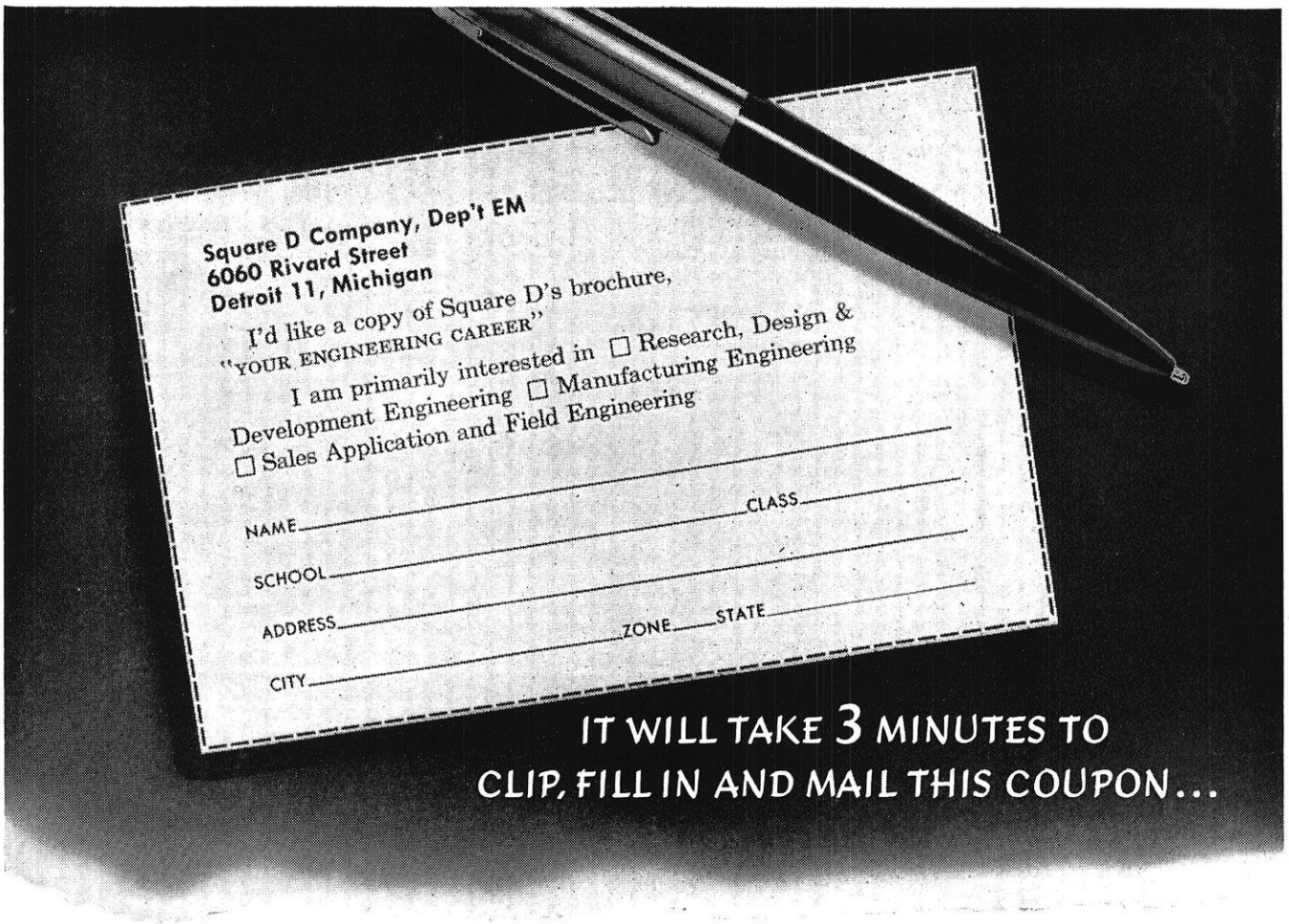

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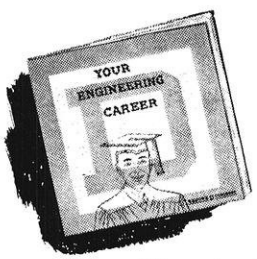

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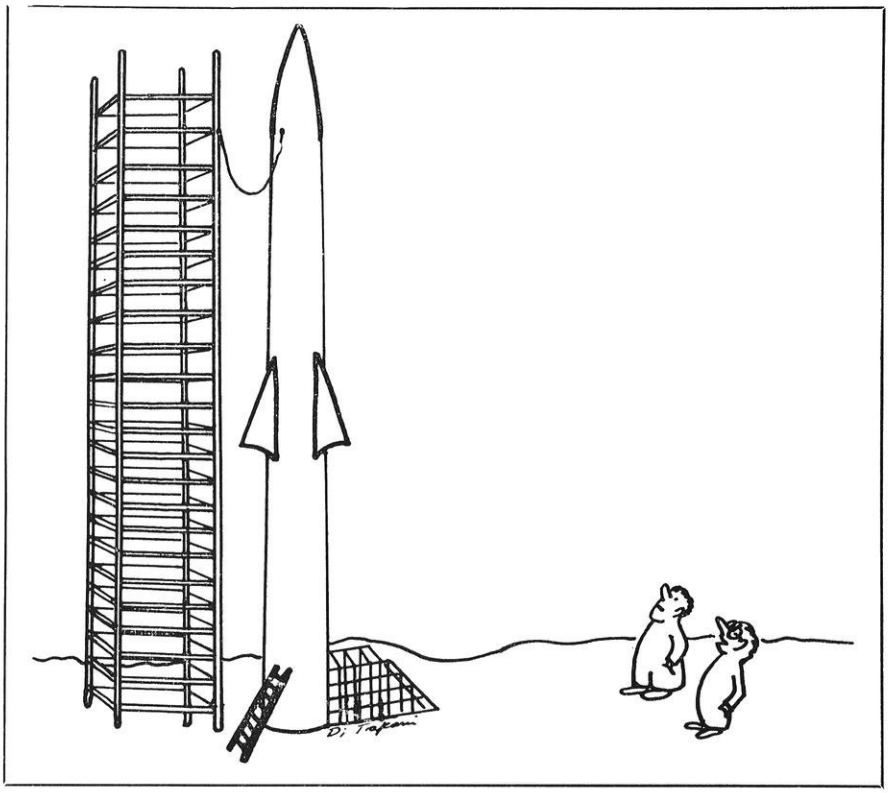

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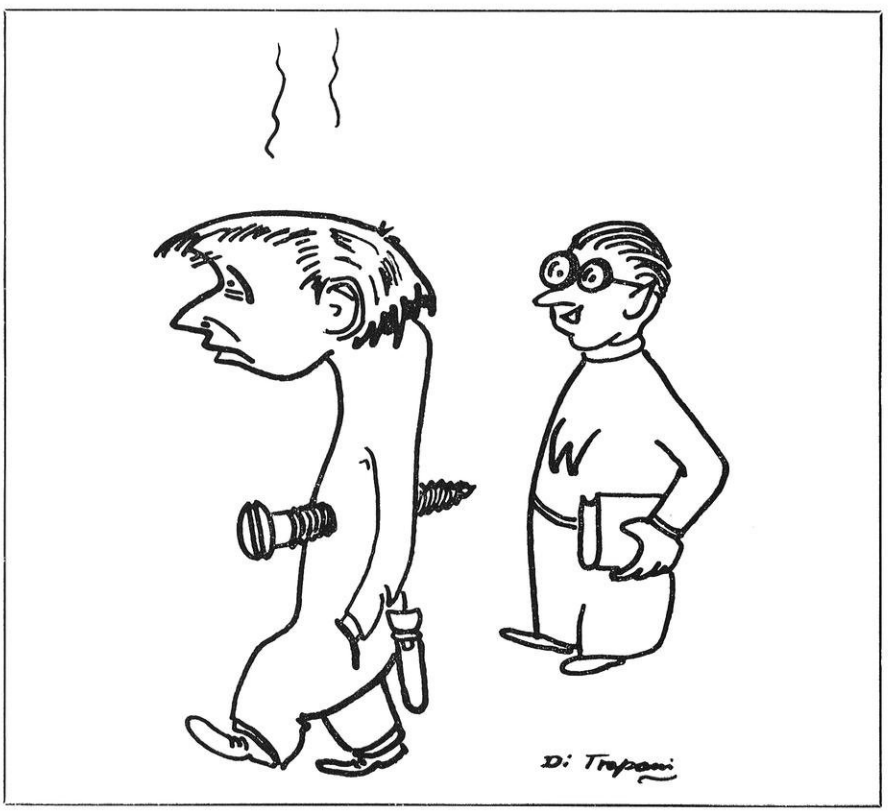

I hear the grades on that thermo exam were pretty low.

Volume 62 MAY 1958 Number 8

WISCONSIN ENGINEER

The Student Engineer's Magazine
FOUNDED 1896

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Cover

View of catalytic cracking area at Shell Oil Company's Anacortes, Washington refinery.

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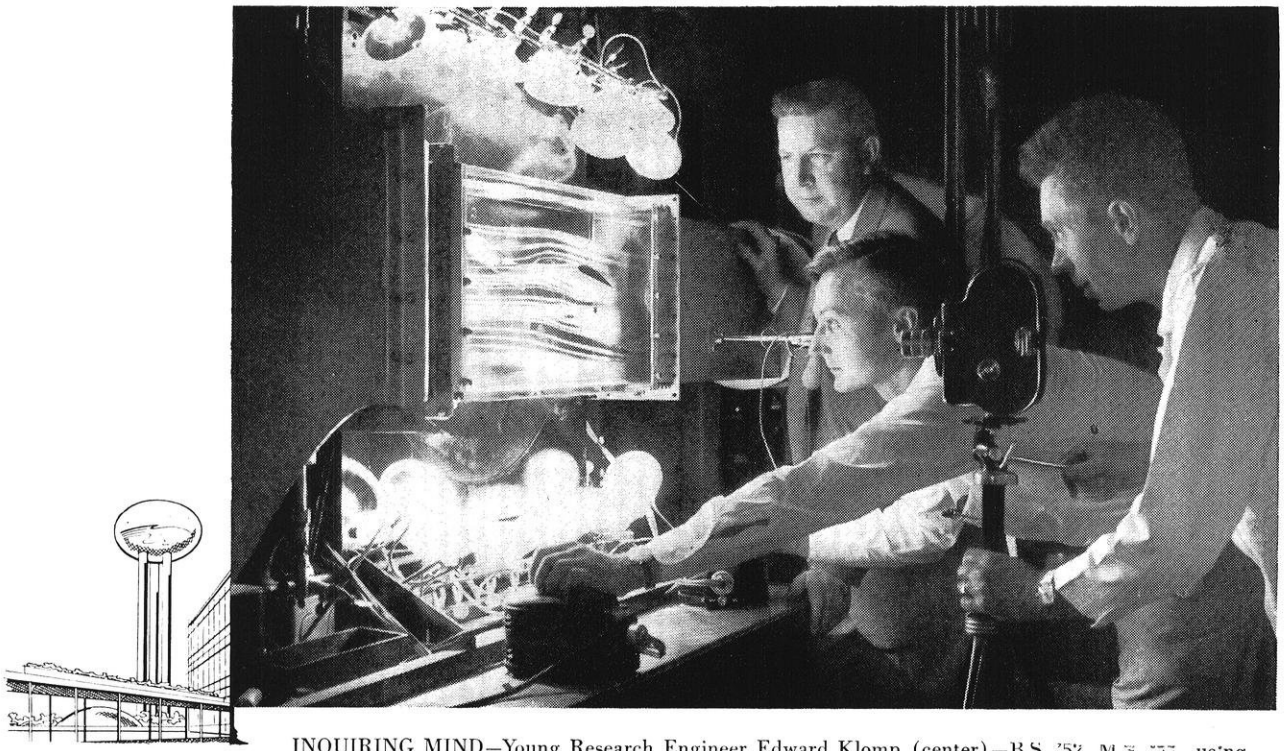

INQUIRING MIND—Young Research Engineer Edward Klomp (center)—B.S. '52, M.S. '53—using smoke tunnel to investigate stall propagation of axial flow compressors. His work is guided by William Turunen (top left)—B.S. '39, M.S. '46—head of the Gas Turbines Department at GM Research—and results recorded by technician George Josie on motion-picture film.

Because *engineering* is a *profession* at GM—your talents can take you to the top

Commencement literally means a beginning—although it marks the end of your undergraduate days.

Perhaps one of your classmates — or you, yourself — has decided to start a career with General Motors. It's a wise choice for many reasons but particularly for this one:

Engineering is a profession at GM. And the engineers who work on our hundreds of products are respected as professional men.

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The fact that more than 179 of our engineers and scientists received more than 164 patents in a recent four-month period is one measure of the intellectual freedom engineers have at GM.

And the fact that 14 of our 33 Vice-Presidents—23 of our 42 Division General Managers—are engineers is an indication of the advancement opportunities for engineering graduates at GM.

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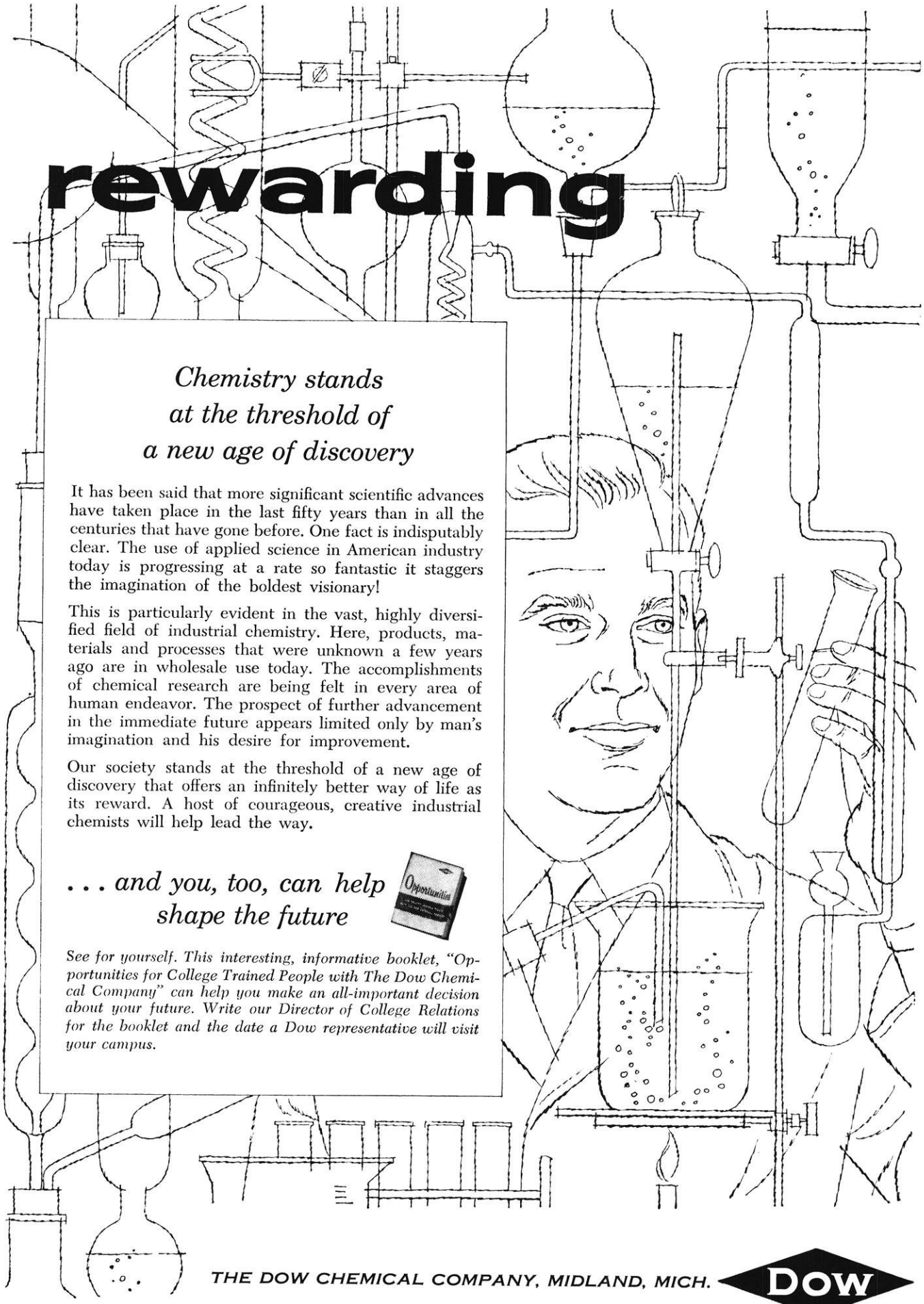
GENERAL MOTORS CORPORATION

Personnel Staff, Detroit 2, Michigan



Chemistry stands at the threshold of a new age of discovery

It has been said that more significant scientific advances have taken place in the last fifty years than in all the centuries that have gone before. One fact is indisputably clear. The use of applied science in American industry today is progressing at a rate so fantastic it staggers the imagination of the boldest visionary!

This is particularly evident in the vast, highly diversified field of industrial chemistry. Here, products, materials and processes that were unknown a few years ago are in wholesale use today. The accomplishments of chemical research are being felt in every area of human endeavor. The prospect of further advancement in the immediate future appears limited only by man's imagination and his desire for improvement.

Our society stands at the threshold of a new age of discovery that offers an infinitely better way of life as its reward. A host of courageous, creative industrial chemists will help lead the way.

. . . and you, too, can help shape the future

See for yourself. This interesting, informative booklet, "Opportunities for College Trained People with The Dow Chemical Company" can help you make an all-important decision about your future. Write our Director of College Relations for the booklet and the date a Dow representative will visit your campus.

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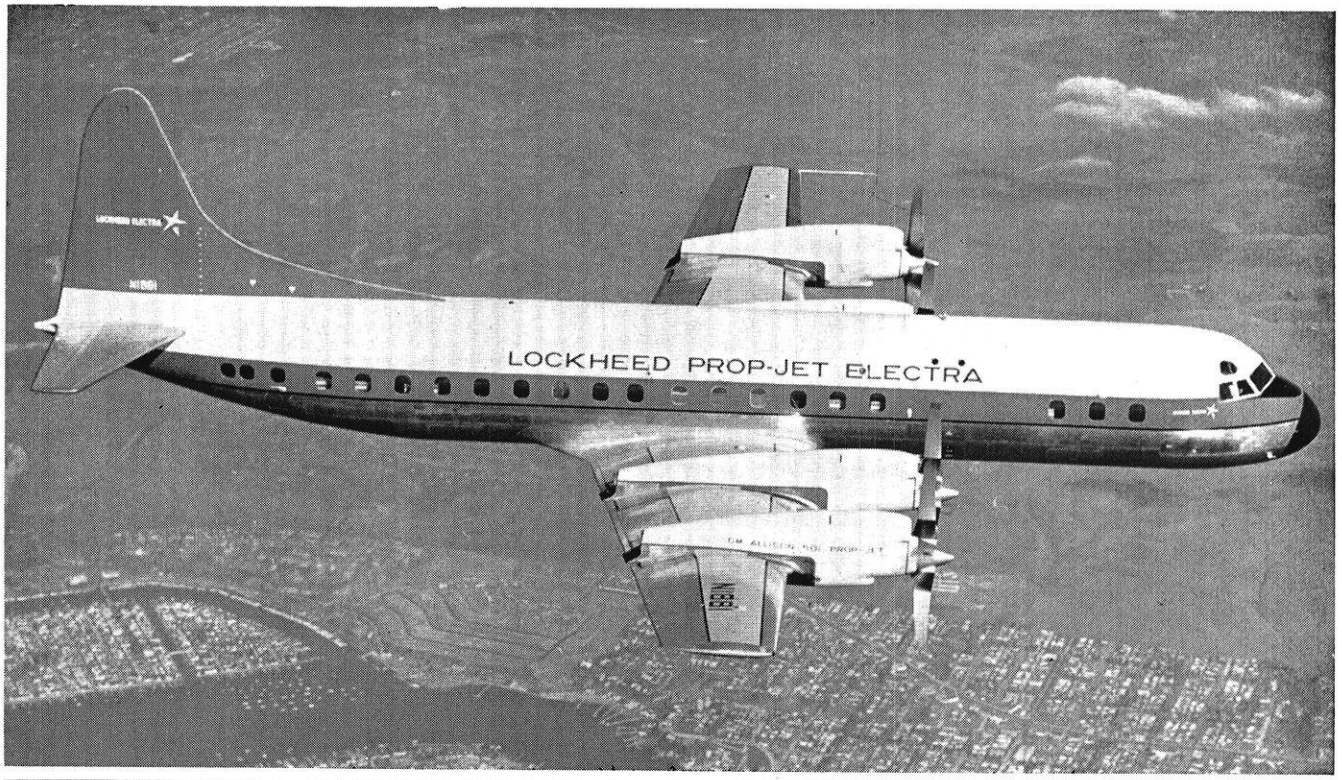
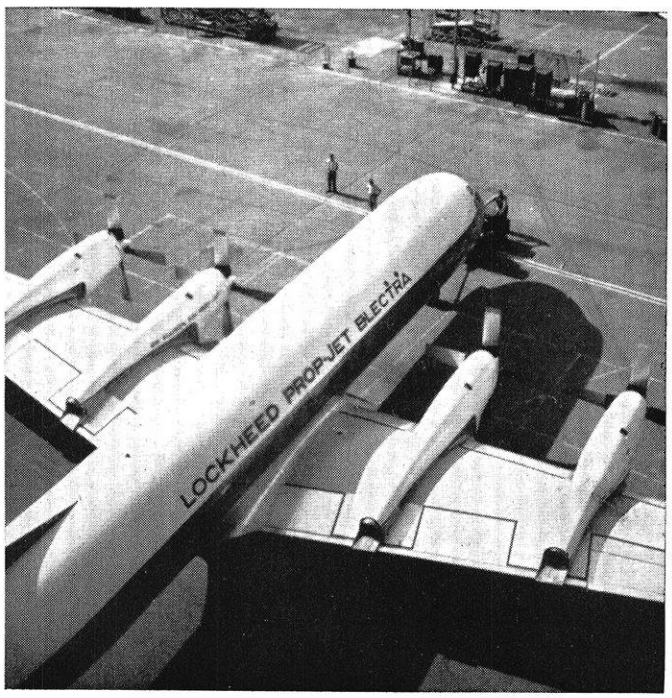
Vilfredo Pareto...on the lifetime of theories

"The logico-experimental sciences are made up of a sum of theories which, like living creatures, are born, live, and die, the young replacing the old, the group alone enduring. As with living beings, the lifetimes of theories vary in length and it is not always the long-lived ones that contribute most to the advancement of knowledge. Faith and metaphysics aspire to an ultimate, eternal resting-place. Science knows that it can attain only provisional, transitory states. Each theory fulfils its function, and there is nothing more to ask of it."

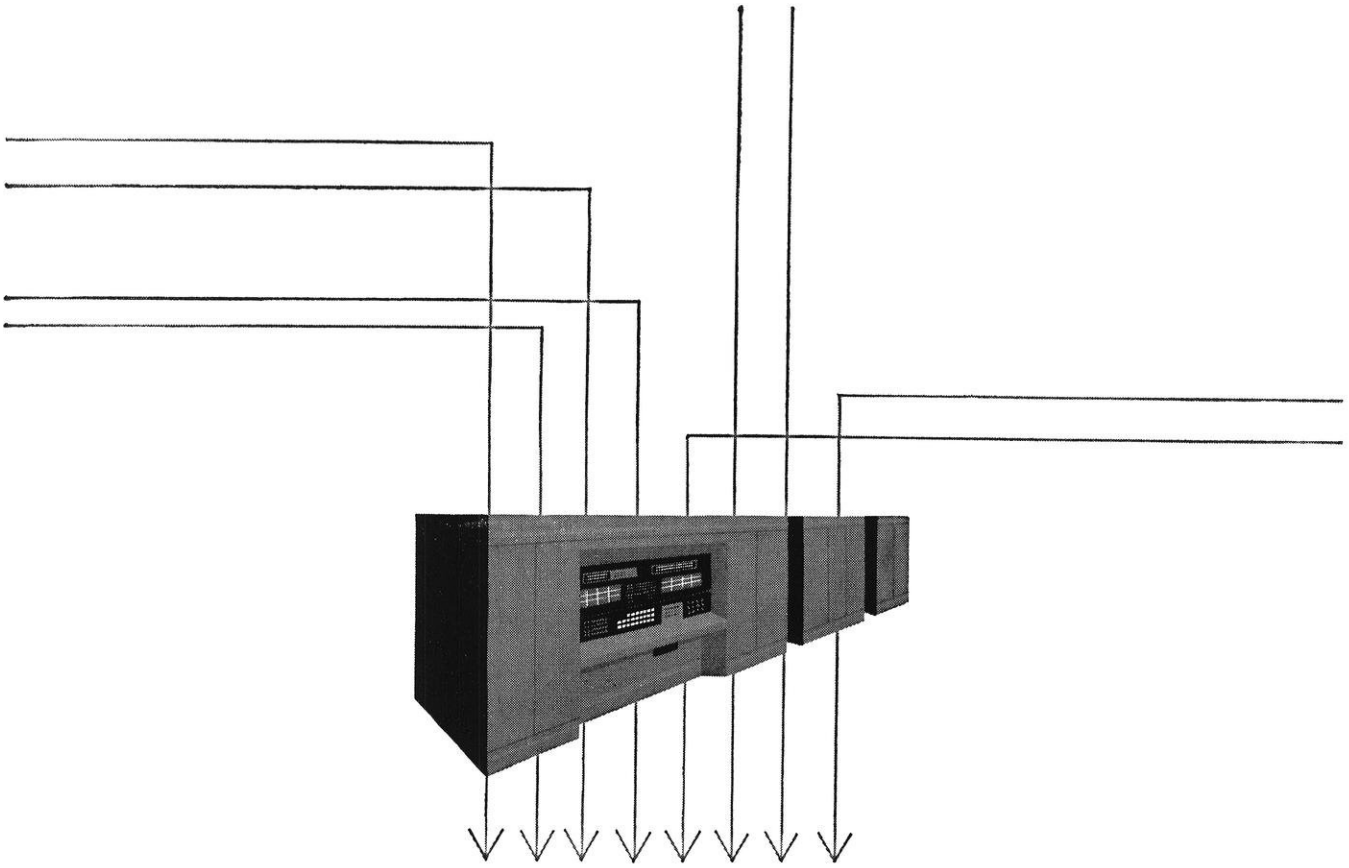
—*Traité de Sociologie Générale, 1919*





INDIANAPOLIS, IND.: (Special) Lockheed Aircraft Corporation and the Allison Division of General Motors Corporation have teamed up to produce a commercial passenger transport that promises to revolutionize air transportation on the medium-and-short-range flights. Cruising at more than 400-mph the Allison Prop-jet Lockheed Electra will bring jet-age speed and comfort to passengers and set new standards of operating economy for air lines of the world.

Teamwork within Allison, just like the Lockheed-Allison team, is highly prized by newly graduated engineers. If you would like to know more about the Allison team, write Personnel Department, College Relations, Allison Division of General Motors Corporation, Indianapolis, Indiana.



The **ORGANIZATION** and **RETRIEVAL** of **INFORMATION**

The organization and retrieval of large volumes of diverse types of information is rapidly becoming one of today's more serious problems. Major areas where the problem exists include business and industry, the military, the government, and the scientific and engineering community itself.

In its simpler forms, the problem may involve, for example, the automatic handling and analysis of business data such as payrolls, sales and manufacturing figures, insurance premiums, and other essentially statistical data. At the other extreme are certain complex military situations which require the concurrent interpretation, analysis, and integration on a very short time scale of data from a wide variety of sources, including field reports, photographs, news reports, estimates of industrial activity, and the like. In many of these situations, there is the additional requirement to translate the information from a foreign language into English.

The development in recent years of electronic data handling equipment is now making possible the practical solution of many of these problems. Such equipment has the capability to perform arithmetic operations, make decisions among alternatives, store and retrieve large quantities of information, and at high speed automatically perform long, complex sequences of operations.

At Ramo-Wooldridge, work is in progress on advanced information handling systems that are characterized by large volume and widely different forms of information, short time scales, and a variety of uses and users. The scope of the work includes the planning of systems and procedures, programming various types of data handling equipment, and formulation of requirements for new equipment. Research is also under way on the machine translation of foreign languages into English.

Engineers and scientists with experience in the following fields are invited to explore the wide range of openings now available:

Systems Engineering
EDP Systems
Computer Programming
Console Design
Display Development
High Acuity Optics
Photo Interpretation

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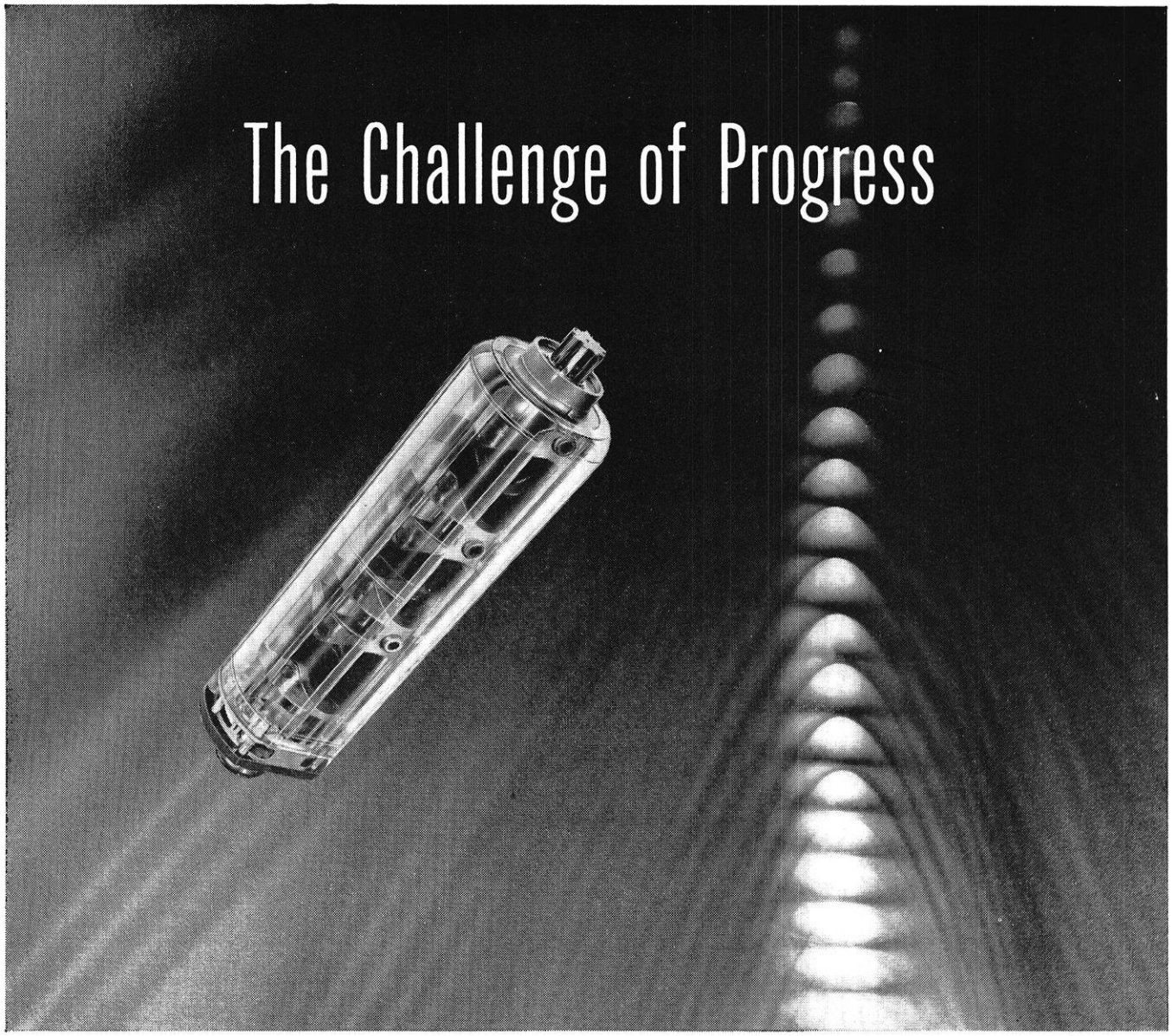

Recently AiResearch engineers were called upon to develop an accessory power motor for aircraft and missiles which would operate at +1000°F. . . . a temperature area where present-day hydraulic and electrical devices fail.

Their answer was this cam piston air motor, pictured above in a specially built transparent shell. Operating on hot air or gas, its efficiency actually increases as temperatures rise.

This problem and its solution are typical of many encountered at AiResearch in aircraft, missile, nuclear and electronic fields. Specifically, you'll find them in system electronics; computers and flight instruments; gas turbine engines and turbine motors; cryogenic and nuclear systems; pneumatic valves; servo control units and air motors; industrial turbochargers; air conditioning and pressurization; and heat transfer.

Upon your employment, in addition to direct assignments, a 9-month orientation program is available to aid you in selecting your field of interest. This permits you to survey the project, laboratory and administrative aspects of engineering at Garrett. Also, with company financial assistance, you can continue your education at outstanding universities located nearby.

Project work is conducted by small groups where individual effort is more quickly recognized and opportunities for learning and advancement are enhanced

• *For full information write to Mr. G. D. Bradley*

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RIVER QUI

Rambling WITH THE EDITOR

In this first "ramble" the new editor, like any other writing his first editorial, can not keep from having certain pulsations of uncertainty and questioning flowing even to the end of his fingertips as he types these words. To be the editor of any magazine involves a large responsibility not to just a few people but to many people in many places doing many things. The editorship of *The Wisconsin Engineer* is no different, for it must somehow attempt to satisfy the needs of many people—all engineers or people interested in engineering—with different interests and professions.

As a student publication *The Wisconsin Engineer* goes out to only a little over 200 engineering students as personal subscriptions, but it reaches many other students through libraries and campus meeting places. In addition about 250 copies are mailed each month to University extension centers, about 50 engineering colleges and public libraries receive copies, over 400 go to high schools, but the largest percentage of the circulation goes to professional engineers with about 1500 going out to alumni and other engineers in the field. This makes a total circulation, this year, of over 2400. We hope that in coming years this number will increase, providing engineering news of Wisconsin to many more engineers than are now receiving it.

Into this business this editor steps to try to fill the footprints left by a very capable and conscientious editor, Jim Schilling, who has guided the magazine through the past year. Jim has edited the copy, proofread the galleys, laid out the pages of ads and printed matter, pasted up the dummy copy, carried it to the printers, and kept up the correspondence he was required to do. Of course this was not done only by him, but he led the way and did a great share of it himself. While doing this he kept his high scholastic record in electrical engineering, continued his training in the advanced army ROTC, and spent as much time as possible at home with his wife. So, the footprints seem big, but they are a part of a long, well trod pathway of good editors of this student publication that makes a man feel honored indeed to be the one to carry on for a year of its history.

The staff for this next year is an excellent one. On it are men who are extremely interested in the welfare of the magazine and its readers, men who are willing to sacrifice their study time and their leisure (if an engineer ever has any leisure) in order to publish an issue each month. And, next year, perhaps for the first time, a girl holds the position as Business Manager of the magazine. And the remarkable thing about these people is the high scholastic records they maintain while participating not only on the staff of *The Wisconsin Engineer* but in many other activities and organizations as well. We are glad to say that we think the staff is made up of the kind of people who will become very valuable assets to their future employers as well as the communities in which they live.

In the beginning of next year the magazine will see a few changes perhaps, a few additions, and many of the fine sections that have been characteristic of the magazine for some time.

The feature section will continue to contain the three to five articles that have formed the nucleus of the reading matter of the magazine in the past. We shall endeavor to run several articles on the most recent items of engineering interest at the time as well as the articles that contain information that is always of interest.

Science Highlights, W.S.P.E. news, and Engineer of Yesteryear will continue under much the same format as it did this year. The Engineer of Yesteryear section was begun this past year, and it seems to have become very popular with the readers. With all the advancements being made in man-made satellites and guided missiles, Science Highlights should always be bulging with current information.

In the area of campus news some more additions and improvements should appear. We plan to include articles and reports of Wisconsin graduate students, written by them or our staff, about various research projects being conducted in various schools of engineering at Wisconsin. A more complete coverage of the engineering societies' news can be incorporated into this section. Pictures of campus activities and displays on the engineering campus are to be used to supply additional information and to brighten up the page layouts.

Sneed's Review will continue to review current books, the engineer's intelligence will still be tested (or exasperated) by the section So You Think You're Smart, and we hope to provide many more chuckles around The Ferrous Wheel.

At any time during the year, though, we sincerely hope to have a close contact with what the readers would like to read, but the only way we can do this is to receive letters from readers expressing their wishes or their criticisms. The quality of a magazine can be improved considerably by the readers themselves, for, oft times, the editor and the staff make mistakes (believe it or not) in article selection or even in general policy, and letters filled with good healthy criticisms could do a great deal for us not only in establishing contact with our readers but in giving an indication of things to include or things to exclude from the contents of the magazine.

A load of overburden falls earthward from the *River Queen's* dipper. The *River Queen* is 140 feet high—the equivalent of a 13-story building—from the ground to the top of the boom sheaves. For more information, see Science Highlights on page 32.

—Photo Courtesy of Caterpillar

Synthetic Fuels

by Alvin Crego ChE'59

A survey of processes that may become economically feasible if natural liquid fuel supplies are exhausted.

WITH the present increased use of petroleum for fuel and heating it is apparent that new methods of producing fuel need to be developed, as natural petroleum production will reach its peak about 1985. A natural source of liquid petroleum would seem to be coal, as most countries have abundant coal supplies and the use of coal has decreased since the use of diesel engines and fuel oil heating systems. It is hoped that more economical processes will be developed and that synthetic liquid fuels will soon be able to compete with natural petroleum fuels. Development of such a process would also restore the coal markets which have recently decreased.

Some methods of producing synthetic liquid fuels from coal have been developed in recent years. Most notable among these is the Fischer-Tropsch process, which will be discussed at some length. There are several variations to this process.

Synthetic liquid fuels are fuels produced from coal or some other medium for use as substitutes for liquid fuels as derived from natural petroleum. The coal is first mined, crushed, pulverized, then gasified, and finally liquefied, to produce the required fuels. The range of synthetic products from coal includes gasolines, oils, waxes, and resins.

Petroleum is the life blood of the nation, both in peace and war. Automobiles, trucks, tractors, airplanes, and ships, depend upon it for motive power and it is now commonly used to heat homes and industrial plants.

It seems clear that the peacetime petroleum demand will continue to rise, costs of exploration and discovery will continue to increase as petroleum becomes more scarce and any future war will require enormous amounts of petroleum. As solid fuels may never be as convenient for many uses as liquid fuels, it seems obvious that new methods of producing such liquid fuels must be developed if demands are to be met.

The Germans did the first work in the production of synthetic liquid fuels and are credited with the discovery of the basic principles used in the synthesis. The Fischer-Tropsch synthesis, which was developed successfully around 1937, is the most widely used process. Peak production was reached in Germany during World War II; nine plants were in operation and the production reached a high of 15–18,000 barrels per day. Since then production has tapered off because the plants cannot compete economically with natural petroleum products.

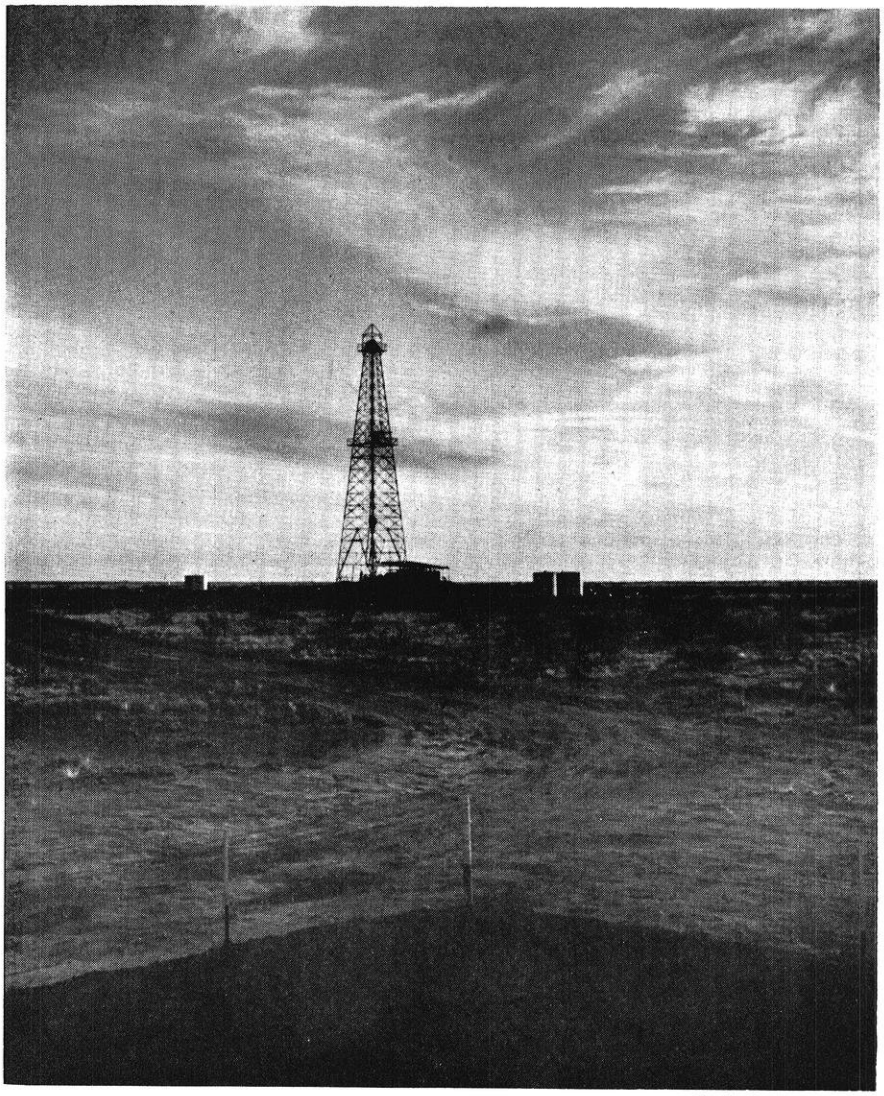
Australia and Africa, and the United States, have recently constructed pilot plants and done a lot of research on synthetic liquid fuel production. At present the only plant which seems likely to succeed economically is the Sasol plant in Africa. None of the plants in the United States are able to produce liquid fuels at prices that compare with present liquid fuel prices.

Unless petroleum becomes extremely scarce, or new developments are discovered in the synthesis processes, the production of synthetic liquid fuels from coal seems to be uneconomical for the time being. Australia has developed a process using brown coal which has low calorific value, but still seems to have definite promise as a source of liquid fuels. The process is not profitable as yet, but with future developments it may result in a major source of liquid fuels.

Germany and other countries have tried to develop profitable methods of producing synthetic liquid fuel from coal due to shortages of natural petroleum and an abundance of coal. This was especially true in Germany's case during World War II, when she was unable to import the petroleum which was needed.

Countries with an abundance of coal are also interested in developing new uses for it. The demand for coal has decreased since the introduction of diesel engines and the use of oil in heating homes and industrial plants. Oil companies in the United States are also interested in methods of producing liquid fuels from coal. They realize that petroleum deposits are limited and that increased costs of production, due to development of harder to reach spots and poorer crude petroleum, will eventually force them to produce liquid fuels by other means.

That every modern country needs a reliable source of petroleum has been amply illustrated by the recent events in the Middle East. South Africa has an abundant supply of coal of pure quality with



—Shell Oil Company

Perhaps oil rigs like this will become obsolete if synthetic fuels can economically compete in the future.

a high ash content, but has no natural petroleum deposits. In 1938 Germany, France, and Manchuria had Fischer-Tropsch factories, and in 1955 construction of the Sasol factory began. Sasol is the largest plant to be built in the world and is the only one which is expected to be economically successful.

Sasol produced about twenty per cent of South Africa's petroleum requirements from high-ash bituminous coal in 1957. Two variations of the Fischer-Tropsch are used in this plant and a range of some twenty chemicals will be made.

The plant was constructed by the M. W. Kellogg Company of America and Arge Construction of Germany. The ultramodern, highly instrumented factory is situated in the banks of the Vaal River, above an extensive deposit of low-grade coal. The coal bed has an estimated 300 million extractable tons.

Eight thousand tons per day are mined, crushed, and conveyed to the storage bunkers. The processed coal is blanketed with nitrogen to prevent spontaneous combustion in the storage bunkers. The coal is sized, with the small sizes being used to fire the pulverized fuel boilers. The larger pieces are gasified under pressure in the Lurgi pressure gasifiers.

The oxygen plant consists of six Linde units, five which are normally in operation. Each unit processes 1,840,000 standard cubic feet per hour (scfh) of air at a pressure of 71.5 pounds per square inch (psi) to produce 347,000 scfh of oxygen gas of 99.1 per cent purity, 675,000 scfh of nitrogen containing 0.03 per cent oxygen and 675,000 scfh of nitrogen containing 2.6 per cent oxygen. The oxygen recovered as product is 94.4 per cent of the oxygen fed in. Provision is also made for the withdrawal of a small amount of liquid oxygen for sale.

The Lurgi high-pressure gasification system was developed in Germany in the 1930's. Basically the gasifier consists of a fixed-pressure bed, generally using lump fuel coal, three-eighths to one and one-half inch mesh, which is fed in, and semi-continuously removed from the bottom. The Sasol plant has nine such gasifiers in all.

A steam-oxygen mixture is introduced in the lower part of the generator. The proportions of the mixtures of steam-oxygen feed are so regulated as to provide the desired composition of gas and to keep the temperature low enough to prevent clinker formation and fusion of the ash. The hot gases, rising through the fuel-bed, heat the descending coal so the volatile constituents of the coal are distilled off in the upper part of the vessel.

Increasing the pressure favors the formation of the multiatomic gases CO_2, CH_4, and H_2O, while increasing the temperature favors the formation of hydrogen and carbon monoxide. Most of the reactions are exothermic. The heat liberated is removed by means of a water jacket.

The gas ratio of hydrogen to carbon monoxide can be adjusted by control of the steam to oxygen ratios. For high hydrogen to carbon monoxide ratio, high steam to oxygen ratio is used.

Table I.—SOME REACTIONS THAT TAKE PLACE IN THE LURGI PRESSURE GASIFIER

$C + O_2 = CO_2 + 169.2$ BTU
$C + CO_2 = 2CO - 74.2$
$2C + O_2 = 2CO + 95.1$
$C + H_2O = CO + H_2O - 56.4$ (Above 1000° C.)
$C + H_2O = CO_2 + 2H_2 - 38.71$ (Below 900° C.)
$2CO + 2H_2 = CH_4 + CO_2 + 106.2$

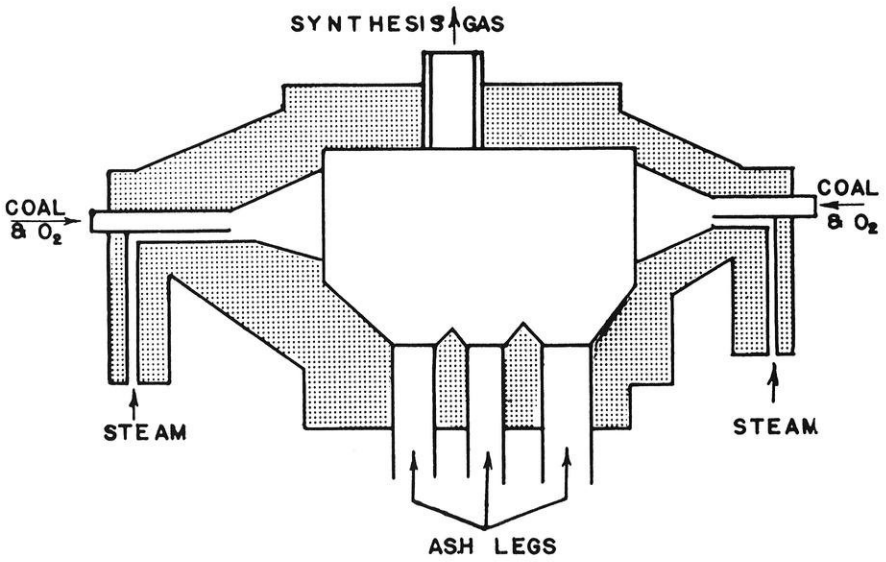
Table II.—SOME ADVANTAGES AND DISADVANTAGES OF LURGI HIGH PRESSURE GASIFICATION

Advantages

1. Decreased plant size for a given output of gas, which is partly offset by increased capital cost.
2. H_2S gas and CO_2 removal is taken care of.
3. Subsequent transference of gas is easier.

Disadvantages

1. Decreased efficiency of steam conversion with consequent increased consumption.
2. Methane is formed, which is undesirable in gas synthesis purposes.



Louisiana plant horizontal gasifier.

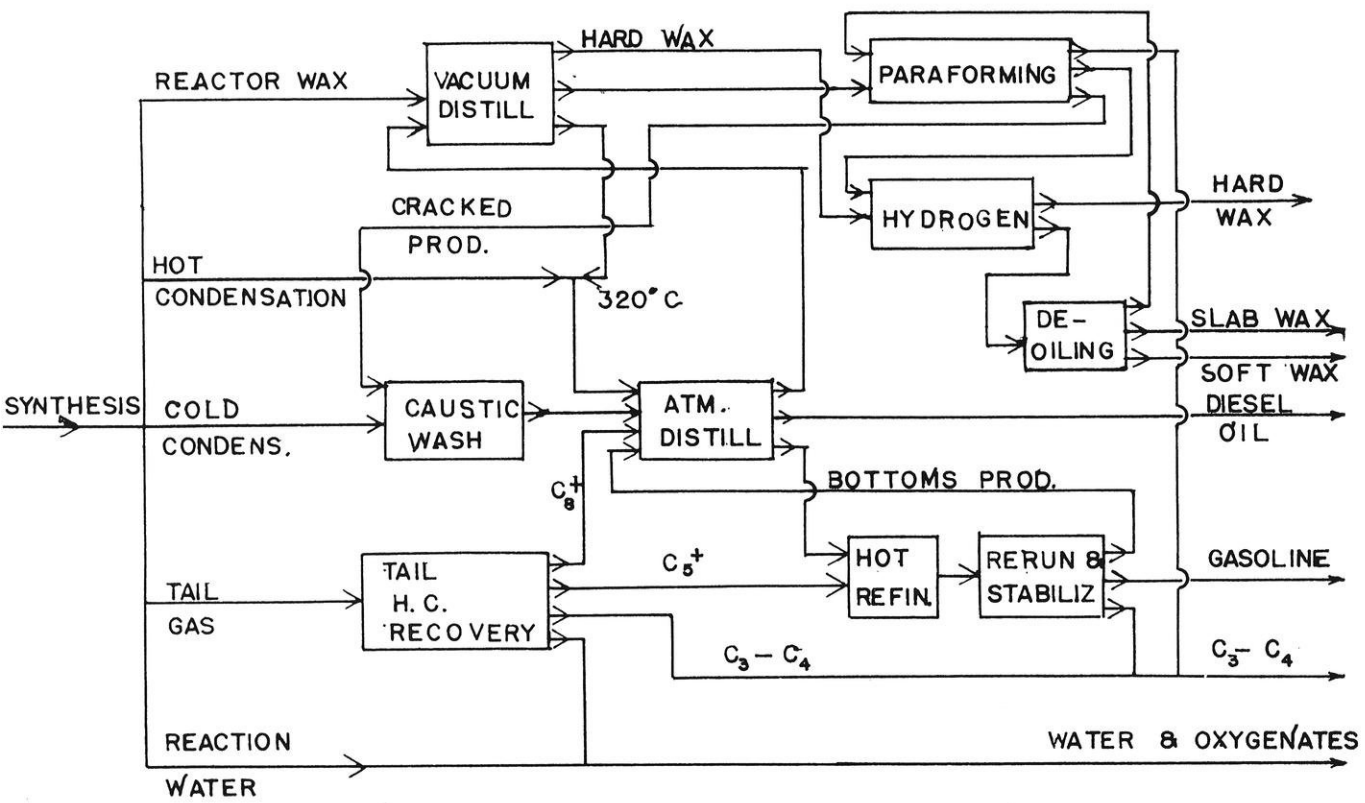
The Rectisol purification process is based on the fact that carbon dioxide and hydrogen sulfide are highly soluble under pressure in cold methanol and are readily released from solution when the pressure is reduced. The gas leaving the gasifier contains a large amount of carbon dioxide and smaller, but objectionable, quantities of hydrogen sulfide, organic sulfur compounds and aromatic hydrocarbons, along with a quantity of fine fly ash. The fly ash and condensate is removed in gas cyclones.

There is sufficient condensate so complete removal of dust from the gas is ensured. The water, organic sulfur compounds, aromatics, and methanol are removed by treatment with low pressure ammonia, cold CO_2 + H_2S, and cold pure gas.

A scrubbing process then occurs, which consists of a pre-wash, main wash, and a fine wash. The pre-wash stage is to remove the last traces of aromatics and organic sulfur compounds. The main wash tower removes most of the carbon dioxide and practically all of the hydrogen sulfide. In the fine wash section the gas is contacted with methanol at —50° F. and the carbon dioxide content of the gas is reduced to about one per cent. The hydrogen sulfide left usually cannot be detected.

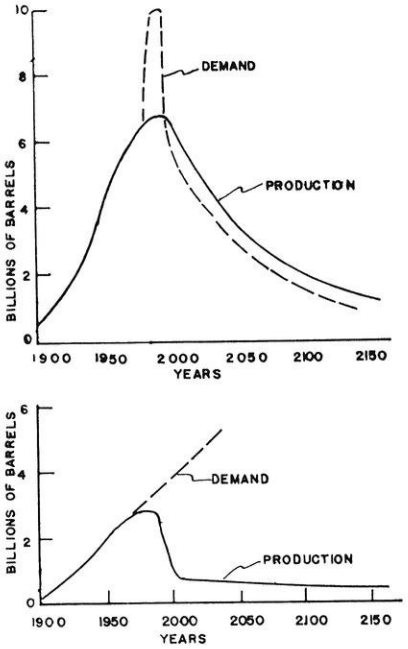
In contrast to the Kellogg synthesis, with its circulating reactors, the Arge synthesis plant uses fixed-bed reactors. The Fischer-Tropsch plants built in Germany before and during World War II had a large number of relatively small reactor units to contend with the heat removal problems. Extensive research on rate of heat removal as a function of tube diameter and gas velocity has enabled Arge to design much bigger units and to use much greater gas loads. The five Arge reactors at Sasol have the same output of hydrocarbons as seventy-five small reactors of pre-war German design.

The feed gas enters at the top of the reactor and consists of fresh



—Drawn by Dick Jones

Flow diagram of the Arge work-up section.



Top—World petroleum production.
Bottom—U. S. petroleum production.

gas from the purification plant and reactor tail gas in a ratio of 1:2.3. Each reactor has a fresh gas feed of 20,000 Nm^3/hr, with a H_2:CO ratio of 1:1.7 and thirteen per cent methane. Arge reactors operate at approximately 360 psi. The reaction temperature at the beginning of a run with fresh catalyst is 200–230° C. and the temperature is raised as the catalyst becomes older.

The Fischer-Tropsch catalyst is extremely pyrophoric. To load the reactor system it is first necessary to purge the reactor system completely with dry inert gas. During transportation to points where it is used, the catalyst is stored under inert gas. The catalyst must be discharged after a completed run and fresh catalyst added.

The products obtained during the reaction consist of hydrocarbons ranging from methane to extra-hard paraffin waxes. At Sasol, only hydrocarbons from C_3 up are regarded as products; the CH_4 and C_2's are reformed to carbon monoxide and hydrogen. Water soluble alcohols are collected in the condensed reaction water and passed to the central oxygenater recovery section.

The hydrocarbon products condense as the temperature drops in the several units of the cooling train of each reactor and are collected separately. In this way, by partial condensation, a rough separation in boiling ranges is obtained. The Arge plant, with four reactors running and one on standby, is designed to produce a minimum of 53,000 metric tons a year of primary products.

The Kellogg synthesis does not require reactivation of the circulating catalyst. The catalyst activity is maintained at the desired level by daily removals of old or "equilibrium" catalyst and addition of a corresponding amount of new catalyst. The catalyst is an important part of the synthesis and is a special type of iron ore. The metal and its concentration are set by the desired product distribution. For the ore to be properly metered it must be completely dry.

The synthesis section of the plant consists of two units. Each unit is operated independently of the other, but in an identical manner. This duplication of equipment exists throughout the stages from synthesis reactor to the separation of gas and liquid products. The product gas and oil streams from both units are combined for processing.

Gas feed to the reactor consists of fresh feed from the gas reforming unit and internal recycle gas in a ratio about 1:2. The temperature of the combined feed is about 400° F., with the total design feed volume being 250,000 Nm^3/hr. It is estimated that catalyst circulation through the reactor is in excess of 4,000 tons per hour.

The reaction takes place at a pressure of 250–300 psi. The reaction is highly exothermic and begins immediately upon contact of feed gas and catalyst. The heat of reaction increases the temperature of the catalyst-gas mixture as it travels through the transfer line and reactor. The rate of reaction and its completeness can be governed to some extent by control of the catalyst loading, i. e., the available reaction surface. Increasing the reaction increases the temperature and the reaction rate; thus careful control of temperature and catalyst loading is necessary.

Vapors leaving the tower first pass through mist extractors. These vapors contain non-condensable gases, light hydrocarbons, other chemicals and water.

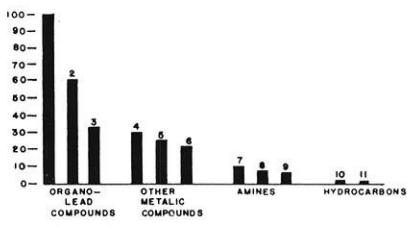
The heavy oil, called decanted oil, from which the catalyst has settled rises to the top of the section and is removed for further treatment. The slurry of catalyst and heavy oil is referred to as "gunk" and is discharged into drums for disposal or later recovery. The liquid production is 140,000 gallons a day, including polymer gasoline produced in the catalytic polymerization section.

A rough separation is affected between high and low boiling-product fractions by partial or stepwise condensation of the reactor products. The Arge work-up procedure is to: 1. refine primary product to final products of the required specifications. 2. separate these products which must be "worked-up" along with the corresponding Kellogg synthesis products.

Feed to atmospheric distillers consists of the cold condensate, the oil fraction used for extraction of the catalyst, the hot condensate, the C_8+ fractions from the tail-gas recovery, and recycle streams from the hot-refining high-vacuum distiller and paraforming plants.

To remove traces of organic acids, the cold condensate, paraformed product, and extracted oil are first washed with dilute caustic and a water after-wash. The combined feed is then continuously distilled into the following fractions: a) overhead; petroleum to hot refining plant. b) side; power paraffins. c) side; diesel oil. d) side; fuel oil. e) bottom; waxy oil to high vacuum distillate.

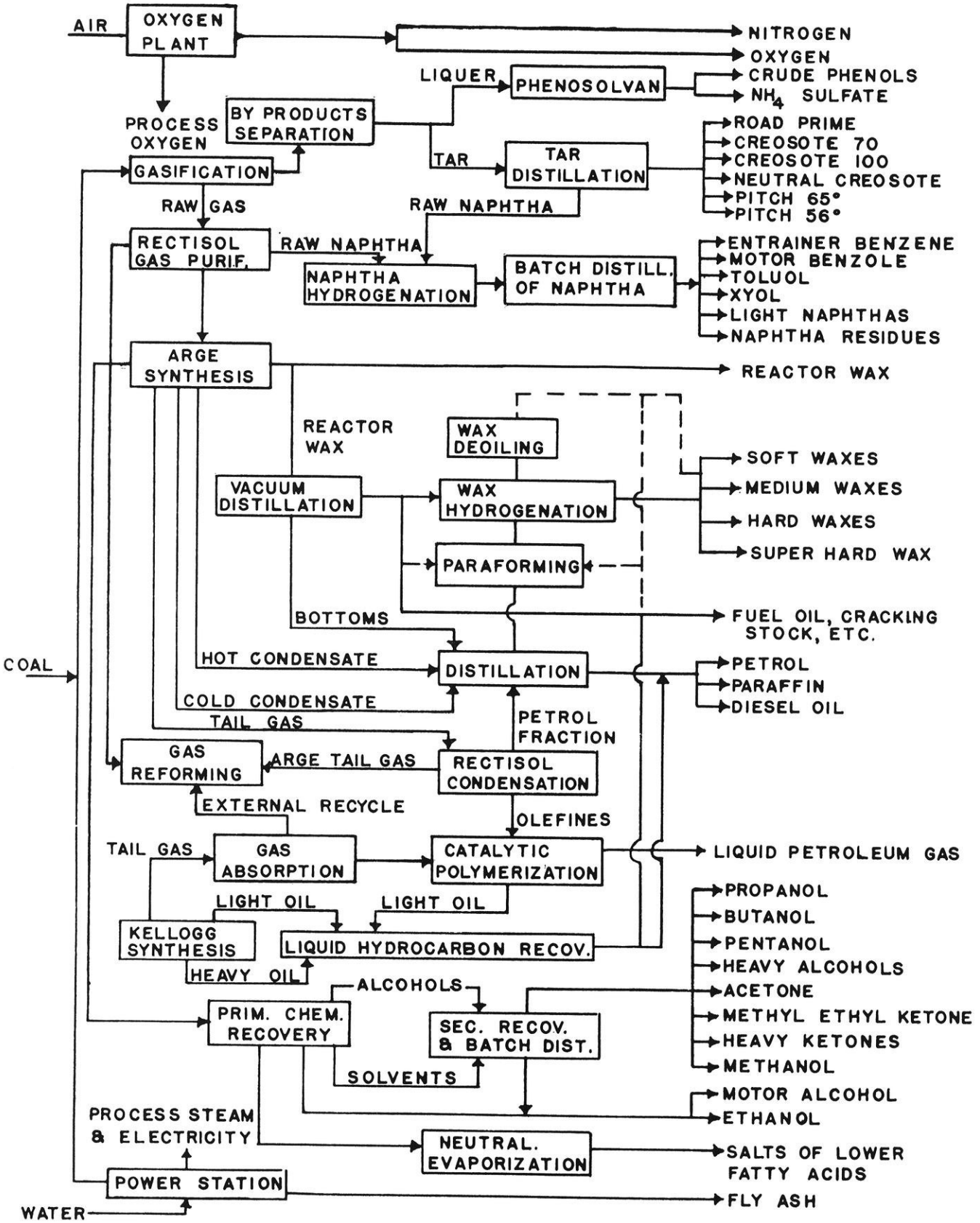
The distillation columns are of standard design. The feed is preheated by heat exchange with the hot product and further heated in a gas fired furnace. The vacuum distilling unit consists of three high vacuum distilling towers and a stripping tower. The reactor wax, which still contains some medium



Relative effectiveness of antiknock compounds compared with tetraethyllead°

Key

1. Tetraethyllead
2. Tetraphenyllead
3. Dibutyldiphenyllead
4. Nickel carbonyl
5. Iron carbonyl
6. Diethyl telluride
7. Xylidines
8. Toluidines
9. Aniline
10. Isooctane
11. Benzen



—Drawn by Dave Sharp

Sasol plant diagram and range of Sasol products.

boiling hydrocarbons, is passed over a vacuum stripper to remove the hydrocarbons boiling under 320°C. The stripper vessel is divided into three compartments.

The partly-stripped product from the first compartment overflows into the second compartment, where it is further stripped, and finally overflows to the third stripping compartment, from where the stripped bottom products leave through the overflow pipe. The stripped light hydrocarbons, after condensation, go to the combined feed of the atmospheric distilling unit. The stripped wax now joins the bottoms product of the atmospheric distillation, and is passed into the first of three vacuum towers.

This tower produces an overhead fraction boiling between 320 and 370°C. The bottom product of the first tower goes to the second and third towers, which operate in parallel. The overhead product of these two parallel towers is the wax fraction 370–460°C., where as the bottom product is unrefined hard wax, with a boiling point of 460°C. Each high vacuum distillation tower consists of a reboiler of special design, a rectifying tower with Raschig rings, and a condenser built on top of it. Each heating element is surrounded by a baffle system to make it a more or less independent unit.

The paraformer is a thermal cracking plant serving two purposes:

1. Cracks hard wax to medium and soft wax.
2. Cracks the waxy oil-fractions into diesel oil and petrol.

The plant consists essentially of a cracking furnace, an atmospheric and a vacuum distillation tower. The vacuum distillation tower is used only in wax cracking.

The hot refining plant is designed to convert alcohols and aldehydes into hydrocarbons and improve the octane rating of the petrol by shifting the double bond of the olefins from the end to the center of the molecular chain. These changes are made by passing the petroleum vapors at 400°C. over a fixed catalyst bed. The plant consists of a furnace for feed heating, two refining reactors, a superheater to supply superheated steam for the steam-air mixture used for catalyst regeneration, and the necessary feed pumps.

Hot, refined vapors are cooled to 70°C., overhead vapors are condensed, separated from water formed in the hot-refining reaction, and passed to the stabilization column. The overhead vapors are condensed with cooling water and the non-condensables of this first cooling stage are deep-cooled by liquid ammonia, which produces more liquid products. The fixed gases from this stage go to the fuel gas system. The condensed overhead product serves as a feed to the atmospheric polymerization plant.

Wax streams are hydrogenated to convert all the non-paraffinic components into the corresponding paraffins. Hydrogenation is carried out in the liquid phase, over a fixed catalyst bed, with pure hydrogen—in concurrent streams. The residence time is two to three hours. The hydrogenated wax fraction consists of a mixture of soft wax, medium wax, and some oil.

The liquid and gaseous hydrocarbon streams from the synthesis section are treated to produce useful products for sale. The overheads from the fractionating column are C_3 and C_4 hydrocarbons, which are condensed into a reflex drum. The two side-draw-off products are lean oil stripper feed and diesel oil stripper feed. The stripping steam condenses out with petrol and is drawn off to drain. The petrol, which is of an exceptionally high quality, is pumped from the reflux drum to storage or else used.

In the catalytic-polymerization section, olefinic hydrocarbon gases are polymerized to produce high grade petrol, which is a standard operation in modern oil refineries. The overhead product is bottled as liquid petroleum or used as fuel gas. Butanes are removed from the bottom of the tower and provided with polymer gasoline.

The basic principles of the Fischer-Tropsch process developed by the Germans are employed at the Louisiana plant. As developed in Louisiana, the process consists of two relatively independent stages; namely, gasification of the coal and synthesis of the liquid fuel.

The original German synthesis plants made their synthesis gas in water gas sets or other standard gas producers, sometimes adding oxygen to the air feed to increase the capacity of the units. Gas from units such as these is too expensive in this country for producing liquid fuels within reasonable prices. Thus, new gasification techniques had to be developed before the gas synthesis process became close to an economic possibility for producing liquid fuels from coal.

Some German experiments had been conducted on direct gasification, but no work had been done on suspended powdered coal gasification with oxygen. Koppers Company obtained one of these designs and used it as a basis for the first gasifier at Louisiana. This unit was a horizontal drum with inlets for oxygen, steam, and pulverized coal at each end. Synthesis gas was discharged from the center of the top of the drum.

The synthesis step has gone through a rather extended evolution. The biggest problem was cooling. The Germans inserted a large number of water-cooled finned tubes into the catalyst bed or used expensive double-tube boiler type converters. They still had hot spots in the bed and had to recycle one to five volumes of tail gas to temper the reaction. They finally experimented with circulation of cooling oils through the reactor.

The Louisiana plant centered its attention on such oil cooled systems. In the first experimental test, oil was sprayed over the top of the catalyst trays, but even the high specific heat and heat of vaporization of the oil did not provide sufficient cooling. The catalyst chamber was then flooded with coolant circulating counter-current to the process flow. This gave adequate cooling, but uniform rates were not obtained. All the oil cooled systems suffered from excessive rise of pressure drop with time, caused by the cementing of catalyst particles by wax formation and swelling.

Finally, a countercurrent flow system was developed in which the catalyst, instead of being held in layers by retaining screens, was charged into the vessel in bulk. The rising stream of oil and gas lifts the catalyst and causes the individual particles to move continually with a jiggling motion. Sensitive tem-

(Continued on page 50)

Gasoline Additives and Motoring Economy

by Alan McCone Che'58

The continual race for a new and better additive and for higher octane fuels is explored by the author. He shows how high compression engines have given new problems to the gasoline industry.

WHEN the automobile industry was in its infancy, motor fuel refining consisted merely of running crude petroleum through a series of topping stills and then shipping the light fraction to filling stations. Costs of production were low, and customers were not very choosy about fuel quality as long as their cars operated.

Since then, however, refining has become a much more complicated operation and the refining business is highly competitive. Advances in automobile design have put very exacting demands on refiners as to product quality.

Some of the fuel properties required by automobile manufacturers simply could not be met by raw gasoline. Others were possible to meet by refining the gasoline further, but only at excessive cost.

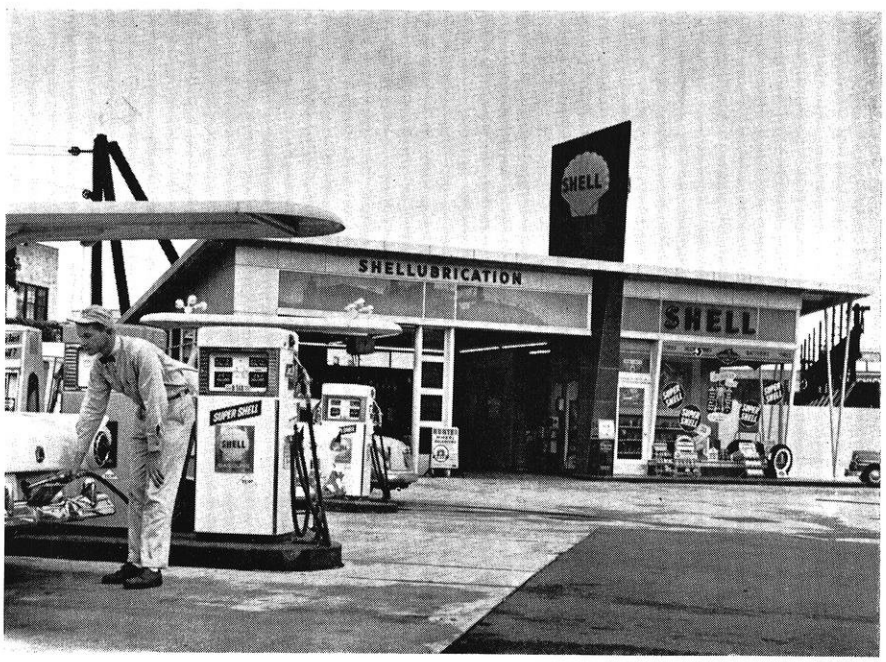
In order to put out a high quality product at reasonable price, the refiners had to add to their product certain compounds that did not naturally occur in petroleum. In many cases these additive substances have become so important that they are now critical factors in all refining cost and product cost calculations.

Gasoline additive compounds can be said to fall into two general classes. Certain additives are used to improve the stability of the refined gasoline in storage and insure proper flow of the fuel through the induction system of a vehicle. Anti-corrosion, anti-icing, anti-gumming agents, detergents and top cylinder lubricants are examples of this type. They could be called fuel conditioners.

Other additives, like tetraethyl lead, combustion chamber scavengers, and deposit modifying agents, affect fuel burning and combustion chamber conditions. These could be called combustion control additives.

Automobile engine designers reached a limit shortly after the Second World War. The engines they had were virtually as good as they could be made. Further development lay in the direction of increasing cylinder compression ratios. But the gasoline available at the time did not have the octane properties required to permit high compression engines to run smoothly. There was too great a tendency to knock.

Then, in the early 1950's, catalytic reforming processes for upgrading straight-run gasolines were developed, and refiners could now



--Courtesy Shell Oil Company

Shell gasoline features a phosphate additive known as TCP.

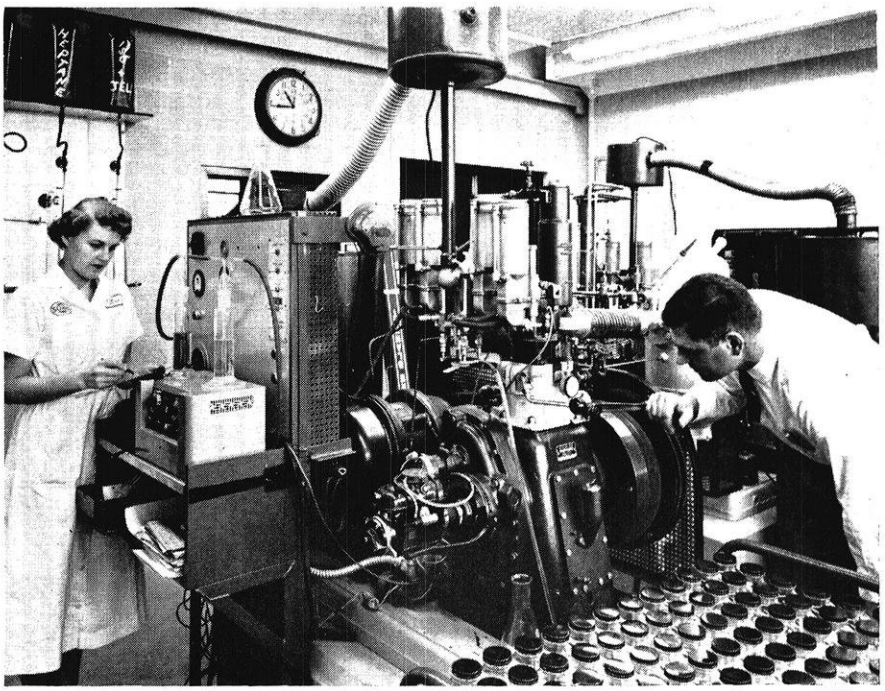
produce higher octane gasoline in quantity. This was the opportunity the auto manufacturers were waiting for. Immediately they began to introduce higher compression engines into their new models.

The consequent rise in demand for the high octane gasoline then led refiners to find ways to produce even more high octane fuel and to raise the average octane level of gasoline even higher. Each new increment in octane level of refinery product permitted engine designers to raise compression ratios more. Each rise in compression ratio produced a demand for a still higher "pool" octane level. The so-called "octane race" was on.

The cycle has continued until at the present time both regular and premium grade gasolines stand at about 10 octane numbers above their figures of a decade ago. And experts predict the rise will continue until the average research octane number of leaded premium gasoline is about 100.

In this high-quality region refining costs for each new octane increment become increasingly high. More than before, fuel manufacturers are ready to use additives that improve fuel engine performance for less expense than that which would be incurred by additional refining.

Tetraethyl lead (TEL) was one of the first compounds to be added to gasoline. In the early 1920's experimenters found TEL had a marked effect of reducing knocking when added to a fuel. It had the same effect on retarding fuel burning rate as enrichment of the fuel by higher octane stock.



—Courtesy Sohio

This photograph illustrates the system of rapid octane ratings used to screen additives. The bottles contain base fuels with various additives to be run in a statistical plan to compare each additive to the base fuel. The engine being used is a standard CFR knock-test engine.

After 35 years of use TEL is still the most effective antiknock compound known. The accompanying bar graph shows the relative effectiveness of other compounds studied compared to TEL. TEL has one disadvantage. It is highly toxic in concentration. For this reason the federal government prohibits use of more than 3 c.c. per gallon of gasoline, and requires all leaded gasoline to be dyed.

Most refiners now seldom use the maximum 3 c.c. lead in their products, it turns out. As the concentration of TEL is increased its ability to increase octane diminishes. Between 2 c.c. and 3 c.c. TEL per gallon there is a balance point at which the cost of octane increment per barrel by adding more TEL is as great as the cost to give the increment by raising the severity of reforming and other up-grading refining processes.

Generally refiners attempt to keep their neat (unleaded) plant output at such octane level that addition of from 2 c.c. to 3 c.c. TEL per gallon will be sufficient to bring the product up to the market octane number requirements.

With the advent of higher engine compression ratios an old problem has become more critical—the problem of combustion chamber deposits. When TEL was first introduced, accumulation of lead salts in the chamber caused difficulty until ethylene dibromide and dichloride were mixed with the TEL. These dihalides formed vola-

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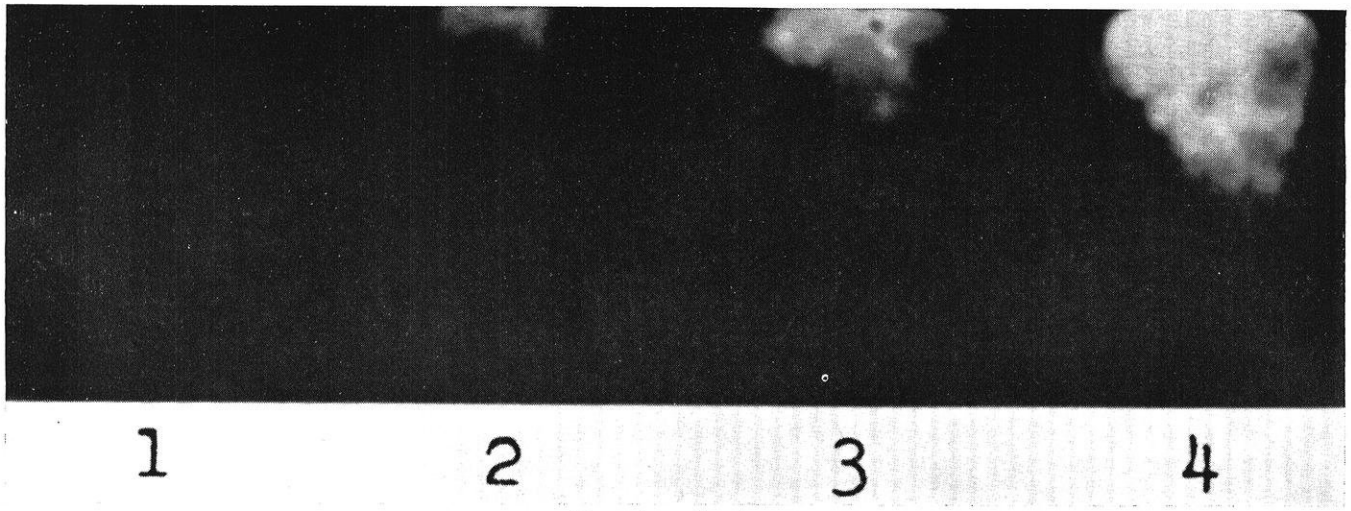
—Courtesy Standard Oil of Ohio

This station got its name from an additive.



Normal combustion.

tile lead halide salts that vaporized and were removed with exhaust gases.

Deposits formed by carbon and fuel impurities are not removed by the halide scavengers, however. Often these deposits have a tendency to retain heat and glow after the fuel is burned, and may ignite the fuel injected for the next stroke before the proper instant. When this preignition occurs, the motorist notices an erratic knocking commonly called "wild ping." The condition produces the same effect as that which results from a badly advanced spark. Similar deposits also form on spark plugs in such a way as to short out the spark current and result in failure of the plug to fire.

As engine compression ratios rise and combustion conditions become more severe, the effect and frequency of these two conditions become more acute. More deposit is laid down, and compression temperatures are higher and make the fuel-air mixture even more prone to preignition.

One way of counteracting these conditions is to increase the octane number of the fuel. Octane improvement has the same effect of retarding the fuel burning rate in the case of preignition as it does in smoothing out regular knocking. As a matter of fact, some of the current efforts to improve octane number have been aimed more at the preignition problem than at the tendency to knock at high compression ratios.

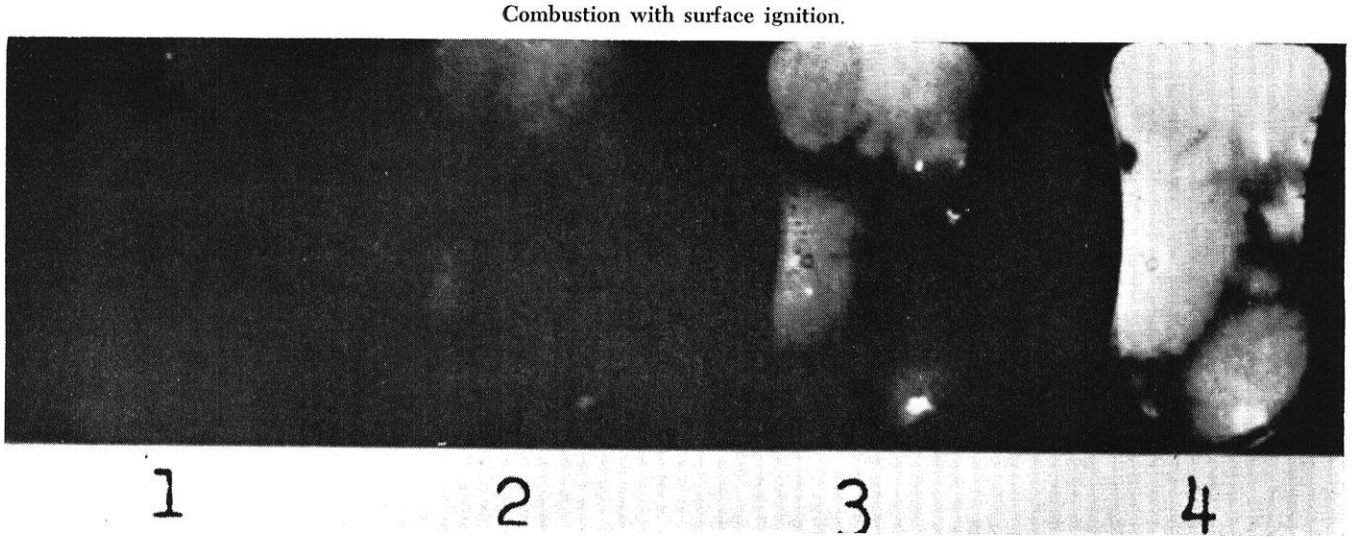
But this increment of octane number to check "wild ping" represents a loss to the refiner. As the editors of PETROLEUM PROCESSING stated it in a January 1954 article, ". . . octane numbers to supress preignition . . . are needed to overcome a condition that is not related to engine efficiency. Hence, they might be looked on as octane numbers that are wasted."

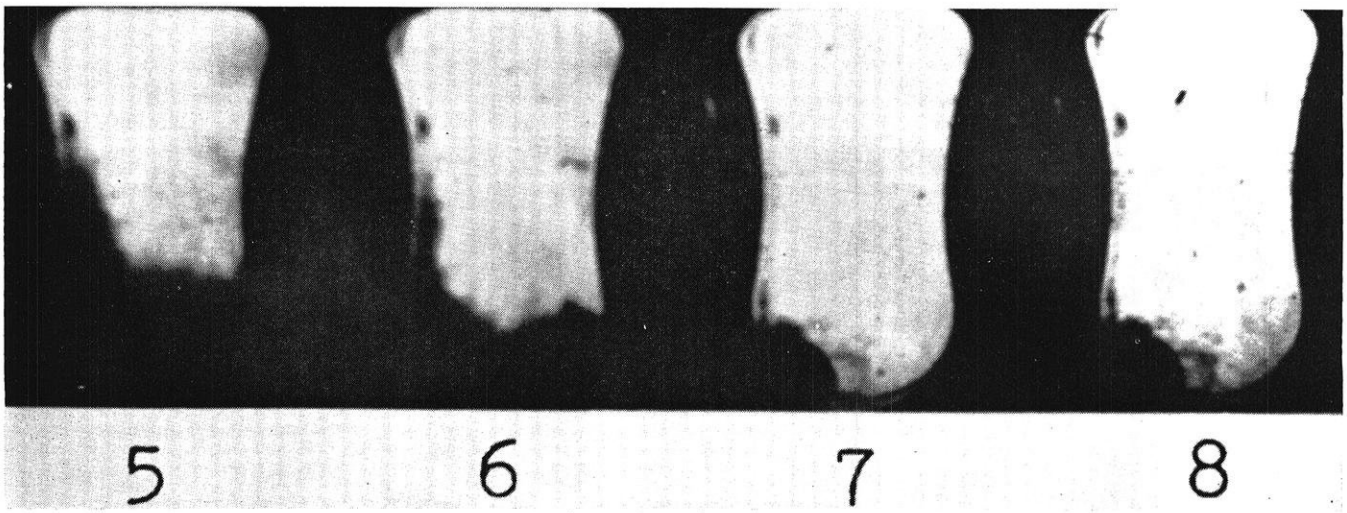
The authors suggested certain engine design improvements that would reduce the effect of preignition and noted also that lower volatility fuels seem to have less tendency to "ping." But the most promising method of correction seemed then to be the discovery of some additive that could scavenge the deposits or alter them so they would not glow.

Several deposit modifiers were studied and developed in 1954, most of them phosphorus compounds. Considerable controversy arose over the effectiveness of one of substances, tricresyl phosphate (TCP), which the Shell Oil company was adding to its gasoline.

Researchers found that TCP did indeed eliminate incandescence to a great extent, and that it modified spark plug deposits so as to make them non-conducting. But phosphorus forms extremely non-volatile salts with lead, and TCP itself seemed to be contributing to general deposit build-up. The Esso company claimed that refining op-

Combustion with surface ignition.





Normal combustion.

—Courtesy Standard Oil of Ohio

erations giving a higher purity fuel with less tendency to form deposits were more satisfactory for reducing preignition than addition of TCP. Nothing conclusive was established from the debate over TCP, and several refiners elected to use phosphorus additives.

One corporation, the Standard Oil Company (Ohio) developed a new type of compound, one containing boron. According to Standard, their additive has all the properties of an ideal modifier, plus. The compound not only modifies deposits to eliminate incandescence, but also increases their friability and acts as a scavenger in the same way the dihalides act with TEL residues. Boron salts with lead are volatile.

Motorists using fuel with phosphorus additives often had to go through two tanks of gasoline before they noticed any reduction of "ping." The boron compound has an immediate effect in reducing preignition.

In addition, the compound has pronounced antiknock properties, especially when TEL is present in concentrations near the 3 c.c. per gallon maximum. The addition of the compound to gasoline in its normal concentration range (approximately 0.008 to 0.04 per cent boron compound) has the effect of the fourth c.c. of TEL that refiners are not permitted to use.

Trace sulfur compounds which usually poison additives actually increased the antiknock effectiveness of Sohio's boron compound. The additive also reduced valve burning and channeling and eliminated spark plug fouling. It is no more toxic than gasoline itself.

The claims of Standard for its boron compound shed light on what is sought by refiners in a fuel additive. Its effect on every phase of motor and fuel system function must be considered when evaluating a new substance.

A report presented to the Society of Automotive Engineers in 1954 by members of the technical staff of the Ethyl Corporation was quoted in PETROLEUM PROCESSING as saying: "To improve fuel basically, the additive should improve the durability of the vehicle. Without this broad yardstick, the particular benefits of additives may be more than offset by detrimental effects on some other phase of engine operation."

The report then lists nine areas in which additives could affect durability:

1. The additive should not corrode metal parts of the fuel system or deteriorate pump diaphragms.

2. The additive should have good inductibility. It should leave no deposits in the carburetor, on hot spots, in the manifold, on intake ports or under the heads of intake valves.

3. The additive should not raise octane requirements of the fuel by forming deposits or by increasing

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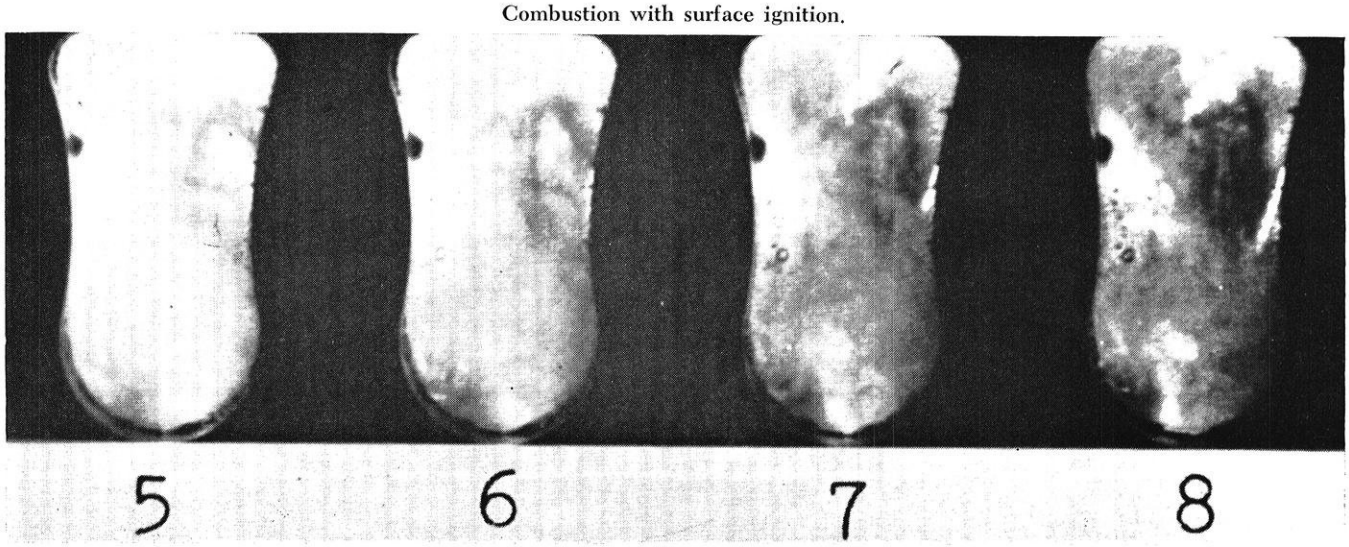
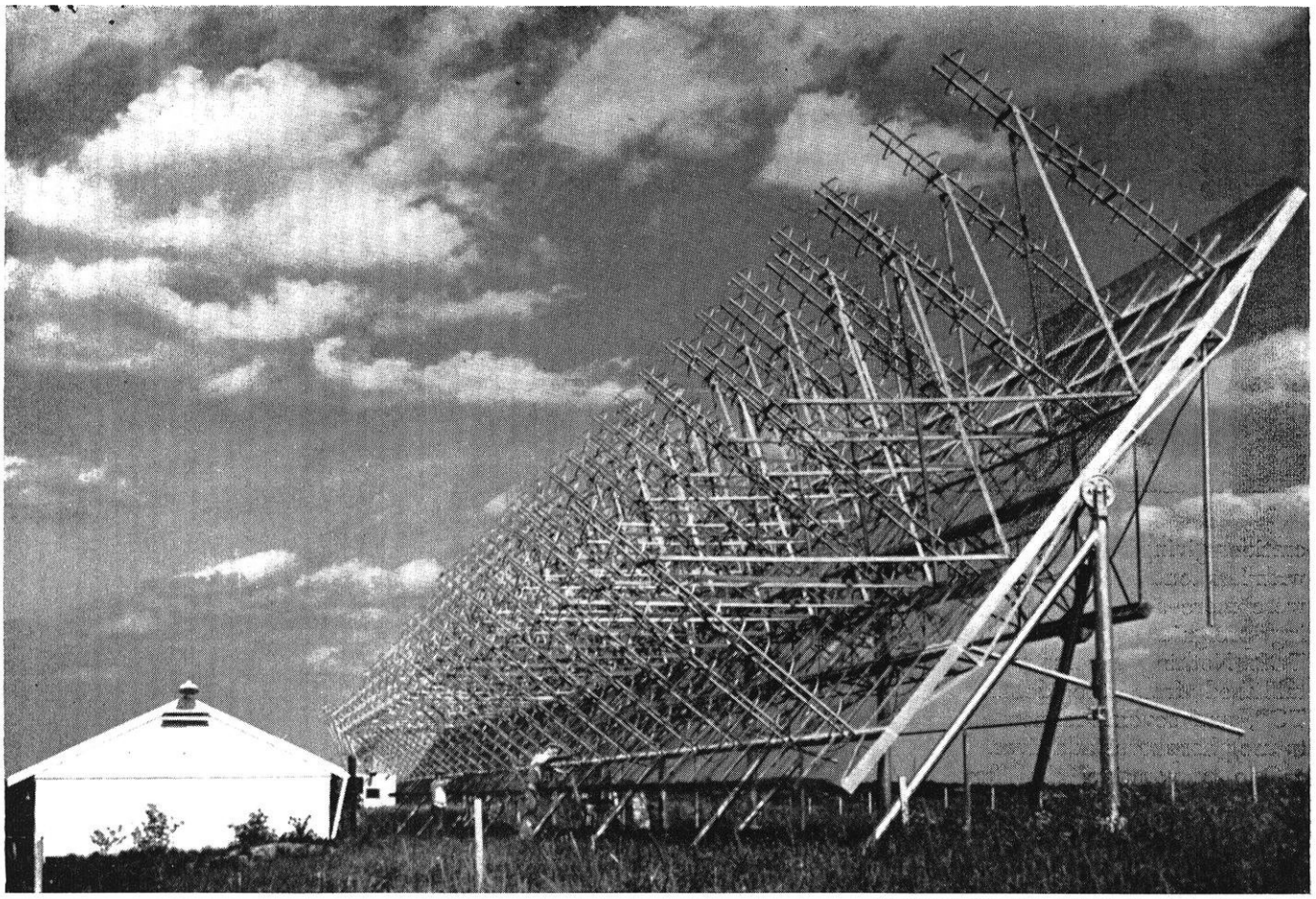
Combustion with surface ignition.





—All Photos Courtesy of Prof. Ko, Ohio State U.

The Ohio State 96-helix radio telescope.

Radio Astronomy —Window Into Space

Since earliest times man has gazed out into space and has been both baffled and fascinated by what he saw. Now a new instrument—the radio telescope—gives promise of unlocking some of the mysteries of space.

by Edward N. Disrud ee'58

RADIO astronomy began in 1932 when Karl Jansky discovered electromagnetic radiation from outer space. The science of radio astronomy did not develop very rapidly at first, but tremendous advances have been made in the last 15 years. These advances can be attributed to the great studies made in electronic equipment since and during World War II.

Jansky graduated from the University of Wisconsin in 1929 and went to work for Bell Laboratories at Cliffwood, New Jersey. He was assigned to study the effects of static and interference on the new short wave Bell transoceanic telephone circuits. During the course of his experiments he came across an unknown hiss static which he thought was of terrestrial origin. This static appeared at 20.53 megacycles, which corresponds to a wavelength of 14.60 centimeters.

This unknown static varied with the time of day and also with the day itself. Jansky's theory of celestial orgin soon vanished be-

cause the equipment received these signals when storms and radio interferences were absent.

After about two years of data taking he noticed that the static varied with the earth's rotation about its axis and also with the earth's rotation around the sun. With the aid of an astronomer, he began the calculations that lead to the conclusion that the static was coming from a spot fixed in space.

This discovery did not cause much interest at first but a man named Grate Reber did become interested. He worked at different frequencies and with a paraboloid antenna. His work along with Jansky's has given the world almost a quarter-century of radio astronomy.

Studying celestial bodies by the radio waves they emit has aided the astronomers greatly. The earth's atmosphere is transparent to light, certain infra-red waves, and radio waves between about one centimeter and 30 meters. Prior to radio astronomy almost all the information from the heavens had been obtained from the small visible band of frequencies. The radio band is about 100 times larger than the visible or optical band so radio astronomy has enlarged the scientists' "window" for examining the universe.

To receive these radio waves large antennas are needed. An antenna is analogous to a mirror in its performance because the size of each controls the amout of "brightness" and also the smallest angular detail they can resolve. The surface finish determines the quality of the image.

Paraboloid antennas are best suited for radiation studies because the radiation is so weak. The paraboloid acts as a headlight in reverse, i.e., it focuses many waves to a small point at the focus. The diameter of the image at the focus is inversely proportional to the diameter of the paraboloid.

At the focus this image falls on a dipole element that is similar to one-half of an H shaped television antenna. Currents and voltages are induced in the dipole and are fed to a receiver. The construction of the dipole determines the operating frequency so the frequency can be changed by changing the element at the focus. The limitations on a paraboloid antenna are the diameter of the aperture and the finish of its surface.

Another type of antenna is a broadside array that is constructed of many dipoles in parallel. Radiation from the F direction arrives at AB at a time that is 180° out of phase to that at CD because the dipoles are displaced by one-half of a wavelength. Therefore radiation from the F direction will cancel which aids in obtaining directivity. Radiation from the X direction arrives in phase at both aerials so it will add. By increasing the number of elements a very high gain can be obtained. The main disadvantage of this system is that it can be used at only one frequency.

A third type of antenna system makes use of interference patterns and is called an interferometer. By placing two or more arrays on a long baseline and feeding their outputs to a common receiver, an interference pattern results at the output of the receiver. When a radio source moves across the aerial, the resulting interference pattern depends upon the angle subtended by the source.

The effective aperture of this system is equal to the length of the baseline so a narrow beam can be produced with reasonable accuracy. The main drawback of this system is that many different beams are produced which makes the results hard to interpret. The measurement of radio source diameters and the distance between

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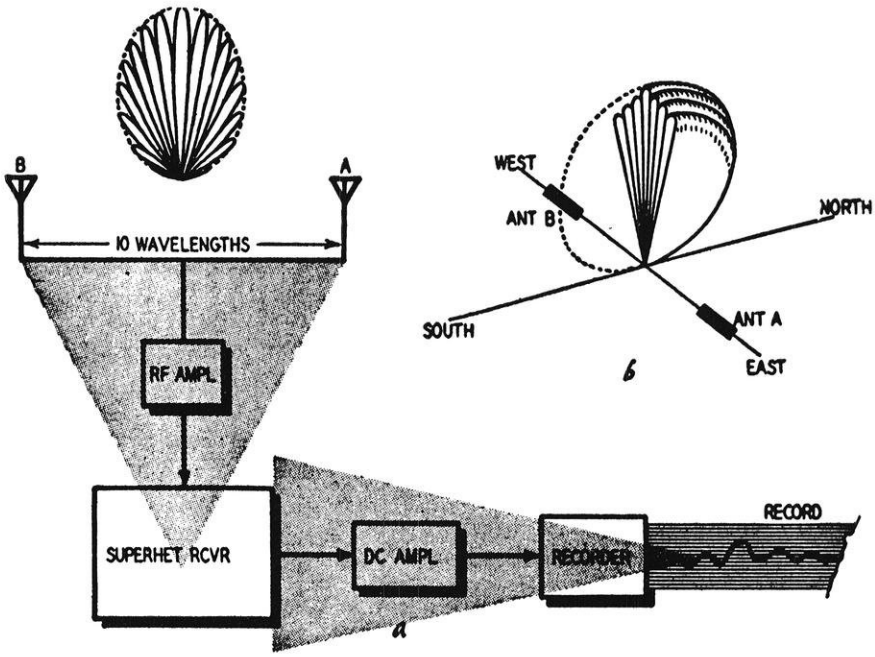
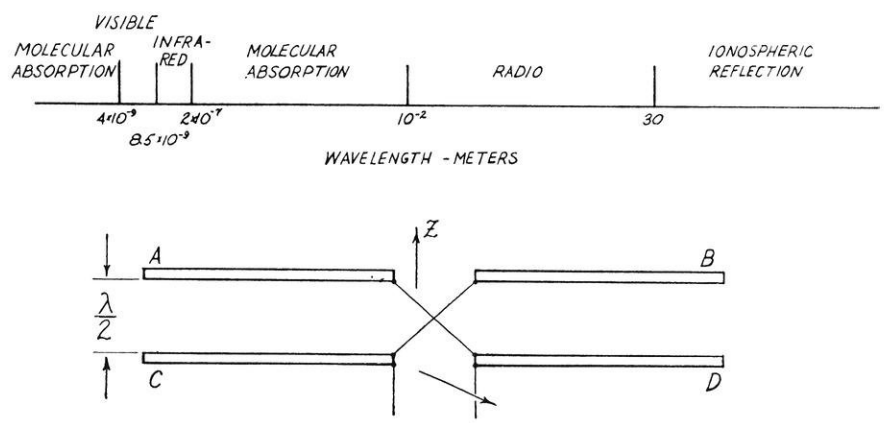


a—Block diagram of a radio interferometer; b—antenna pattern of interferometer.



Top shows the radio window as part of the energy spectrum. Bottom shows radio frequency antenna constructed of many dipoles in parallel.

sources is the main application of the interferometer.

From the radio telescope the signals are fed to a receiver that is similar to those used in television receivers. Great care has to be taken to maintain a constant gain because a slight variation such as produced by a filament temperature fluctuation would change the noise output and mask the faint signals that are being detected.

To maintain a constant output the receiver is calibrated 25 or 30 times a second by a standard source. This standard source is usually a diode because its noise power is accurately known in terms of its current and bandwidth. The noise power is independent of temperature and the resistance through which it flows. A 25 or 30 cycle output is produced whose amplitude is independent of receiver noise and is proportional to the difference between the signal and the standard source.

An impressive way of displaying the output of the receiver is by means of a loudspeaker system. Sun and radio source static produce a gentle hiss while radiation from Jupiter rumbles and roars. However, if the results are to be used for scientific investigation they must be recorded accurately and permanently. There are several recording systems, such as rectifying the output and feeding it through a millammeter. The movement of the meter will be proportional to the amplitude of the noise and can be recorded on a revolving drum by a pen arrangement.

Because of the great importance of the sun in our existence it has been the center of much study. As early as 1894 a man named Lodge gave a lecture in England in which he stated that radio waves could be received from the sun. He tried but was unsuccessful. The crude equipment that he used explain his failure. Throughout the early past of the 20th century other scientists made calculations based on black body theory and most of them came to the conclusion that it was impossible to receive radio waves from the sun with the equipment available.

The actual discovery of solar radiation is credited to wartime research in radar. In 1942 various military installations received strong signals at wavelengths of 4 or 6 centimeters. These signals caused quite a bit of concern because it was feared that the Germans had come up with a new jamming technique. After examing the data carefully the conclusion was reached that the signals were from the sun. All this was kept secret until after the war but others in the field of radio astronomy discovered solar radiation during this period.

It was not until after the war that the equipment was far enough advanced to make a detailed study of the sun over all wavelengths. At wavelengths of one centimeter the sun "looks" uniform through the radio telescopes. The sun appears to have a dusky center with a bright halo at 20 centimeter wavelengths. At wavelengths around 50 centimeters the sun is an exceedingly strong emitter. The radiation at meter wavelengths corresponds to a temperature of 106 degrees Kelvin. Both the diameter and output vary with changes in wavelength.

The output of the sun varies by factors of 106 during periods of sunspot activity. It has been known for many years that the variation in the sun's intensity affected the earth's atmosphere. By studying radiation with radio telescopes we have a good indication of solar variability. It is hoped that through radio astronomy an understanding of the effects of this variability can be found.

An interesting experiment was carried out during an eclipse of the sun in an attempt to determine the exact location of radiation at different wavelengths. It was hoped that as the moon passed over the sun that the radio signals would disappear at some point and therefore pinpoint the location of the source. This did not happen and even at total eclipse the radio sun was shining brightly. This leads one to believe that the sun is larger than what we see optically, but the radiation probably comes from the sun's corona.

During the development of radio astronomy the possibility of detecting radiation from the planets received much consideration because of their relative nearness to us compared to the stars. Some scientists believe that terrestrial storms on the planets could produce radio waves.

In 1955 two Australian astronomers came across an intense radiation that was coming from the direction of Jupiter. Following these observations they began studying their previous data. Sudden bursts occured at different times on their previous graphs. These bursts had been passed over as of terrestrial origin because there had been some storms and radio interference at the time.

A detailed study showed that these bursts occurred when Jupiter was on the aerial beam. However, these bursts were spasmodic in that some times they occurred when Jupiter was on the beam; and at other times when Jupiter was on the beam, no signals were being received. From calculations of Jupiter's rotation about its axis it was found that these bursts occurred in synchronism with this rotation. This lead to the conclusion that the radiation was coming from a certain spot. The approximate location of this spot has been determined.

There are components in this radiation that are usually associated with the random motion of thermal electrons. This seems rather unlikely because Jupiter's atmosphere is calculated to be at -140° C. and the planet itself is thought to be a mass of solid ice. An active volcano could be causing the radiation and this would explain the apparent thermal effects.

The pulses from Jupiter came in bursts of two or three in a rapid series. This could be explained in terms of an ionosphere if the source were located above the planet. The first pulse could be from direct transmission; the second pulse could be produced by an echo from Jupiter; and the third pulse could be reflected from the ionosphere to Jupiter and then to the earth.

Besides radiation from the sun and Jupiter, there is an excess of 2000 known radio sources and a general background radiation that produces a continuous spectrum throughout the radio range. The finding of these radio emitters has aided the optical astronomer in locating other visible sources although no definite connection has

been made between most radio and optical sources.

In order to make accurate calculations the positions of these radio sources have to be determined. Because of their large distances away the signals that they produce are so weak that most radio sources cannot be studied fully until the equipment advances. Most of these advances must be made in electronic equipment.

One powerful source that is being observed by optical and radio astronomers is the collision of two galaxies. This is a rather spectacular sight because stars on the order of magnitude of 3×10^{20} meters along with their atmospheres are colliding. This is occurring at distances of 200 million light years, so the astronomers are observing something now that happened 200 million years ago.

The origin of radiation from space is very intriguing and confusing to scientists. There are many theories or hypotheses on this subject. One of the first theories on radiation from the sun was that it was of thermal origin which follows formulas quite well when the sun is quiet.

However, calculations based on emission during sunspot activity shows that if the radiation was of thermal origin the suns temperature would have to be 10^9 degrees K. The highest temperature on the sun is thought to be about 2×10^7 degrees K.

One explanation for radiation during periods of sunspot activity is that the sun has a magnetic field that is not aligned with its axis. This would make it possible for a potential difference to exist to accelerate electrons up to high energies. However, not much backing for this theory exists, because experimental results are in disagreement.

In 1944 a Dutch astronomer predicted that it would be possible to detect 21 centimeter radiation of neutral hydrogen. The discovery of this occurred in 1951. According to physics theories, if the proton and electron are aligned in the same direction, there is a tendency for the spins to change. The probability of this change is very low, but it is thought to occur once in several million years. When this happens a quantity of energy equal to 9.4×10^{-25} joules is radiated. This is a very small amount of energy, but if enough atoms are present radiation will occur of sufficient magnitude to produce the 21 centimeter wavelength signals.

This is a good example of what has been done by the radio astronomers. The possibility of neutral hydrogen was thought to exist in outer space, and the radio astronomers proved it. It is possible that other lines may also exist that will enable scientists to find other elements in space. Since this original discovery in 1951 many bodies of neutral hydrogen have been found throughout space.

Another theory of celestial radiation is that of free-transitions. This occurs when electrons are set free from hydrogen atoms that are ionized by ultra-violet light. These free electrons may revolve around the nuclear of another atom and enter its field of force. Now electrons can exist only in certain orbits according to Bohr's theorv. If a free electron moves to a bound orbit it radiates energy corresponding to the change in energy levels between the free and bound state. There are no limitations on the amount of energy a free electron may have, so a continous spectrum results.

At the present time the sun is being studied very extensively. The center of our galaxy contains huge masses of dust so the optical astronomer cannot see what is in this dust cloud. This area has not been studied very much in the past but will get increased emphasis in the future.

The United States has been lagging behind other countries, but we now have radio telescopes at the Naval Research Laboratories, Ohio State University, Cornell, and California Institute of Technology. Most of these are of the paraboloid type with an 80 foot aperture. The one at Ohio State is a broadside array of helical design. Several universities have graduate courses in radio astronomy. Collins Radio Company is building radio telescopes and radio sextants.

The University of Manchester in England has the largest steerable antenna, a huge paraboloid 250 feet in diameter. This is a massive structure that weighs about 200 tons. If this telescope system proves successful, it will probably be copied in other countries.

The astronomers at the University of Manchester did a great deal of work in connection with the Russian Satellite. By using radar techniques they were able to calculate the satellite's orbit, and also the distance that it came close to the earth over a period of time. This information is of great practical value because it can be used to calculate the density of the air at the altitude of the satellite.

Radar has been used to study the moon to a certain extent. With further developments in radar it is hoped that the planets can be studied.

The main drawback in the development of radio astronomy is the expense, as can be seen by the large telescope at the University of Manchester. Smaller systems can be utilized and are being used elsewhere but eventually it will be necessary to build larger telescopes if the astronomers are to separate the huge entanglement of millions of stars that appear close together because of their large distances away.

The development of electronics is probably the most critical item, but it appears that electronics will continue to advance. Antennas can be built bigger and better at added expense.

There is a possibility that some novel design may cut down the expense and increase the effiectiveness of the equipment now in use. Some Australian astronomers are planning a 300 foot paraboloid that will be partly underground. This will result in decreasing the cost, and also in eliminating some wind effects, which is a major factor in the design of a large structure like this.

For radio astronomy to advance there must be cooperation between astronomers, physicists, and electronic engineers. Foreign countries must and are cooperating to a great extent.

Radio astronomy has advanced rapidly in the past few years, and it appears that it will advance at an increasing rate in the future. Radio astronomy will undoubtedly aid the world greatly in conquering space. **THE END**

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Young men like Dr. Wayne E. Smith are helping to shape the future through research in the exciting and challenging field of polymers in the laboratories of Standard Oil.

In just a few years time, petrochemicals have mushroomed into a major industry—and there is still much pioneering work to be done.

Specifically, Dr. Smith is working on the fundamental chemistry of catalysts—an area in which Standard is a leader. From such basic research will come new and useful products for the future. Used in making polyethylene, our catalysts are also proving useful in preparing many other new products.

Dr. Smith received his B.A. in 1951 from Tarkio College, Tarkio, Missouri, and his Ph.D. in physical chemistry from the University of Nebraska in 1955. He is married and has three daughters. He is active in church work and sports.

Hundreds of other young men with scientific and technical backgrounds are building successful careers at Standard Oil. Their work is helping to make important contributions to petroleum progress.

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"Well, I talked to a number of people and did as much letter writing and looking around as I could. The way I figured it, I wanted opportunity . . . a fair chance to put my capabilities to work and to be recognized for what I could do. Of course, I wanted to be well paid, too. It all seemed to add up to the aircraft industry . . . and to me it still does.

"In the space of just a few years I've worked on quite a few projects, important projects that some day may mean a great deal to this country. They sure meant a lot to me. And I wasn't standing still either. My salary and my responsibilities have increased with each promotion. That means lots of challenges, new and tough problems that we have to solve, but that's the way I like it. So, if you want some advice from this "old grad," choose the aircraft industry. It's the wisest choice, I'm in the business and I know."

Probably no other industry in America has grown so fast *and advanced so far* in a short time as has the aircraft industry. And yet there is no limit to how far man's inventiveness and imagination can push the boundaries. Radical new concepts that would have been unthought of just a few years ago are the drawing-board problems of today.

Truly aviation is still in the pioneering stage, and one of the leaders is Northrop Aircraft, which has been making successful contributions to our nation's defense for over 18 years. Projects such as the Snark SM-62, world's first intercontinental guided missile, have identified Northrop as a successful pioneer. And new aircraft such as the supersonic, twin-jet T-38 advanced trainer are maintaining this reputation.

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BUILDERS OF THE FIRST INTERCONTINENTAL GUIDED MISSILE

The Strain Gage

by Edgar A. Wellens m'58

The history of engineering is the history of man understanding the properties of materials. Measurement of stress and strain relationships is basic to this understanding.

SINCE the origin of man, the solution to his technical and structural problems has been dictated by the properties of the few materials he could fabricate satisfactorily. While other materials were available, he knew little of their properties, and furthermore had no possible way of measuring or determining them.

As man advanced he realized a thorough understanding of stress and strain relationships was needed. Many attempts were made in order to find a practical method to accurately measure strain. Of these, one showed promise in that it was not only practical but reasonably accurate.

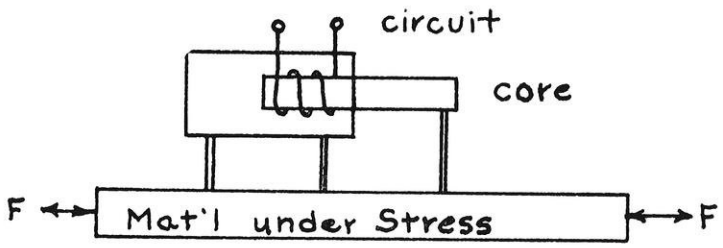
The method consisted of taking a fine piece of copper wire and passing an electric current through it. Knowing the current parameters, the amount of resistance in the wire could be determined.

The same wire was then subjected to tensile and compressive stresses and its resistance again measured. The change in resistance along with the loads applied to the wire were then studied, and a relationship between the two determined. From this study, man was now able to predict with some accuracy the stresses and strains of available materials.

Having established the approach to the problem, the measurements and methods of attaching the wire to the material to be studied still remained crude and complex. Wires of uniform cross section were not available and instruments of extreme accuracy had not yet been developed. As industry advanced in other fields, technological advances soon developed new instruments and an increased need for measuring devices.

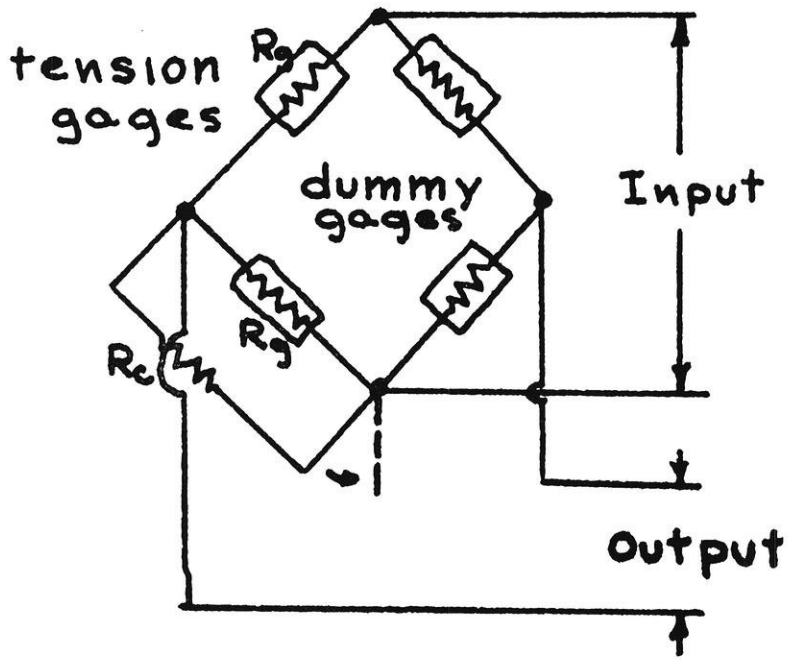
In the late 1920's a number of instrument manufacturers began exploring the commercial opportunities of the gage. Most noteworthy of these was the Baldwin-Lima-Hamilton Corporation (BLH), who eventually received a patent on the strain gage. After many modifications and improvements, a gage was developed by their people that gave extreme accuracy and could be attached to materials with ordinary adhesives. The gage was marketed but achieved little success, as industry was overly cautious in accepting new ideas during the depression of the thirties. However, with the beginning of the second World War, the gage began to receive attention, and soon was being used in many electronic instruments.

Upon completion of the war, industry began applying the principles of the gage to its civilian problems, and had soon developed many uses for the gage. The applications became so varied that the company introduced different types of gages to suit the situation in which it was to be used. Some of the more common types follow.



Inductive gage.

The inductive type strain gage utilizes the principle of changing inductance in an electrical circuit. This is accomplished by using a coil of wire wound around a metal



Wheatstone Bridge incorporates strain gages into its design.

core which is moved in or out of the coil. As the bar is strained, the core is drawn out of the coil, decreasing the flux density, and, of course, the inductance. This gage is somewhat cumbersome and is not widely employed. Its chief advantage is that it may be reused.

Resistive gages are the most commonly used. These gages are divided into two classifications, bonded and unbonded. The bonded gage will be given emphasis in this report.

The bonded gages are so made that they rely on the variation of resistance of a grid of 0.001 inch diameter Cupro-Nickel wire cemented to a thin piece of paper. This piece of paper is in turn cemented to the member in which the stress is to be determined. This gage has been given the trade name of "(SR-4) Strain Gage", and is marketed under that name. Its cost varies from $1.15 upward, depending on the size of the gage.

Some performance characteristics of the (SR-4) gage are:

a) Accuracy—0.1 per cent above circuit errors.
b) Sensitivity—One millionth of an inch per inch of length.
c) Range—Up to 20 per cent elongation.
d) Dynamic Response—Up to 50,000 cycles per second.
e) Temperature—Up to 1600 degrees F.
f) Strain Direction—Pick up axial strains only, however can be arranged in "rosettes" to pick up both magnitude and direction.

From the performance characteristics it can be seen that the gage is extremely accurate. However, it will only record what is transmitted to it by the material on which it is used. Therefore the manufacturer has supplied a detailed list of instructions for applying the gage to a surface. It is extremely important that these instructions be followed to the letter.

The procedure is as follows:

1. Surface must be regular, free from paint and scale.
2. Remove file and machine marks with medium emery cloth using a circular motion.
3. Clean with carbon tetrachloride or acetone.
4. Apply precoat cement, allow fifteen minutes to dry.
5. Apply gage cement.
6. Press gage firmly into cement, allow at least eight hours drying time.

The unbounded gages are made up of a pre-stressed tightly coiled wire wound around two pegs rigidly fastened to the material being tested. As the material elongates or contracts, the pegs move and change the stress of the coil. Appropriate instruments measure the change in current due to the resistance change and allow the strain to be computed.

In order to measure the small amount of resistance change in the gage, accurate instruments must be used. Some of the more widely used instruments are:

The Wheatstone Bridge incorporates the strain gages into its design, allowing current changes in milliamps to be read with accuracy.

By use of the following equations and the values obtained from the Wheatstone Bridge stress or strain may be computed:

$$Fc = \frac{\Delta Rg}{Rg\epsilon}$$

Fc = gage factor stamped on gage.

$$\frac{1}{R} = \frac{1}{Rg} + \frac{1}{Rc} \qquad R = \frac{Rg\ Rc}{Rg + Rc}$$

Rg = Unstressed gage.

$$\Delta Rg = Rg - R = \frac{Rg^2}{Rg + Rc}$$

ΔRg = Change in resistance due to strain.

$$\epsilon = \frac{\Delta Rg}{Fc\ Rg} = \frac{Rg}{Fc\ (Rg + Rc)}$$

ϵ = Strain in inches/inches.

$$S = E\epsilon$$

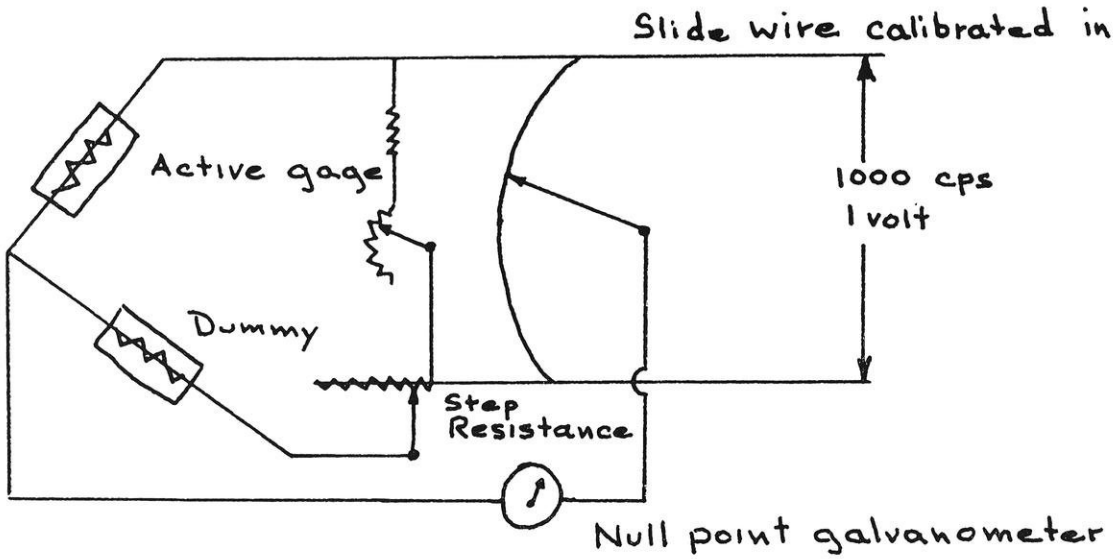
S = Stress in psi.

The strain indicator was developed in order to eliminate the computations involved to determine the strain. This indicator has a galvanometer in its circuit in place of the Wheatstone Bridge, and may be balanced by the use of a dial on the instrument. The indicator will give the strain in inches by reading the dial used to balance the galvanometer.

Often strains are of a cyclic or dynamic nature. These values change very rapidly and cannot be recorded except by the use of an oscillograph. An example of this would be the strain produced in a rotating crankshaft. An accompanying figure illustrates the principles employed in the Hathaway S-12 I. C. oscillograph.

The galvonometer is deflected by the strain occurring at the gage, and is in turn recorded on a moving film. Variation in film speed

(Continued on next page)



Strain indicator.

will allow operation over a wide range of frequencies.

In this and other instruments, a dummy gage is employed to make allowances for temperature variation. The dummy gage is a gage that is attached to the same type of metal, only it is not under strain. Therefore any variation in temperature will be accounted for in the circuit of the instrument.

The applications of the strain gage are numerous and can not be covered in detail. However, in order to give a better understanding of their use, a few specific examples in three branches of engineering will be covered.

In automotive engineering the drawbar pull is an engineering performance characteristic and can be determined by connecting two vehicles with a strain gage drawbar and using one vehicle to tow another. During the actual towing, readings are taken on the strain gage; and from this information the vehicle can be evaluated in regards to its pulling power.

Tractive resistance is also an engineering performance characteristic and is a measure of the friction, air and grade resistance that a vehicle must overcome. By applying strain gages to the driveshaft of the vehicle, the torque may be measured at the shaft. With the torque available, the tractive horsepower may be computed.

In aeronautical engineering the acceleration is often desired in order to evaluate the craft's performance. Commercial accelerometers which have strain gages built into them are used in measuring this characteristic.

The gage is of the unbonded type and will measure accelerations in only one direction. The gage is mounted on a gyroscope in order to remove all unwanted effects of the plane.

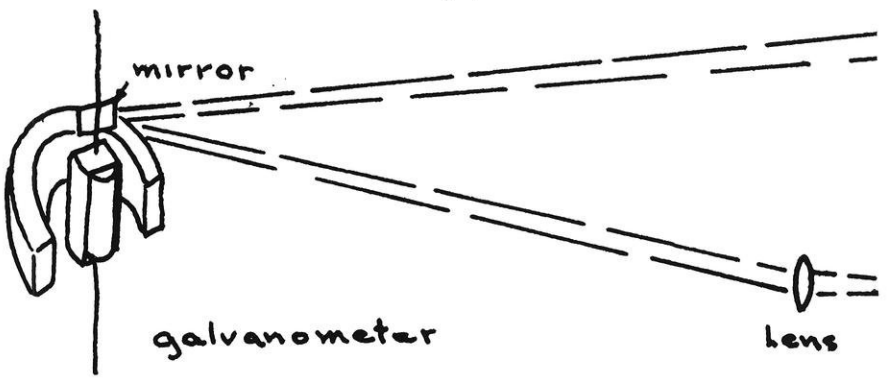
Usually the test is made for an entire flight; therefore permanent recordings are made with the oscillograph.

Stress measurements are conducted on all parts of the plane. These may be made at rest or in flight. As failure or deformation occurs at points beyond the elastic limit, values of stress on all critical members must be accurately known. Due to the small size of the strain gage, it is often built directly into the plane at assembly. Tests may then be performed upon completion of the plane or be used for future checks on the plane's structural condition.

Also in civil engineering strength of materials is now primarily determined by the use of strain gages. Gages have been adapted for use on wood, cement and, of course, metals. They are attached to the material as previously described. The use of repetitive testing has led to the classification of materials, and the accurate determination of their properties.

Building construction is now aided by the use of strain gages incorporated into the structure. Checks on the stress, as the building is constructed, verify engineering calculations and remove any chance of error. While this procedure involves additional cost, it has enabled engineers to introduce many new ideas safely as construction progressed. **THE END**

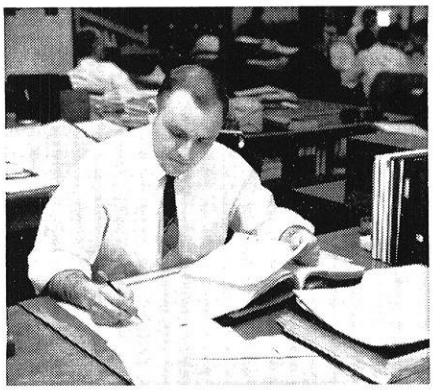
Oscillograph.



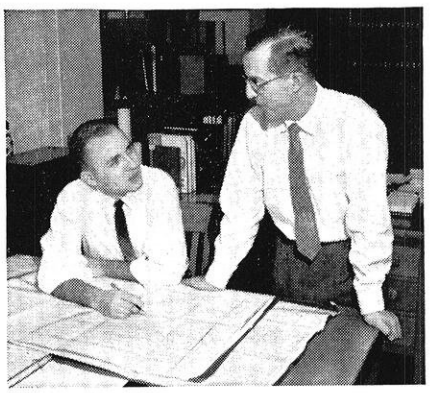
KEITH LYNN, B.S.E.E., PURDUE, '52, INVITES YOU TO

"Spend a day with me at work"

"I'm an Equipment Engineer for Illinois Bell Telephone Company in Chicago. Speaking personally, I find Bell Telephone engineering darned interesting and very rewarding. But judge for yourself."

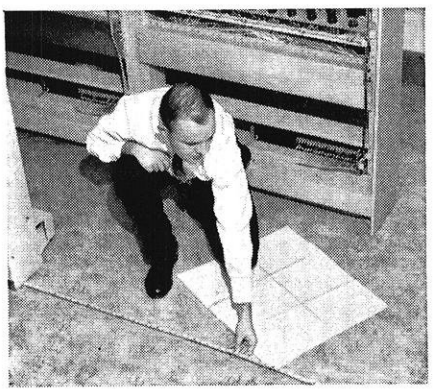


"8:30 a.m. We start at my desk. I'm studying recommendations for additional dial facilities at the central office in suburban Glenview. This is the beginning of a new engineering assignment for me."

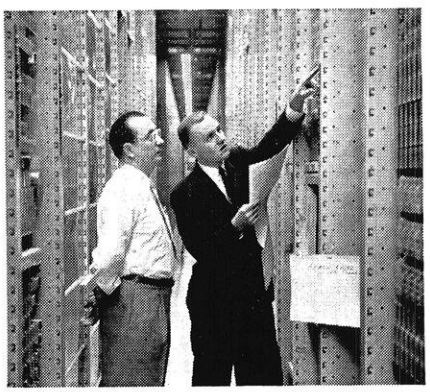


"10:20 a.m. I discuss a proposed layout for the additional central office equipment with Supervising Engineer Sam P. Abate. Since I'll want to see the installation area this afternoon, I order a car."

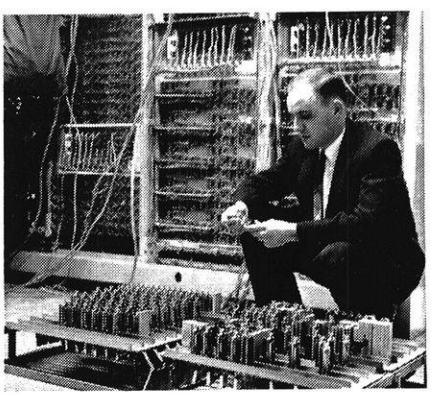
"11:00 a.m. At an interdepartmental conference I help plan procedures for another job I'm working on. Working with other departments broadens your experience and know-how tremendously."



"2:00 p.m. After lunch I drive out to the Glenview office. Here, in the frame room, I'm checking floor space required by the proposed equipment. The way our business is growing, every square foot counts."



"3:10 p.m. Then I drive to the office at nearby Skokie where a recent assignment of mine is in its final stages. Here I'm suggesting a modification to the Western Electric installation foreman."



"3:30 p.m. Before starting back to Chicago, I examine a piece of Out Sender equipment being removed from the Skokie office. This unit might fit in just fine at another office. I'll look into it."

"Well, that was today. Tomorrow will be different. As you can see, I take a job from the beginning and follow it through. Often I have a lot of jobs in various stages at the same time. I think most engineers would agree, that keeps work interesting."

Keith Lynn is one of many young engineers who are finding rewarding careers in the Bell Telephone Companies. Find out about opportunities for *you*. Talk with the Bell interviewer when he visits your campus. And read the Bell Telephone booklet on file in your Placement Office.

BELL TELEPHONE COMPANIES

SCIENCE HIGHLIGHTS

by Pete DeWitt che'60

NEW PROGRESS TOWARD TELEVISION-ON-THE-WALL

A new experimental television display screen—brighter than any previously reported and no thicker than a picture frame—has moved the idea of "television-on-the-wall" a step closer to reality.

Developed by scientists at the Westinghouse Research Laboratories in Pittsburgh, Pa., the new display screen is an important step in efforts to replace the bulky, high-vacuum television picture tube with a flat, bright "solid state" display screen.

The new display is called an Elf screen, getting its name from two words: electroluminescent and ferroelectric. It combines in a single structure an electroluminescent panel—man's newest source of light—and a flexible, built-in storage and control structure made of ferroelectric materials.

In describing the development, Dr. E. A. Sack, manager of the dielectric devices section of the Westinghouse Research Laboratories declared, "A satisfactory solid state display screen is an important objective of modern electronics research. When such a screen is fully developed, it will do such things as display radar pictures or other information in aircraft, show the ever-changing air traffic pattern around an airport, or bring television-on-the-wall to the average American living room.

"In a cathode-ray tube the picture is 'painted' on the phosphor-coated inner surface of the tube by a beam of electrons which periodically sweeps across the phosphor surface, causing it to glow in accordance with information supplied by the beam," the Westinghouse scientist explained. "For television service, 30 such pictures, or frames, are painted each second. Between frames, the phosphor should continue to glow long enough to retain a given image, thus displaying what looks like a continuous picture to the viewer.

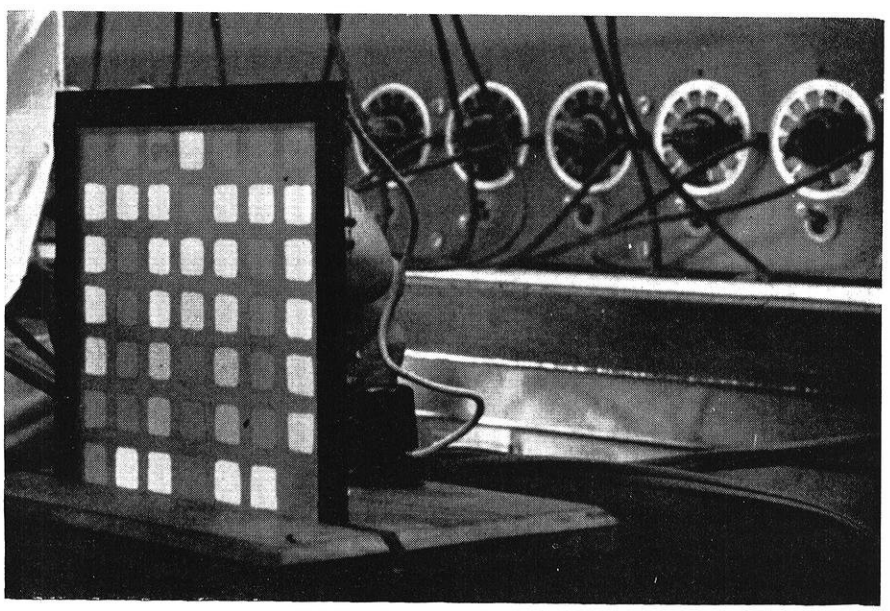
"Many military applications, however, require fewer than 30 frames per second, which brings on a serious problem of flicker of the picture. This fact, plus the low maximum brightness of the tube, has placed limitations on its usefulness in a variety of situations.

"The Elf screen overcomes the problems of low brightness and excess flicker by providing for continuous—not interrupted—excitation of the screen. The built-in ferroelectric cells store and control the information to be displayed. They distribute excitation to the screen in accordance with an applied electrical charge. Once this charge distribution is established, the screen is excited without interrupting throughout the complete frame, or picture. Then the charge distribution is changed to form a new picture. The result is a picture of high average brightness and very low flicker."

80-TON BITES BY HUGE POWER SHOVEL

One of the largest mobile land machines ever built in the United States, a 2,400-ton power shovel named the River Queen, has been working for more than a year in an open pit coal mine in western Kentucky.

Taller than a 13-story building,



—Courtesy Westinghouse

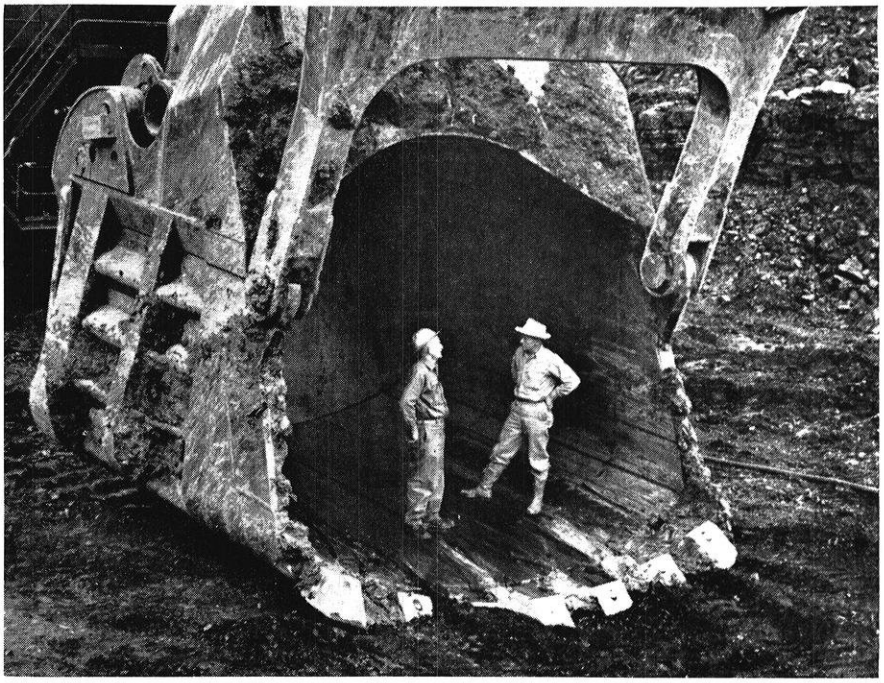
This small "checkerboard" represents an important forward step in the development of a display screen that will eventually bring television-on-the-wall to the average living room.

heavier than a Navy destroyer and able to take more than 80 tons of rock and earth in a single bite, this new shovel uncovers two seams of bituminous coal in the River Queen Mine near Central City. The mine is owned jointly by the W. G. Duncan Coal Co. and Peabody Coal Co. It is operated by Peabody. When in full operation, its output will be 2 million tons of coal annually, mine officials say. Shipments will be both by rail and in barges loaded over the River Queen Dock on the nearby Green River.

The River Queen, a special long-range stripping shovel equipped with a 55-cu. yd. dipper, is the largest power shovel ever built by Bucyrus-Erie Co., South Milwaukee, Wis.

The 1650-B stands 140 feet high. It is equipped with a 145-ft. boom and an 86-ft. dipper handle, enabling it to dump rock and earth overburden nearly 300 feet away from the digging point and to stack it more than 100 feet high. In each pass of its mammoth dipper, the River Queen excavates enough material to fill a room 14 x 12 x 9 feet.

And, what an appetite the River Queen has. At the rate of one digging-dumping cycle in a little less than a minute, this mechanical giant in 24 hours could pile up a mountain of more than 100,000 tons of overburden. The River Queen excavates only down to the coal seam; actual coal loading is done by smaller power shovels. They load into large diesel haulers, which take the coal to a washing and screening plant geared to wash 1,000 tons of coal per hour.



Two's Not a Crowd! Two men step inside the *River Queen's* 55-cu. yd. dipper to show off its spaciousness.

Despite the River Queen's size, one operator controls its entire digging operation with two hand levers and two foot pedals. The operator's glass-enclosed cab, perched 30 feet above the ground at the right front corner of the machine, offers full visibility. An 8-ft. wiper keeps the windshield clean on rainy days.

The cab has an air conditioning system and an inter-communication hookup with four telephone sets. A loudspeaker attachment on the boom enables the operator to keep in contact with his ground men and those in the pit area. Further enhancing the cab's comfort and utility are tile flooring, wood paneling, a water cooler, clothes lockers and a foreman's desk.

Fifteen General Electric motors power the shovel—eleven for digging and four for propelling. The main motors are two 1,500-hp AC motor-generator-set, synchronous-driving units. The main functional DC motors consist of four hoist motors rated at 375-hp each; three swing motors at 187½-hp each; two crowd motors at 187½-hp each; and four 200-hp propel motors.

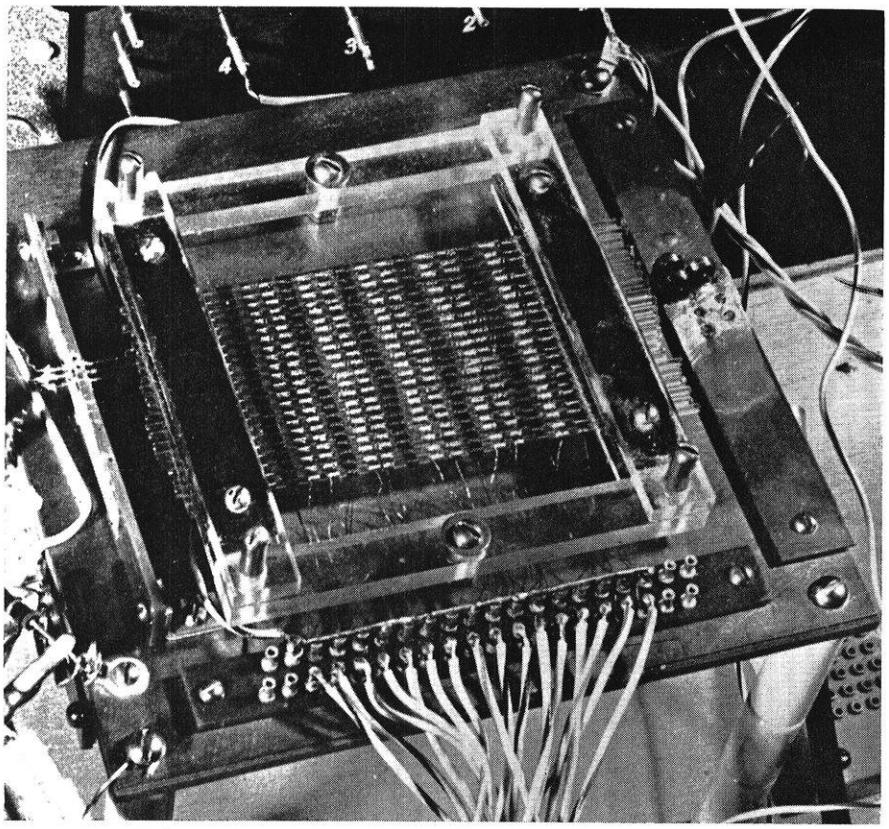
—Courtesy Caterpillar

Swinging High! Standing on one seam of coal the *River Queen* clears limestone overburden from an upper coal seam. Note the pickup truck in the foreground.

THE TWISTOR—A NEW MAGNETIC MEMORY CONCEPT

A new concept in memory devices has emerged from exploratory work at Bell Telephone Laboratories. This concept, which has been named the "Twistor", is expected to make possible memory systems which are simpler to fabricate and more economical to manufacture than existing systems. Such devices may have extensive applications in computers and electronic

(Continued on next page)



An experimental magnetic memory array which has been set up at Bell Telephone Laboratories to evaluate the "Twistor"

switching systems where rapid-access, high capacity memories are necessary.

The "Twistor" concept opens the way for the construction of magnetic memory arrays by merely interweaving horizontal copper wires and vertical magnetic wires, much as window screen is woven. Such a device would be similar in appearance to a ferrite core array, but without the cores, and would operate in much the same manner as a core array.

This new concept gets its name "Twistor" from a characteristic of wire made of magnetic material. Torsion applied to such a wire shifts the preferred direction of magnetization from a longitudinal to a helical path. The coincidence of a circular and a longitudinal magnetic field can then be used to insert information into this wire in the form of a polarized helical magnetization, and the magnetic wire itself can be used as a sensing means. Application of torsion to the magnetic wire in a final device may be unnecessary, as the helical path for the preferred direction of magnetization can perhaps be "frozen" into the wire during processing.

In practice, the circular magnetic field is provided by a current pulse through the magnetic wire, and the longitudinal field by a current pulse through the copper wire which is perpendicular to the magnetic wire. Thus, storing a bit requires two coincident current pulses. One pulse by itself is insufficient to store a bit. Readout is accomplished by overdriving the longitudinal field in the reverse direction. The readout signal is sensed across the magnetic wire. Because the lines of magnetic flux along the helical path wrap the magnetic conductor many times, a favorable increase in the output signal is obtained.

Investigations are now under way to determine optimum size and composition for the magnetic wires. It appears that a conductor plated with magnetic material may have some advantages. Diameters as small as one-thousandth of an inch appear to be feasible. At least 10 bits per inch may be stored on such a wire without adverse interaction.

In conventional magnetic core memory devices, conductors must be threaded through the cores to make up a suitable matrix. When a ferrite sheet is employed, either a threading or a plating operation is necessary to suitably locate the conductors. However, with the "Twistor", the ferrite material is completely eliminated and no threading or plating is necessary. Speed of operation and output of the "Twistor" are comparable to ferrite memory systems.

NEW GERMAN FORDS NOW IN U. S.

Six models of the compact, new Taunus passenger car, manufactured in Cologne by Ford of Germany, will go on sale in the United States in May.

The new Taunus sedan is two and one-half feet shorter and more than half a ton lighter than 6-cylinder models of the Big Three American cars. And it provides up to 35 miles per gallon in fuel economy.

Taunus models to be imported for sale here include the Taunus 17-M de luxe two-door sedan and the standard model; the Taunus 17-M four-door sedan in deluxe and standard models and the Taunus two-door Combi-wagon (station wagon) in both de luxe and standard models. They were shown at the 1958 International Automobile Show in New York City.

Featuring unitized body construction, the Taunus models are powered by an economical, overhead valve, four-cylinder, short stroke engine which develops 67 brake horsepower at 4400 rpm and 97.6 foot pounds of torque at 2200 rpm. Engine displacement is 103.62 cu. in. and compression ratio is 7.1 to 1. Test runs over American roads at 40 miles an hour show an average of 35.3 miles per gallon fuel consumption. Cruising speed is 78 mph.

The Taunus two and four-door sedans feature a smartly styled, American inspired low silhouette. Built on a 102.5 inch wheelbase, their overall length is 172.2 inches, overall width 65.7 inches and overall height 57.7 inches.

Deluxe Taunus models have an attractive, padded instrument panel with a full complement of instruments and a lockable glove compartment. The safety steering wheel is of the dish type and the finger-

(Continued on page 36)

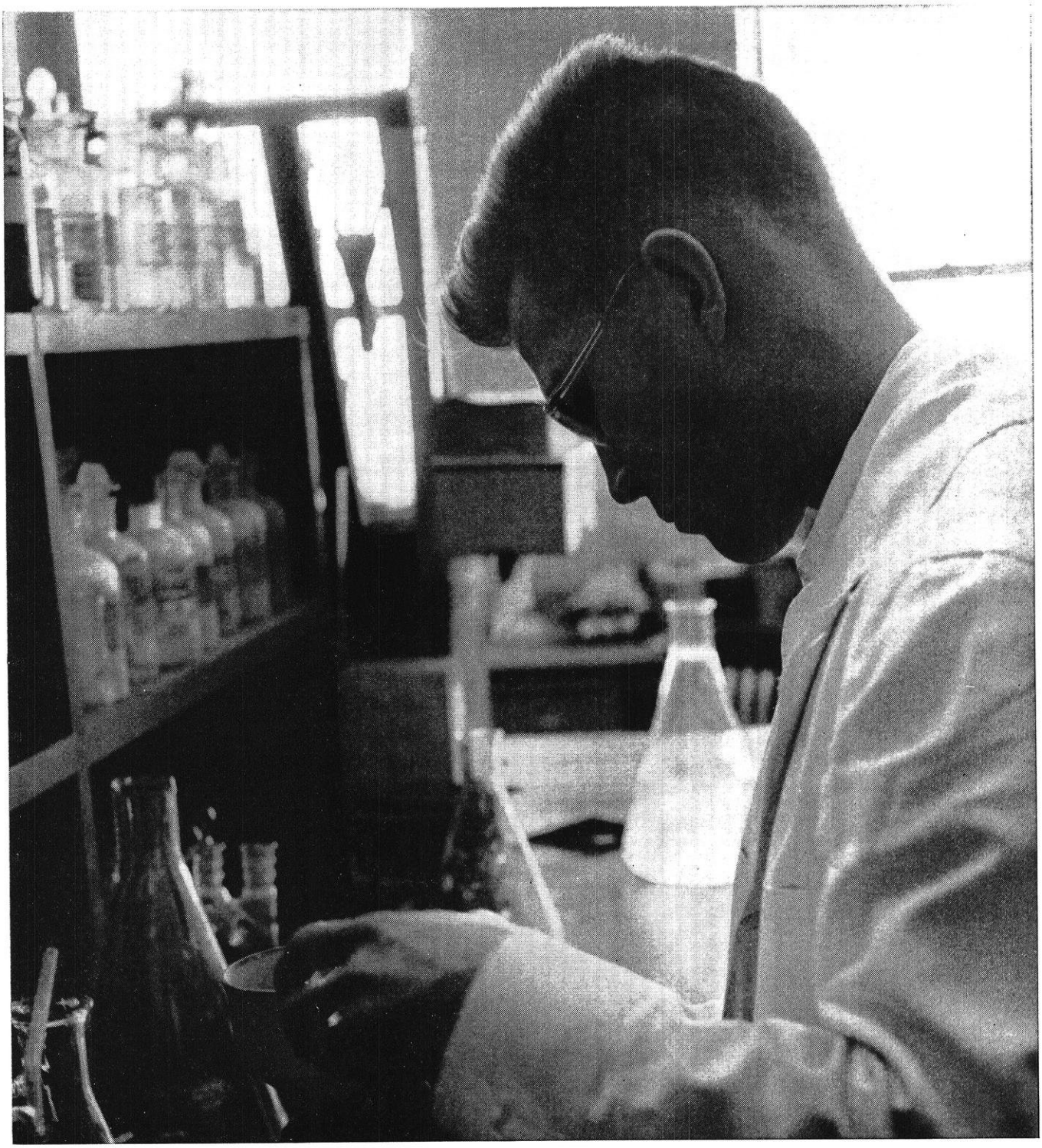
Allied Chemical

What will your first assignment be like?

At Allied Chemical, you could be working on one of our more than 3,000 products . . . perhaps in chemicals, plastics or fibers. You could be located at one of our 12 research laboratories, over 100 plants, or many sales offices throughout the country.

At Allied, there are assignments with a future for chemists, chemistry majors, engineers (chemical, mechanical, electrical). We have prepared a new book, "Allied Chemical and Your Future," which suggests what your first assignment might be like. Why not write us for a copy today? The Allied interviewer can also answer your questions. Your placement office can tell you when he will next visit your campus.

Allied Chemical, Dept. C-3, 61 Broadway, New York 6, N.Y.



Science Highlights

(Continued from page 34)

tip gear shift is mounted on the steering column and controls the three-speed transmission which is synchronized in all forward gears including first.

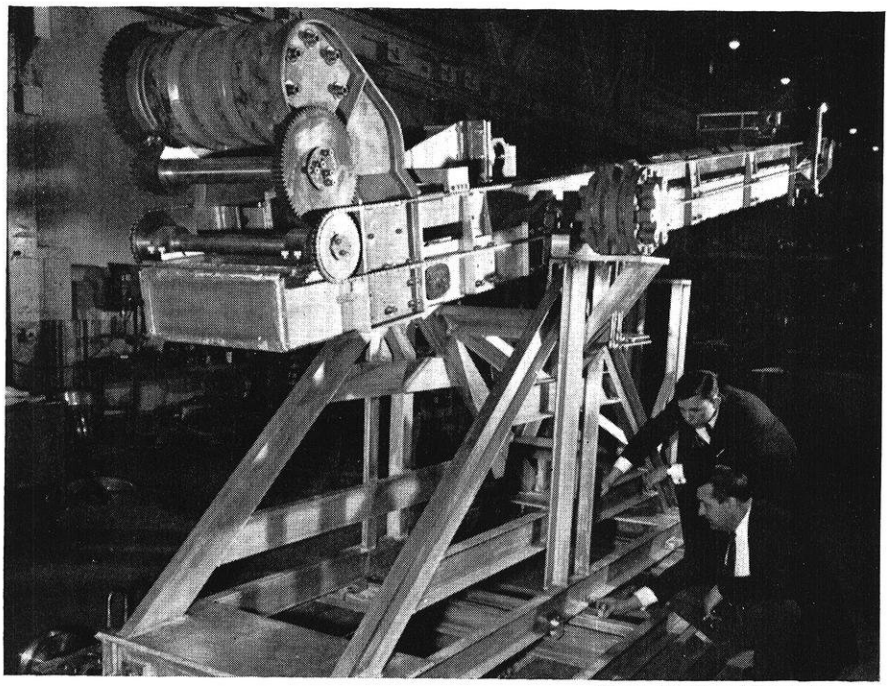
A novel automatic clutch called the Saxomat, is an extra cost option which entirely eliminates the clutch pedal. All shifting is accomplished simply by moving the gear shift lever on the steering column to first, second, high or reverse gear. An electric control switch in the gearshift lever actuates the magnetic clutch-operating mechanism automatically. This mechanism also automatically adjusts the engine speed as gears are changed.

The neatly styled interior of the Taunus utilizes colorful upholsteries of smooth, easy-to-clean and durable plastic materials in two-tone combinations covering foam-rubber padding. Two passengers ride comfortably in the front seat and three in the wide rear seat.

The unusual riding and handling ease of the Taunus results from a combination of the MacPherson independent, front suspension and the semi-elliptic, progressive acting rear springs which adjust themselves to load and road conditions.

The front suspension employs a high-mounted coil-spring and shock-absorber combination with a large tubular member extending from the lower control arm upward into a spring tower in the engine compartment.

The tubular member is a long shock absorber that is integral with the wheel spindles and rotates when the steering wheel is turned. The coil springs surround or encircle the upper half of the shock-absorber outer body. When the wheel hits a bump, the absorber body travels upward to compress the coil spring. A front sway bar also is used with this system.



—Photo Courtesy Westinghouse

This unique machine will handle radioactive materials under 18 feet of water and will operate on its own small railroad track.

MACHINE FOR HANDLING RADIOACTIVE MATERIALS

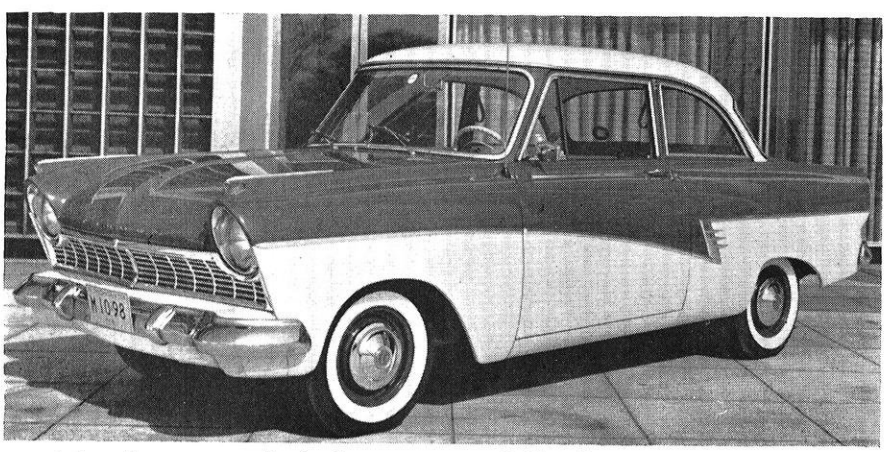
A unique machine for handling radioactive materials under 18 feet of water and which operates on its own small railroad track was shown by Westinghouse Electric Corporation for the first time at the 1958 AtomFair in the International Amphitheatre in Chicago.

The machine will be installed this year in the world's first industry-owned nuclear materials testing reactor now under construction at Waltz Mill, Pa., about 30 miles from Pittsburgh.

Requirements for the safe handling and transportation of large radioactive samples between the reactor core and the "hot cells" of the facility led to the design of the new machine. It will be capable of operating at all times under 18 feet of water which is used as protective shielding during transportation and storage.

The machine is about 22 feet long, 6 feet wide and 8 feet high. It has been designed to handle experimental containers, or thimbles, 18 feet long and 2½ inches in diameter. The thimbles will be moved about 100 feet by the machine along a small railroad track and then by remote control inserted through the bottom of the reactor vessel into the core for testing.

Experiments will include testing of various types of reactor materials, such as uranium oxide and aluminum alloy, which may be suitable for reactor applications.



A brand new contender in the compact car field is this 5-passenger Taunas sedan, to be imported from Germany by the Ford Motor Company in May for sale in the United States. Styled with clean, modern lines, the Taunus has a 102.5-inch wheelbase and an overall length of 172.2 inches.

GERMANIUM RESISTANCE THERMOMETER

A germanium resistance thermometer having high sensitivity

(Continued on page 45)

STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Co., Inc.

Here at Douglas we're involved in a greatly accelerated missile and space program. This requires one of the most intensive engineering and research efforts in our history.

The problems are great ones as we move into the new dimension of unmanned and manned space vehicles. They require specialists in almost every engineering field. But their solution will result in great benefits not only to our own nation but to all mankind.

If you're interested in tackling these problems with us... in giving your best in an all-out drive to solve them... we're interested in you!

Please write to Mr. C. C. La Vene
Douglas Aircraft Company, Box X-6101
Santa Monica, California

ENGINE EARS

by Wayne Rogers, me'59

WISCONSIN MEN CITED

Five men widely known in science, engineering, transportation, and industry, two of them natives of Wisconsin and three of them graduates of the University of Wisconsin, were cited for outstanding accomplishments in their fields at the 10th annual Wisconsin Engineers Day celebration on the UW campus May 2.

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

They are:

Howard Aiken, professor of applied mathematics and director of the Computation Laboratory at Harvard University, Cambridge, Mass.;
Harry C. Brockel, municipal port director for the city of Milwaukee;
George H. Johnson, president of the Gisholt Machine Co., Madison;
William B. Murphy, president of the Campbell Soup Co., Camden, N. J.; and
Arthur F. Peterson, vice president of the Bethlehem Steel Co., Bethlehem, Pa.

The citations were presented at the Engineers Day dinner in Great Hall of Wisconsin's Memorial Union at 6:30 P. M. May 2. Close to 400 engineers and industrialists from all parts of the state and nation attended.

Two of the men honored this year are Wisconsin natives—Johnson born in Madison and Murphy born in Appleton—and three of them are UW graduates: Aiken, Murphy, and Peterson. All have won wide recognition in engineering, industry, and public service fields.

Howard Aiken, professor of applied mathematics and director of the Computation Laboratory at Harvard, was born in Hoboken, N. J., in 1900, and came to the University of Wisconsin to get his BS degree in electrical engineering in 1923. Later he studied at Harvard to earn his MA degree in 1937 and his PhD in 1939. Editor and author of numerous technical publications, he has gained recognition as a distinguished scholar of international reputation and a pioneer in the development of computers.

Harry C. Brockel, municipal port director for Milwaukee, has won wide recognition as an outstanding authority in waterway transportation and port development. He was born in Chicago in 1908, and his family moved to Milwaukee where he was educated in the public schools. He gained wide experience as a seaman in merchant marine operations throughout the world. He has long been active in promoting the St. Lawrence Seaway and Great Lakes shipping and harbor development, and has frequently appeared before congressional committees as expert witness on harbor and waterways legislation and as adviser to the Interstate Commerce Commission, the Maritime Commission, and other governmental agencies.

George H. Johnson, president of the Gisholt Machine Co., of Madison, is also chairman of the board of the Gisholt Machine Co. of Great Britain. Born in Madison in 1901, he received his AB degree from Harvard University in 1923. Widely recognized as an outstanding industrialist and manufacturer of machine tools, Johnson served as consultant to the War Production Board during World War II and to U. S. foreign missions and administrations following the war.

William B. Murphy, president of the Campbell Soup Co., of Camden, N. J., was born in Appleton in 1907, and received his BS degree in chemical engineering from the UW in 1928. He received an LLD degree from Lawrence College in 1954. Murphy has won recognition as an executive in the manufacture of widely known food products developed under a policy of attaining high quality through research. He is a director of the Wisconsin Alumni Research Foundation.

Arthur F. Peterson, vice president of Bethlehem Steel Co., was born in Ironwood, Mich., in 1893, and came to Wisconsin for his higher education, receiving his BS degree in 1918. After graduation he became a mining captain at the Anvil-Palms Mine in Michigan and progressed steadily in his profession to become vice president of Bethlehem Steel. He is widely known both as mining engineer and industrial administrator, and is a director of the Bethlehem Steel Corp. and president of its raw materials division.

1948 GRADUATE RECEIVES AWARD

A native of Racine and a member of the class of 1948, William R. Mickelson, will use his Rockefeller Public Service Award for advanced study of the technological state and philosophy of British and European science in the application of the statistical theory of turbulence to the basic mechanisms of heat, mass and momentum transfer.

Mickelson, who received his MS degree in Aeronautical Engineering from Case Institute of Technology

is one of the country's recognized authorities in aerodynamic mixing and turbulence which is becoming more and more important as the aeronautical field moves toward higher and higher speed flights. He will center his studies around the University of Cambridge, England, and will also visit other centers of aeronautical research in England, Scotland, Holland and France.

ENGINEER'S DAY BIG SUCCESS

Wisconsin engineers from all parts of the state and nation returned to the University of Wisconsin campus Friday, May 2, to help the University's College of Engineering celebrate its 10th annual Engineers' Day.

Some 12,000 invitations to visit the college and see it in operation were sent to engineers and industrialists throughout the state and to Wisconsin engineering alumni throughout the nation. Prof. Ben G. Elliott was in charge of arrangements.

Wisconsin Engineers Day, conceived in 1949 as a part of the University's Centennial Year celebration, has been so enthusiastically received that it has become an annual event.

The dinner was held this year in Great Hall of the Memorial Union at 6:30 P. M. on May 2. Features of the program were presentation of citations by the University, the annual Engineers Day address, and a musical program.

During the day, visitors inspected the University's engineering campus and heard special lectures on "Satellites of Science" by UW faculty members. The visitors and UW engineering faculty members and their wives had a social hour in the lounge of the new Engineering Building during the late afternoon.

WISCONSIN UTILIZATION CONFERENCE SET

Thursday, August 21, 1958, has been selected as the date for the Wisconsin Conference on Utilization of Engineers, Scientists, and Technicians. The meeting will convene in the new Milwaukee County War Memorial Center, 750 North Lincoln Memorial Drive. Governor Thompson will address the Luncheon Meeting of the Conference at the Milwaukee Elk's Club, 910 East Wisconsin Avenue.

Wisconsin's Utilization Conference is the result of recommendations made by President Eisenhower's Committee on Scientists and Engineers. Similar meetings have been or will be conducted throughout the United States. The Wisconsin meeting will enjoy the benefit of drawing upon the experiences and findings of more than twenty earlier meetings.

Agencies cooperating in the Wisconsin meeting include: The University of Wisconsin, Marquette University, Milwaukee School of Engineering, Wisconsin Institute of Technology, Wisconsin Society of Professional Engineers, Engineers' Society of Milwaukee, Wisconsin State Chamber of Commerce, Milwaukee Association of Commerce, and others including the President's Committee on Scientists and Engineers.

The theme of the local meeting will be "Effective Use of Wisconsin's Brainpower." The Conference will take up problems confronting present-day America. Suggestions inspired by recent findings in neighboring meetings, as well as time-proven solutions for more effective use of the nation's skilled minds, will be discussed by the several distinguished Conference speakers.

This one-day meeting will be of immediate interest and concern to owners, executives, and managers of industrial enterprises; to educators; and to the employers of engineers, scientists, and technicians; as well as to engineers, scientists, and technicians, themselves.

More information about this meeting may be obtained by writing the address given below or by using the coupon that has been provided.

QUARTER MILLION FOR SOLAR ENERGY STUDY

A $250,000 grant from the Rockefeller Foundation for continued support of Wisconsin's solar energy program was accepted by University of Wisconsin regents Saturday.

The grant will extend Wisconsin's present program for another three years—from July 1, 1959, to June 30, 1962. The research is directed toward finding methods of utilizing the energy of sunlight, especially as it might be applied in underdeveloped, non-industrial countries.

An initial Rockefeller grant, also for a quarter-of-a-million dollars, was made in 1955 for a four-year period.

"The extension of the grant means we can do some long-range planning with emphasis on basic research that should lead to more significant and fruitful applications," said Farrington Daniels, chairman of the University's chemistry department and solar energy expert. Prof. Daniels will continue in charge of the over-all Wisconsin solar research program.

Dr. John A. Duffie of the University's Engineering Experiment Station will continue as director of the Solar Energy Laboratory.

In outlining the solar energy work for the future, Prof. Daniels said: "In the first three years we've explored several possible ways for the direct application of sunlight and have attempted to screen out the most helpful ones. The new grant will mean we can approach these applications from a more fundamental and useful point of view. In other words, we will be able to carry out more basic research in solar chemistry and solar engineering."

(Continued on next page)

Paul J. Grogan, Conference Secretary and Treasurer
Utilization of Engineers, Scientists, and Technicians
The University of Wisconsin Extension Division
Madison 6, Wisconsin

☐ Keep me informed of your plans for the Wisconsin Conference on Utilization of Engineers, Scientists, and Technicians, August 21, 1958.

☐ Enroll me for the Conference, Luncheon, and Proceedings at a fee of $10.00. (Enclosed ..... Bill Me .....).

.....

Make check or money order payable to Paul J. Grogan, Conference Treasurer .....

.....

Currently, Daniels explained, research is being conducted along several lines: solar cookers, solar-operated refrigeration, solar reflectors for heating or for the running of steam engines, and photochemical re-actions that can be used to store the sun's energy directly.

"Although there has been quite a bit of talk about the use of sunlight as an energy source, the University of Wisconsin is one of the very few laboratories in the world carrying on a broad, active research program in this field," Daniels stated.

Right now one of the biggest Wisconsin activities is research on solar refrigeration, the UW scientists said. "We're collecting basic data on the physical chemistry and engineering principles involved in this type of application. Such refrigeration is needed in the non-industrialized areas of the world to conserve the supply of food and to decrease some of the causes of disease."

One of the initial developments of Wisconsin's solar energy program has been solar cookers—large, concave, reflecting surfaces which collect the sun's rays and focus them at the bottom of a cooking vessel. Wisconsin scientists have run field tests using the solar "stoves" in Mexico and Colombia.

"Inexpensive solar cookers could replace badly-needed materials now used as fuel in some poverty-stricken countries," Daniels pointed out. "With this grant, further field tests will be carried out."

In the photochemistry field, preliminary experiments have found that new chemical compounds can be formed by absorbing a large amount of sunlight. Daniels explained that these compounds can later be separated and allowed to react, giving off stored energy in the form of heat.

Besides the main Solar Energy Laboratory on the UW campus, a small substation is located in Denver for year-round solar experimentation, Daniels noted.

ASME MEETING

Jim Hogan, president, and Jim McCollough, vice president, presided over their last meeting as leaders of our group. Both graduate in June. Attendance of the members at the ASME Regional Speech Contest in Milwaukee was recommended.

Joe Chajnacki, St. Pat's Chairman, made his report and thanked Tony De Trapini and Sally Trieloff for their work on the poster for the dance.

Bill Fagerstrom—a freshman—was elected as our new Polygon Board Representative.

Mr. Michael A. Pappas of Standard Oil of Ohio gave a lively and very interesting talk on—"Mechanical Engineering in the Petroleum Industry."

NUMERICAL CONTROL—EXTREME INTEREST, LITTLE KNOWLEDGE, SAYS ASTE

The American Society of Tool Engineers has recently completed a preliminary study of industry opinion about tape and punched card controlled machine tools.

The results of the study are of particular significance to industry in that they represent the opinions of top management executives in every geographical location in the U. S. and parts of Canada. They indicate that tool engineers everywhere are extremely interested in programmed machine tools as the answer to automation for short run production schedules but most engineers are reluctant to put a stamp of approval on this type of equipment until they know more about it.

The study shows what specific information is desired by tool engineers. It also indicates that larger plants (10,000 or more employees) are leading the way in application of these controls. Drilling operations are the processes deemed most adaptable to tape or punched card controlled machine tools by most tool engineers, and savings in direct labor are indicated by the study to be the most important advantage to be gained by their adoption. Decreased lead time, and lower fixture cost are also shown to be important factors in tool engineering thinking.

Complicated systems, lack of standardization, and high costs are shown to be the main obstacles to full acceptance, along with the fears based on lack of knowledge mentioned earlier. That tool engineers regard these obstacles optimistically, however, is indicated by

(Continued on page 49)

Wisconsin Society of Professional Engineers

The Future in Engineering for Me

by Jon Bischel

The Author: Jon Bischel, a student at St. Catherine High School, Racine, was the successful winner selected from the first place winners of each of eight W.S.P.E. Chapters. The essay contest on the subject, "The Future in Engineering for Me", was sponsored by each chapter of W.S.P.E. awarding a first prize of $25.00 to each chapter winner. Jon's prize as state selection gives him an additional $50.00 Savings Bond.

WHAT do you wish to be? This is a question that confronts every one. Our answers are usually in terms of the occupations which we intend to pursue in order to earn a living. The possibilities are numberless. Some of the deepest satisfactions in life come from the sense of accomplishment that we have after work well done. To have a share in producing the goods and services whereby the community lives is the ambition of every worthwhile individual.

For myself I can think of no more rewarding field than engineering. Engineering has always been a great profession because it offers intriguing opportunities to those who are willing to acquire both the broad education and intensive technical training necessary to cope with complex living. The engineering profession provides its members with dignity, economic security, opportunity for service, and a challenge equalled by none other.

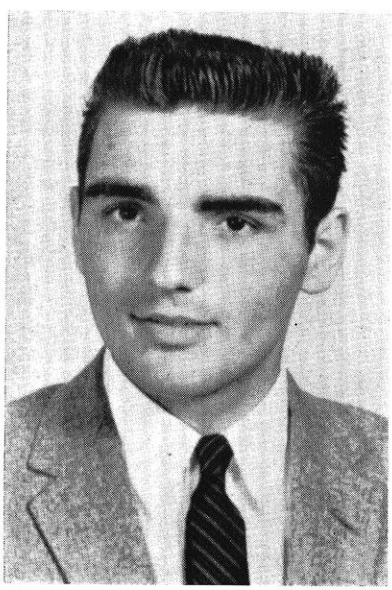
Engineers are largely responsible for the high standard of living we have in the United States, the highest that the world has ever known. They are responsible, too, for the development of our mass production techniques and more recently, for automation. Automation frees productive manpower from routine, mechanical operations so that it can be employed in occupations of higher skill and greater importance. Thus the production of all items which contribute to our high standard of living is still further increased while the cost of production is lowered.

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.



Jon Bischel.

The need for young men with engineering training in almost every field of useful endeavor is greater today than ever before. Engineers are in exceedingly short supply at the present time and opportunities for them are almost unlimited. While we need more engineers to assure a continuing high standard of living in the nation, we need even more urgently the international security which only trained engineers can provide.

The word engineer means an ingenious designer or planner. One of the definitions of engineering reads: "Engineering is the art of applying the laws of the natural sciences to the utilization of the materials and forces of nature in producing facilities for the benefit of mankind, and the art of organizing the human effort required in connection therewith."

As a vocation, engineering is a profession and involves to a greater or lesser degree the characteristics of a science, an art and a business. As a science, engineering requires a knowledge of the physical laws of nature and an acquaintance with the mechanical properties of the materials which the engineer must use. As an art, engineering is based on the accumulated experience of the past masters. As a business, engineering involves the selling of one's professional services advantageously. Since almost every field of human activity has an engineering aspect, there is opportunity for satisfying all kinds of interests.

It is my intention to pursue a career in the field of electrical engineering. I am confident that the electric utility industry can offer me unparalleled opportunities for achievement and adventure. From the research I have done I know there are few industries which con-

(Continued on page 44)

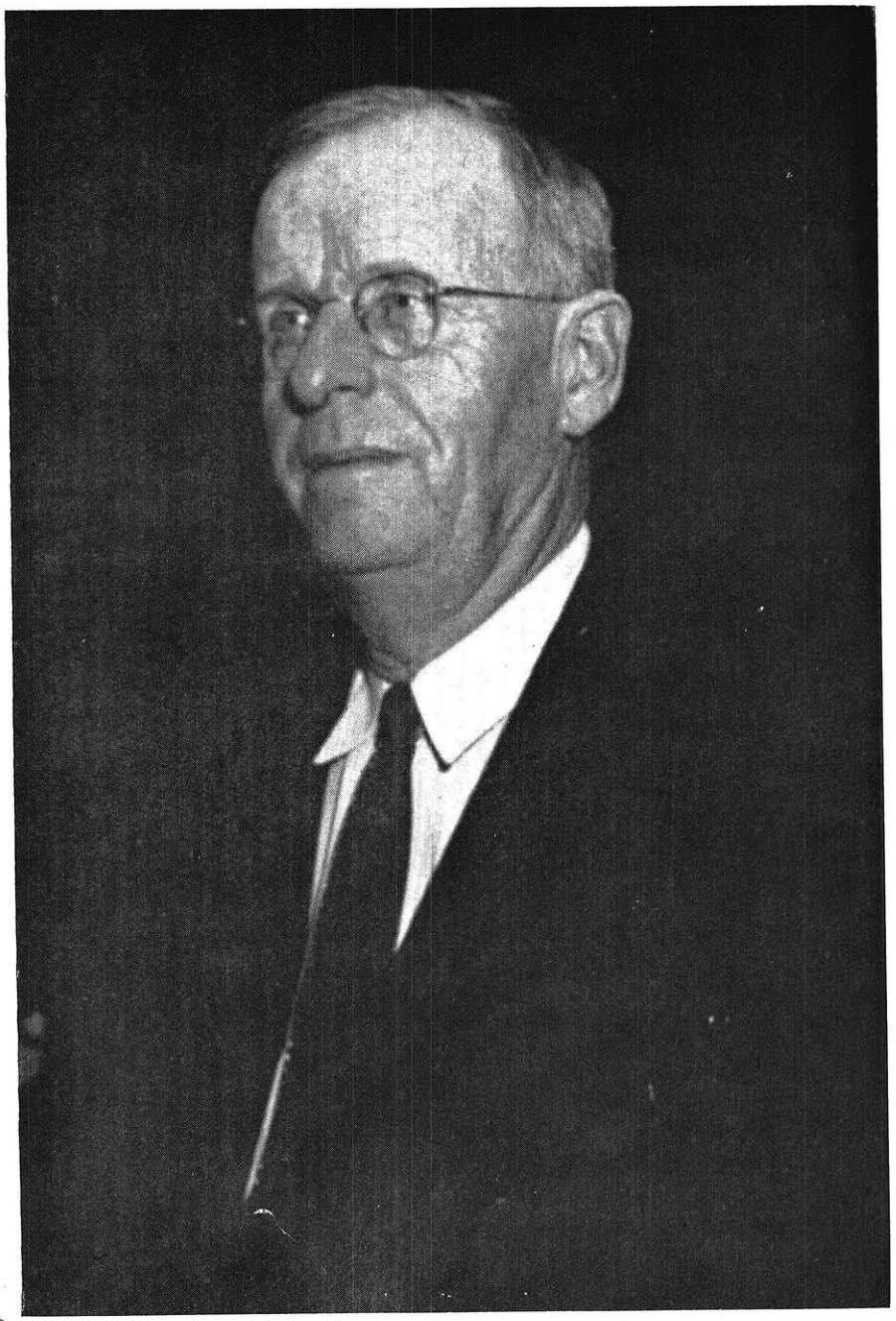
Meet the President

PAUL L. SCHROEDER, President of the Wisconsin Valley Chapter was born in Watertown, Wisconsin, on January 6, 1893. At the age of 24 he went to serve in the 89th Division during World War I. It was during this service that he decided on an engineering career and after being discharged he took his training in structural design at the Veterans Institute at Nauvoo, Ill., and the University of Wisconsin.

"Construction is my business," Paul would say when asked "What's my line?" He has spent 34 years doing this kind of engineering. Since first joining the Hoffman Construction Company in 1924, he has served with the Wisconsin Highway Commission, as a city engineer and as a war plant engineer. Since 1946 he has been with the Genisot Engineering Co. and at present serves that company as treasurer and chief engineer.

Paul, a member of the Wisconsin Engineering Society in 1933, is a long time member of WSPE. He has been very active in the Wisconsin Valley Chapter serving as Chairman of numerous committees. After serving as vice-president in 1956–57, he became our 1957–58 president. Paul spends some of his spare time in American Legion activity and also has taken up photography for a hobby.

Mr. and Mrs. Schroeder have just returned from the southern state of sunshine and oranges where they spent an extensive vacation. It was in Florida that he met and married Cecilia Plourde. Paul must have sold her on the merits of living in Wisconsin for they now make their home in Rhinelander.



Paul L. Schroeder.

W.S.P.E.

(Continued from page 42)

template doubling their production in the next ten years, as does the electric power industry. I believe that this increased growth will result in greater opportunities and challenges for electrical engineers.

At the turn of the century, American industry as a whole employed one engineer for every 250 workers. Today, American industry employs one engineer for every 60 employees. It is clear that the proportion of engineers to other workers will continue to increase as we progress.

Great advances have taken place in the art and science of generating, transmitting and distributing electric energy. We are just getting started in the exciting new technique of producing electric power from the atom. The development of atomic energy for the peacetime generation of electric power is just one of the many engineering challenges that will be met by the electric utility industry in the future.

What lies beyond the immediate horizon? Less than a century ago, men of science like Edison, Tesla, and Steinmetz could not have envisioned the worth of their contributions. Electric power has become the lifeblood of our nation within a span of only a few short years. Electricity has reached such an important stage in our day-by-day way of living that every man, woman and child depends in some manner on it for the necessities of life. The electric power industry is setting the pace for the entire American economy.

Who is to carry forward the torch of enlightened technology in the electrical industry? In this age of atoms and electrons, we, the youth of America, have tremendous engineering opportunities. The one industry upon which all others depend is the electric power industry. Where then, but here, could an engineering future be as promising and rewarding?

Electric power has become our third largest industry. Surely such an industry is a challenge to any man deciding on his life's vocation. The future sound growth of electrical engineering will depend on the vision, the bold concepts, the unremitting efforts, the ability to achieve, and the native leadership of its engineers. The people of our nation look up to, have great faith in, and have a right to expect much from the electrical engineers of our country. Men of power—a true definition of electrical engineers.

I believe I can best serve my community, my country and my fellow man as an electrical engineer. That is why I have chosen engineering for my life's work.

NSPE TESTIFIES ON FEDERAL AID TO EDUCATION

Clark A. Dunn, P. E., NSPE vice president in charge of educational interests and Director of the Office of Engineering Research at Oklahoma State University, recently appeared before House and Senate Committees in connection with proposals dealing with Federal aid to education. As the NSPE spokesman, Dr. Dunn declared that the Society is opposed to any Federal program of undergraduate scholarships since such a program would put the emphasis on the need for more students, when enrollments in the United States are at an all time high and are still growing rapidly. "The primary concern of the Federal Government should be with improving the quality of students and only after the quality is adequate should it concern itself with the quantity of our college and university students," Dr. Dunn stated.

In his statement, Dr. Dunn suggested several broad courses of action which the Federal Government could undertake either by legislation or the implementation of existing programs of Governmental agencies in order to meet this Nation's educational needs. These recommendations are as follows:

1. Improving the ability of all educational organizations (primary, secondary and college) to attract and hold superior men and women in scientific and engineering education positions.

2. Assisting in programs that encourage the improvement and expansion of existing physical facilities which are essential for a well-rounded engineering education curriculum.

3. Encouraging technical institute educational programs where the courses are at the post high school level.

4. Assisting science and engineering students of proved ability who have completed their bachelor's degree program to pursue graduate work.

One point emphasized heavily during the testimony, which received very favorable comment from several Senators, was the NSPE suggestion that Federal departments and agencies presently involved with education embark upon an extensive program of emphasis on the value of education, enlisting the support and co-operation of industry as well as the general public in this activity. The necessity for Federal action along this line is aptly illustrated, Dr. Dunn said, if one considers the $1400 by which the annual earnings of a college graduate exceed those of a high school graduate, and that consequently the mutual effort of a $6000–$7000 per year teacher and approximately 20 students increases the total lifetime potential earning power of those students by hundreds of thousands of dollars.

SOUTHWEST CHAPTER

Nearly a hundred members and guests of the Southwest Chapter of the Wisconsin Society of Professional Engineers gathered at the Cuba Club in Madison on March 28, for the regular meeting of the Chapter.

After an excellent meal, a short business meeting was conducted by President Jack Maxfield.

The speaker for the evening was Dr. George Sievers, consulting engineer and psychologist from Milwaukee. Dr. Sievers held the attention of the group as he discussed the professional status of the engineer in our social system.

The message was an inspiration to the younger engineers as Dr. Sievers spelled out what professional recognition means, and how it has been achieved by the work of many who have gone before us.

Dr. Sievers also answered several questions which had been submitted by members of the Southwest Chapter. He suggested that there was ample room in the field of engineering societies for the NSPE

and the Founder Societies where the engineer can focus on his specialties.

The meeting was a highlight of the Southwest Chapter's program for the year and Dr. Sievers' remarks shall be long remembered.

STEUBER WINS WRITERS AWARD

A Madison engineer, and a W. S. P. E.–Southwest Chapter member was awarded one of the nation's biggest writing prizes–the $1,000 Friends of American Writers award for 1958.

He is William F. Steuber Jr., 2210 Lakeland Avenue, author of a novel, "The Landlooker."

Steuber is an engineer with the State Highway Department and is a native of Prairie du Sac.

"The Landlooker" is his second novel. The award was presented at a noon luncheon in the Congress Hotel, Chicago, by Mrs. Howard C. Hill, president of the "Friends" group.

Steuber's book is based on the disastrous Peshtigo fire of 1871. The title is derived from the lumber days of the era. A landlooker was a timber cruiser or forest appraiser.

The award is given to a native or resident Midwesterner or done with a Midwestern locale "to encourage and promote high standards and ideals among American writers."

Among previous recipients is famed biographer Carl Sandburg.

THE END

APPLICATIONS FOR MEMBER AND AFFILIATE MEMBER—MARCH 15, 1958

Name and Position	Address	Reg. No.	Sponsor
MILWAUKEE			
Edward N. Potter, PE Plant Engineer International Harvester Co.	1714 W. Bruce St. Milwaukee 1, Wis.	E-6483	F. C. Koehn, PE
Walter R. Ratai, EIT Engineer Loft & Fredericksen	5431 W. Greenfield Milwaukee 14, Wis.	ET-1697	W. C. Dries, PE
Ralph A. Swing, PE Engineer Wis. Telephone Co.	740 N. Broadway Milwaukee 2, Wis.	E-6469	W. C. Yaeger, PE W. H. Stumpf, PE
NORTHWEST			
Charles E. Bieber, Jr., PE Chief Engineer Sterling Pulp & Paper Co.	144 Garfield Ave. Eau Claire, Wis.	E-6515	Chapter Board
Walter W. Zentner, EIT Public Health Engineer Wis. State Bd. of Health	3 Judith St. Chippewa Falls, Wis.	ET-1608	Robert Cooper, PE
SOUTHEAST			
Louis J. Svoren, EIT Design Engineer Howard Industries, Inc.	2046 Wustum Ave. Racine, Wis.	ET-1535	Gerald Randa, PE
SOUTHWEST			
John W. Ockerman, PE Chief, Topo. & Hydro. Sect. Eng. Div., Wis. Conservation Dept.	31 Sherman Terr. Madison 4, Wis.	E-6615	L. F. Motl, PE
Total—Members 4 Affiliates 3			

Science Highlights

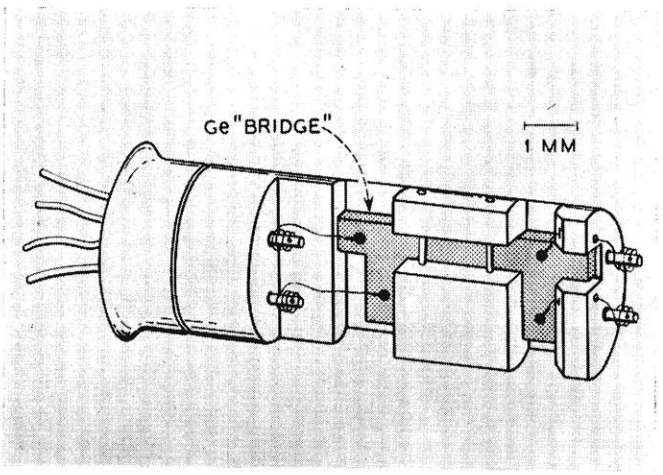
(Continued from page 36)

and exceptional stability in the temperature range near absolute zero has been developed by Bell Telephone Laboratories. Once calibrated, this thermometer is reproducible to better than a few ten thousandths of a degree at the boiling point of helium (4.2°K) even after repeated cycling from room temperature. Such characteristics indicate that this thermometer might be useful for the accurate measurement of temperatures in outer space, when mounted in a suitable space vehicle.

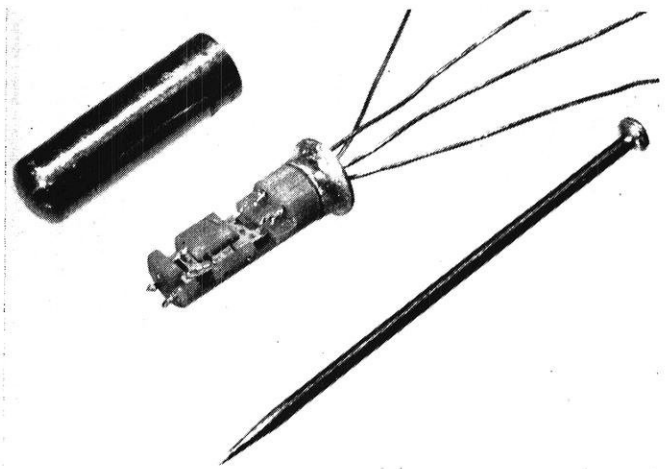
Continued emphasis on low-temperature research has highlighted the need for a thermometer which would indicate low temperatures accurately and reliably, and would not need continued recalibration. Such a device would be of great help in low-temperature calorimetric work. The germanium resistance thermometer meets these specifications.

The heart of this thermometer is a very small "bridge" cut from a single crystal of arsenic-doped germanium. Actual size of this bridge is about 0.025″ x 0.210″. Current and potential leads are attached to the bridge, and it is supported in a strain-free manner in a platinum-glass enclosure containing a small amount of helium gas to aid in thermal conduction. The resistance is determined by measuring the potential drop when a small, approximately 10 microamperes, known current is passed through the bridge.

THE END

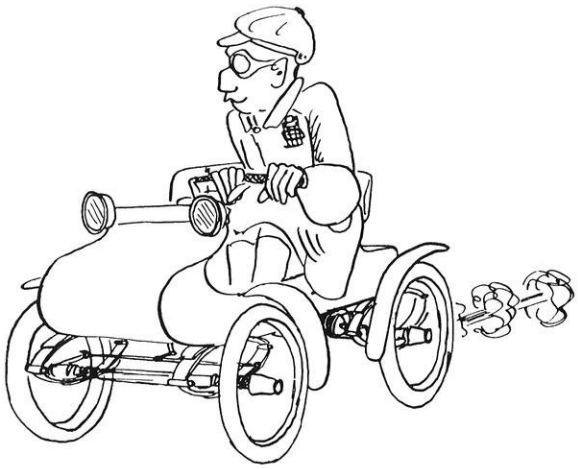


Cross section drawing showing internal construction of the germanium resistance thermometer.



—Courtesy Bell Telephone

The germanium resistance thermometer compared in size with a common pin.



THE ENGINEER OF YESTERYEAR

by John Nichols and Ken Lewandowski

May 1928

THE new American tempo is manifesting itself in the public's disconcerting willingness to turn its back on established institutions, products, methods and ideas. Witness the public's promptness, amounting almost to aggressiveness, in accepting new products, methods, institutions and ideas. As examples consider the radio, balloon tires, the tabloid pictorial newspapers, the movie, Duco finish, electric refrigeration, pale ginger ale, four wheel brakes, stepped-back skyscrapers, cooperative apartments, symphony concerts by radio, installment buying, and air mail. These new developments lose their novelty so fast, and are accepted with such matter-of-factness, as to take away the breath of the older generation of business men.

April 1928

The effect of automobiles upon grades seems to us to rest entirely upon circumstances. In the case of some students, and with the Madison street railway in its present state of efficiency, an automobile undoubtedly aids in getting larger amounts of work done. In the case of other students, there is no doubt but what large amounts of time are wasted just driving around and displaying their affluence before less fortunate members of our university community.

The "*Engineer*" believes in student automobiles, but it also believes that the operation of these machines on the campus must be strictly regulated, and the regulations put into force immediately. If this is not done, it is just a question of time before we have a serious accident on some one of our campus roadways.

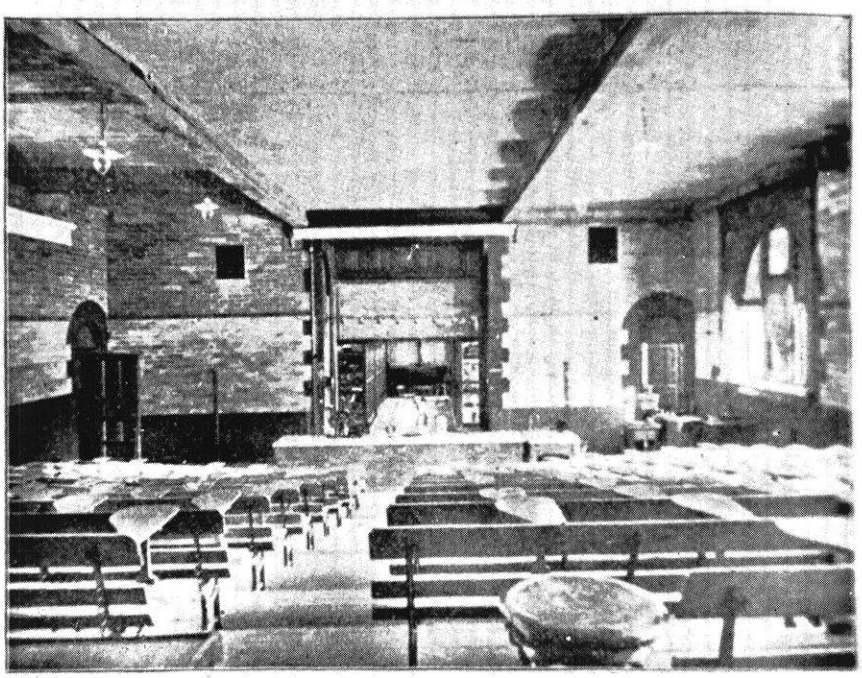
For example, go down by Chadbourne Hall some day when the students (most of them coeds) are using the roadway to get up onto the Hill. Then watch some college idiot with an overload of fraternity brothers come racing up that roadway, loudly honking his horn, and making an attempt to take the Hill in high. His length of vision is in any case more than 150 feet, and he is usually traveling 25 miles an hour with a 50 per cent overload in his machine. What chance has he to avoid striking and maiming some girl who has become temporarily confused by the raucous bellow with which his horn has startled her?

We who use the campus roadways ask the deans, the faculty, and the board of regents: "How soon will pleasure automobiles be barred from the campus while classes are in session?" "Must someone be injured before traffic regulation is taken from the hands of a poor old gentleman with a red and green broomstick and given to someone with real authority?"

May 1929

The old type of television receiver, with the large scanning disc

University Views.

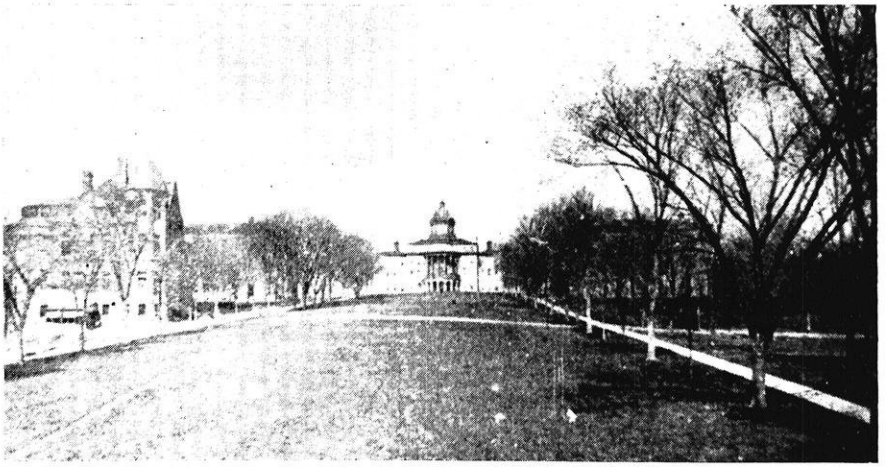


Physical lecture room. The Physical Lecture Room contains seats for 200. Its equipment is the most modern. The lights are connected with a stage dimmer by the use of which they can be regulated to any desired degree of illumination. By means of curtains controlled by a hydraulic device the room can be darkened on turning a valve. There are two stereopticons, the screens for which can be raised or lowered at pleasure. The lecturer's table is fitted with a small Pelton-wheel for operating light machinery. There are numerous other conveniences, all of which help to make this an ideal lecture room.

and large neon tube that required so much current, has been superseded by a more practical piece of apparatus. This new set is the result of four years of television research and experiments made by C. Francis Jenkins, the owner of Station W3XK, Washington, D. C. The unusual television set has a picture screen of 1½" x 1½" whereas the new set produces an image about a foot square. This is done by reflecting the picture through a magnifying glass. In Jenkins' new set, he employs a special lamp with four plates, each plate serving to illuminate one fourth of the screen. The plates are flashed on the screen in rotation, similar to the way auto spark plugs fire. Enormous illumination may be obtained with only the ordinary radio's two units of audio frequency amplification. The operation spells simplicity in itself: a switch starts the motor that drives the scanning drum. The radio set is tuned to the broadcast wave lengths or short wave lengths, if convenient, that carry the television signals. A second switch turns on the neon lamp, and a series of parallel lines and flickering shadows appear on the screen. A third switch brings the picture into perfect synchronization with the transmitter. The picture is framed by means of a level placed on the screen.

November 1925

The popular demand for radio in the United States has prompted the installation of receiving sets in some of the metropolitan hotels. Individual sets in each room are too expensive to run profitably but a solution has been reached in the Robert Morris Hotel in Philadelphia. A simple receiver costing about $25 is installed in each room. This set is connected with the main receiver in the lobby. The same program which is broadcast in the lobby is sent to the rooms. The main telephone switchboard is also the control board for the receiver. The operator selects the best program which is being broadcasted at any particular time and plugs it into the rooms desiring service. The installation of radio in the rooms is a feature which has attracted many guests to the hotel, especially since this service is given without charge.



January 1928

Of immediate interest to the general public is the fact that the talking motion picture may be adapted to supplying a full orchestral accompaniment for pictures. This is of great value to the exhibitor in a small town who finds it impossible to spend a great deal of money on the music score of his motion picture exhibitions. Through the new type of talking motion pictures people in small communities will be enabled to both see and hear famed speakers or musical organizations. Educationally, such a system will be of great value, since it will be possible to record lectures and demonstrations simultaneously then to later show them in widely separated classrooms not equipped with sufficient laboratory apparatus to make such experiments feasible. It is entirely possible to predict that when the times does arrive when motion pictures will register with absolute fidelity all of the natural colors involved in photographing a production, suitable talking motion picture apparatus will have been developed so that entire operas may be shown upon the screen and simultaneously heard by the audience.

February 1926

The human mind outwitted nature recently near Pueblo, Colorado, when a bridge contractor constructed a 100 foot steel bridge on the river bank and then pulled it into place.

Workmen, on two occasions, constructed the piling and falsework upon which to build the superstructure, as is usually done in bridge building. On both occasions the creek became swollen with flood waters and washed out the falsework, just as the steel work was started.

Workmen then built the entire bridge on the road-way. When it was completed they constructed the falsework again, and pulled the span into place before another flood had an opportunity to wreck the piling. Timbers were greased and the steel span pulled into place by means of a large tractor on the other bank. Only an hour was required to install the bridge which was then bolted to the concrete abutments previously poured.

March 1925

An inventor, with a pump that would lift water forty feet by simple suction, disturbed the serenity of the hydraulic faculty a few weeks ago. The inventor ambled into the laboratory one day with the pump and his startling claim of a 40-ft. lift. Professors Corp and Ward expressed polite doubts about the claims, but told him to set up the contrivance and give a demonstration. He called them from other duties when he was ready and, sure enough, he was lifting water forty feet. He did not get much of a stream to be sure, but he did get some water. No, gentle reader, this story isn't a lie, nor was the inventor a wizard who could change the laws of Nature. A little investigation showed that his suction pipe had some leaky joints so that air entered at each stroke and gave him the benefit of an air-lift. When the joints had been made tight, the pump refused to function further, and another invention was laid regretfully upon the scrap heap.

THE END

Gasoline Additives

(Continued from page 21)

the tendency of normal deposits to ignite the charge.

4. The additive should not increase spark plug deposits which cause the plug to short out. It also should not increase the rate of spark gap growth.

5. The additive should not detract from the general cleanliness of the engine system.

6. No increase in bearing corrosion should occur due to the presence of the additive.

7. Intake and exhaust valve life should not be shortened.

8. The additive should not increase exhaust system corrosion.

9. Corrosion of the bumper by agents in exhaust gases should not be increased by the introduction of the additive.

The above specifications for a good additive show where the fuel stabilizing and conditioning agents are needed. They are designed to take positive action to eliminate some of the conditions that additives developed for other purposes should not aggravate.

Anticorrosion and antigumming additives were first developed primarily to maintain stability in refinery storage and handling. But now fuel manufacturers are giving more attention to the same problems in the fuel induction system. The anticorrosion agents check the tendency of active acids or bases or oxidizers to attack metal in storage tanks and fuel lines.

Gumming is caused by polymerization and oxidation of olefins in the gasoline. Gumming inhibitors are generally antioxidant compounds. Experimenters are finding, however, that induction system deposits follow from other factors in fuel chemistry as well. Detergent additives have been developed to remove fuel line deposits after they have formed.

Top cylinder lubricants have been added to some fuel brands to insure smooth functioning of moving parts in the combustion chamber.

Anti-icing compounds reduce the tendency for ice to form in engine carburetors. Heat to evaporate gasoline in the carburetor prior to induction into the combustion chamber must be supplied by the throttle blade and barrel. If the ambient temperatures of these parts are lowered below the freezing point by the heat loss, any moisture in the incoming air or in the fuel itself that contacts these parts will begin forming a coating of ice on them.

When the throttle blade is coated, intake air flow is restricted, often until engine speed is reduced to the stalling point. The anti-icing additive counteracts this condition by forming a low-freezing solution with water in the air or fuel.

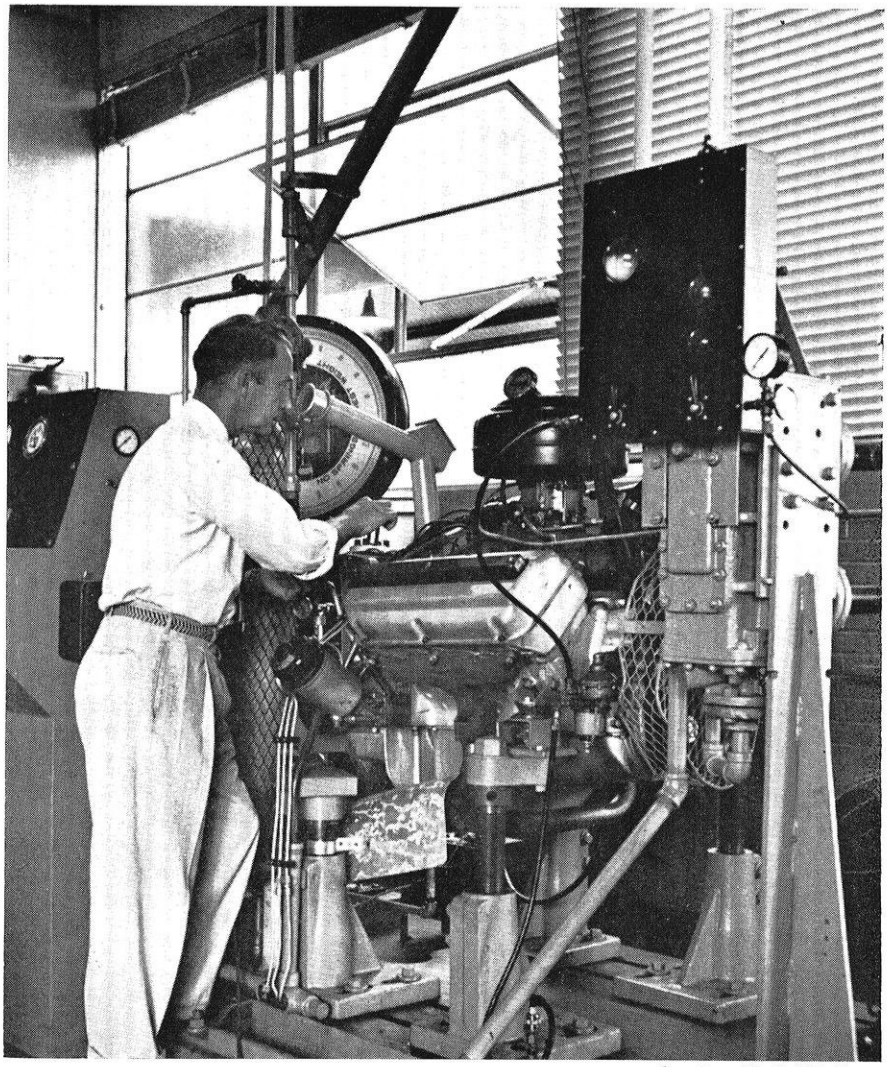
As automotive and fuel development continue, experts predict refiners will rely more and more on additives to give their products optimum quality at minimum prices.

TEL consumption is expected to rise from the present 430 million pounds per year in 1955 to 720 million pounds in 1970. Halide scavenging agents and dyes mixed with the TEL should rise from 270 million pounds to 380 million pounds.

The average motorist now consumes approximately 9.5 pounds of additives other than the TEL-scavenger mix in his fuel and lubricating oil annually. Total consumption of these additives is expected to triple or quadruple by 1965, if present trends continue.

The use of a fuel injection system for automotive engines or the introduction of the gas turbine engine, two developments expected in the next decade, however, would greatly alter the additive market. TEL, anti-icing agents, preignition inhibitors and detergents would no longer be necessary. Fuel chemical consumption might drop as low as 0.6 pounds per car per year.

THE END



—Courtesy Shell Oil Co.

You can't give any one person the credit for TCP. But the man who set it moving was R. J. Greenshield, Director of Research at Shell's Wood River Research Laboratories. Here Greenshield checks timing of test engine on the dynamometer, the laboratories section.

Campus News

(Continued from page 40)

the fact that they expect their companies to spend over a half-billion dollars on programmed machine tools over the next five years.

A summary of the study is available by writing ASTE Numerical Control Study, 10700 Puritan Avenue, Detroit 38, Michigan.

$100,000 GRANT FOR GRADUATE FOUNDRY STUDY

The University of Wisconsin is expected to participate in the $100,000 educational grant from Wheelabrator Foundation to the Foundry Educational Foundation that was announced in March at the F. E. F. College-Industry Conference in Cleveland, Ohio.

The announcement was made by James F. Connaughton, President of Wheelabrator Corporation, Mishawaka, Indiana, manufacturers of airless blast cleaning equipment, steel abrasives and dust collection equipment.

Bulk of the grant is accounted for by 50 fellowships of $1,500 each. The fellowships commemorate the 50th Anniversary which Wheelabrator is observing in 1958. The grant also puts $25,000 at the disposal of F. E. F. for fellowships, scholarships or other educational purposes approved by the F. E. F. and the Wheelabrator Foundation.

The F. E. F. was established in 1947 by six associations serving the foundry industry. It works with industry and colleges to advance the foundry industry and to stimulate interest and understanding of the industry.

The grants for graduate study are intended to foster and improve education in foundry science, engineering and operation. The University of Wisconsin is one of 17 schools throughout the country that are designated as F. E. F. schools. It receives scholarship support from the F. E. F. and works in cooperation with the Foundry Educational Foundation to strengthen foundry education at the collegiate level.

The new fellowship program for graduate study leaves choice of school to the applicant, but the type of education for which the fellowships are designed will be most readily available at the F. E. F. schools because of their emphasis on improving foundry education under the F. E. F. program since 1947.

Richard W. Heine, Associate Professor of Mining and Metallurgy, is the F. E. F. key professor at the University of Wisconsin and is the primary contact at the University for F. E. F. activities.

ROCKEFELLER PUBLIC SERVICE AWARDS

William R. Mickelsen, 34-year old aeronautical research scientist, who heads the special problems section of the Propulsion Chemistry Division of the Lewis Flight Propulsion Laboratory, Cleveland, Ohio, has been associated with the National Advisory Committee for Aeronautics since 1948.

In the next academic year Mickelsen, one of the country's recognized authorities in aerodynamic mixing and turbulence, will use his Rockefeller Public Service Award for advanced study of the technological state and philosophy of British and European science in the application of the statistical theory of turbulence to the basic mechanisms of heat, mass and momentum transfer.

Pointing out that the turbulent transport of mass, heat and momentum is of major importance as the aeronautical field moves toward higher and higher speed flights, Mickelsen will center his studies around the University of Cambridge, England, and will also visit other centers of aeronautical research in England, Scotland, Holland and France.

A native of Racine, Wisconsin, and a member of the Class of 1948 at the University of Wisconsin, Mickelsen received the degree of Master of Science in Aeronautical Engineering from the Case Institute of Technology, Cleveland, Ohio, in 1953.

Paul W. Rose, 46-year old career employee, has been the director of the United States Operations Mission to Nepal since its inception in 1952. In the past six years in a feudal, underdeveloped country located on the borders of India and Communist China, Rose has directed a complex program that has increased from $250,000 in 1952 to some $8,500,000 in 1958.

Serving under the U. S. Ambassador to India, who is also this country's Ambassador to Nepal, Rose has organized and staffed a U. S. mission that has been concerned with a wide variety of projects in the fields of agriculture, health, education, community development, industry, mining and construction. He has been largely responsible for the extension and improvement of Nepal's communications system and has recently completed a survey for a Nepal-India-USA Regional Roads Project that will be undertaken under President Eisenhower's Asian Economic Development Program.

MINCK WINS FELLOWSHIP

A University of Wisconsin graduate student has been awarded the National Electronics Conference fellowship for the 1958–59 academic year.

William R. Minck, 23, is the winner chosen from national competition. He is currently studying toward his master's degree in electrical engineering, having received his bachelor's degree from the University of Notre Dame.

The fellowship award, worth $2,500, is the second to be given under a program recently adopted by NEC for sponsoring advanced study in electronics, according to an announcement by Dr. E. H. Schulz, conference fellowship award committee chairman.

Minck plans to use the award for continuing study in the field of high frequency theory and techniques at the University of Wisconsin. Born at Defiance, Ohio, and now residing at Madison, Wis., he is single but plans to marry Sept. 1.

The NEC fellowship is given for a year of graduate study at any one of the nine colleges and universities cooperating in the Conference. These include: Illinois Institute of Technology, Northwestern University and University of Illinois as sponsors. Michigan, Michigan State, Notre Dame, Purdue, Wayne State and Wisconsin Universities are participating institutions.

Other sponsors of the Conference are the American Institute of Electrical Engineers and Institute of Radio Engineers; the Electronic Industries Association and Society of Motion Picture and Television Engineers are also participants.

THE END

Fuels

(Continued from page 17)

perature control can be obtained by changing the flow rate of the cooling oil. The constant motion of catalyst particles keeps them free from gum formation and cementing, which are the major causes of increased pressure drop.

The Louisiana unit is the only large Fischer-Tropsch plant to use the jiggling catalyst bed. The main advantage is that methane production is only about fifty per cent of that of a conventional fluid system. The reason for this difference has never been satisfactorily explained. Jiggling bed reactors also use less hydrogen than do fluid systems. Optimum efficiency is at a 1:1 hydrogen to carbon monoxide ratio in the feed, whereas the conventional fluid catalyst reactors require a hydrogen-carbon monoxide ratio of 1.6:1.

Table III.—PRODUCT DISTRIBUTION OF THE LOUISIANA PILOT PLANT

Product	*Per Cent*
Gasoline	70
Diesel oil	10
Heavy distillate	10
Waxes	10

The coal used in the Louisiana plant is semi-coking type, obtained from Rock Springs, Wyoming. Other coal can be used without modifications of the process, as the composition of the coal seems to have no effect on the operation of the gasifier. The coal is shipped in by rail, unloaded, crushed, pulverized, and stored under a nitrogen blanket until it is charged into the gasifier.

A stream of oxygen enters the coal and carries the coal in a fluidized state into the gasifier. The ratio of coal to oxygen is 1900 pounds of coal per hour to 18,000 cubic feet of oxygen per hour. Steam is introduced at a rate of about 1500 pounds per hour. This rate of feed results in a gasifier temperature of about 2500°F., with gasification of about ninety-seven per cent of the carbon in the coal. About 70,000 cubic feet per hour of synthesis gas leaves the top of the gasifier.

The synthesis gas leaving the gasifier is diluted with clean, cool synthesis gas. The gas is then purified before it is introduced into the reactor. The purified synthesis gas is converted to hydrocarbons, oxygenated organic compounds, carbon dioxide, and water, at about 425–450°F., by use of a reduced iron catalyst. The gas from the gasifier is combined with an equal volume of recycle gas, and then mixed with 600–1800 gallons of coolant oil.

The gas-oil mixture enters the bottom of the reactor and passes up through the catalyst. The products of the reaction with the unreacted gas leave the top of the reactor, pass through the exchanger, and are deposited in an overflow type vessel. The water layer, which contains almost all the oxygenated compounds, settles out and is drawn off and put in storage tanks.

The liquid synthesis product is reduced to atmospheric pressure and proceeds to the distilling area at about 100°F. Primary fractionation yields four fractions; gasoline, diesel oil, heavy distillate, and bottoms. The bottoms and heavy distillate are sent to storage, and will be further processed when needed.

About seventy-five per cent of the diesel product goes through the diesel oil absorber to assist in the recovery of light ends and then returns to the fractionator as reflux. The other twenty-five per cent is cooled and passed through a ten per cent caustic solution spray to neutralize and remove acid constituents. This fraction is then suitable for direct consumption as diesel fuel.

The overhead from the primary fractionator contains gasoline, water, and light ends. These products are treated by conventional gasoline refinery practices, including polymerization and catalytic reforming, to produce a satisfactory motor fuel.

At the present time the only economical coal to liquid fuel plant is the Sasol plant in South Africa. The other plants constructed could not produce liquid fuel at costs that can compete with liquid fuels produced from petroleum. Germany ran several plants during World War II, only because they had no other source of liquid fuels, but decreased production in the plants when the war ended.

After World War II ended, most oil companies expanded refining facilities and intensified exploration and drilling efforts. Thus, the production of synthetic liquid fuels did not develop as had been expected. However, industry and government feel that now is the time to make intensive technological and economical studies, before the problem of liquid fuel supply becomes urgent, and while natural petroleum is still abundant.

Estimates of peak petroleum production have been set at approximately 1985, with the production being about seven billion barrels per year. As shown by the graph, world production is about five billion barrels per year at the present time.

A promising development is the coal carbonization method of producing synthetic liquid fuels. This is a low temperature process and was developed by the Pittsburgh Consolidation Coal Company of Pittsburgh. The unique feature of this development is that it provides a means for supplying both solid and liquid fuels from one plant.

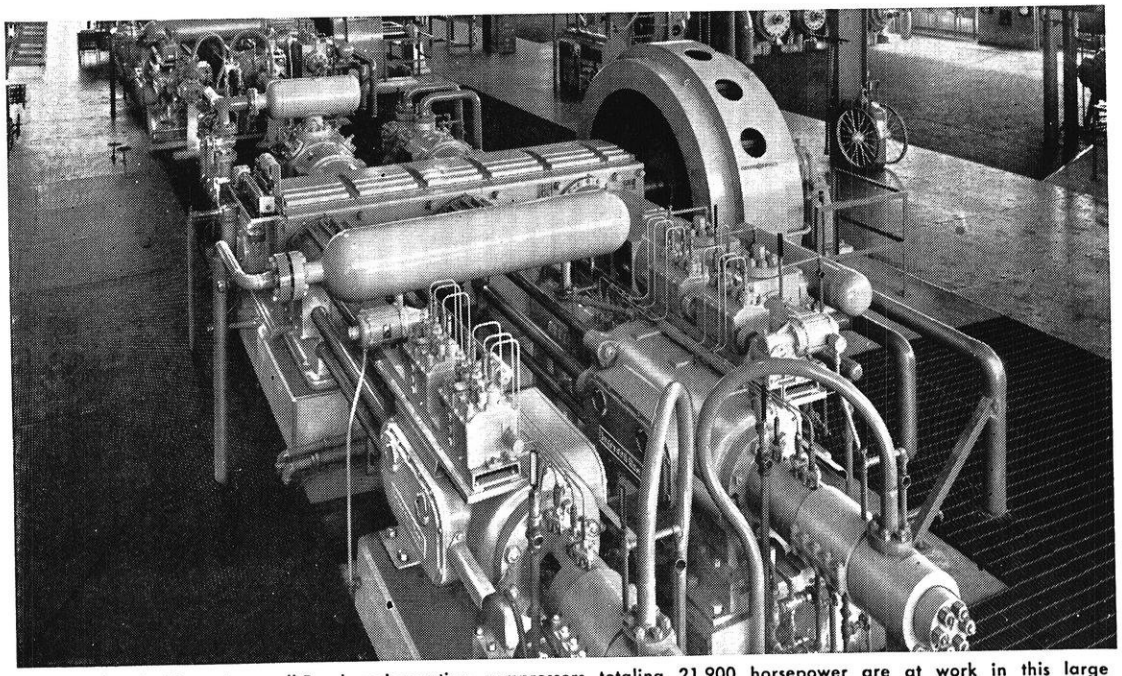
The method of Pitt-Consolidation consists of using fluidized solids technique, now used in catalytic cracking of petroleum, to move powdered coal through a partial conversion stage. A fine char residue is obtained, containing about seventy per cent of the original BTU value of the coal, thirty to forty gallons per ton of tar liquid, which could be converted to fuels, chemicals, and other products in demand, and about 1,000 cubic feet of high BTU content gas.

Some work has been done on direct hydrogenation of coal to produce synthetic liquid fuels, but at present this method does not look too promising. The initial cost of establishing a plant is too high and the operation itself is expensive. The technology of coal hydrogenation is also quite complex and clumsy. Unless some new radical developments are made in this field, coal hydrogenation will probably fade out of the picture.

United States oil companies have not given up, though, and are spending about $10,000,000 this year on development and testing of new processes. Thus, liquid synthetic fuels may be a major source of liquid fuels in the not too distant future. **THE END**

YOUR ENGINEERING CAREER

with **INGERSOLL-RAND**



Seven electric-driven Ingersoll-Rand reciprocating compressors totaling 21,900 horsepower are at work in this large ammonia synthesis plant. The units in the foreground compress mixed gases to more than 12,000 pounds per square inch.

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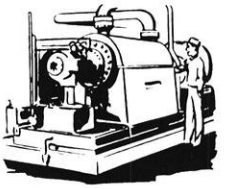
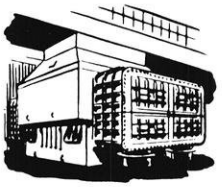
LEADERSHIP
in



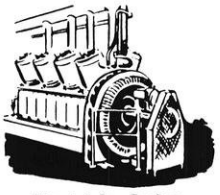
Centrifugal Pumps

Rock Drills

Air & Electric Tools



Steam Condensers



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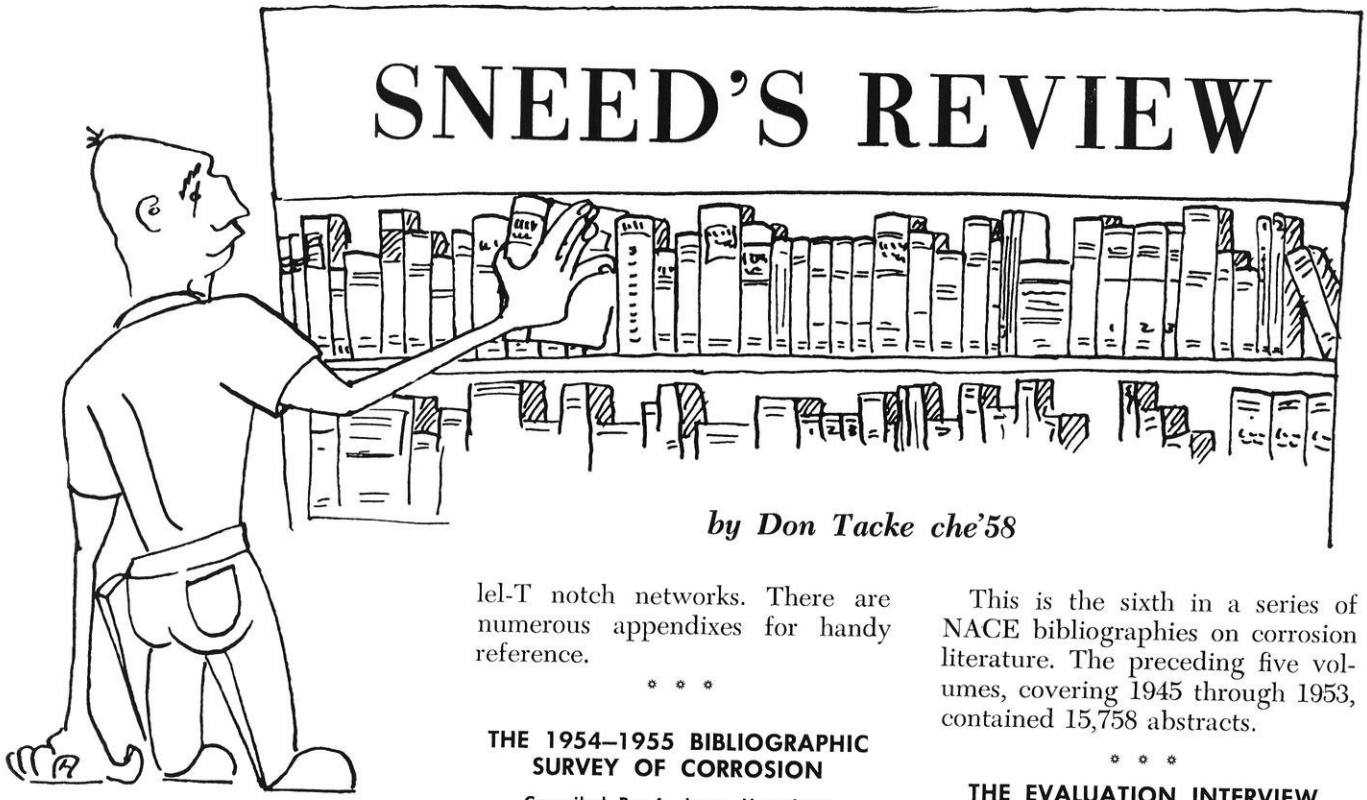
SNEED'S REVIEW



by Don Tacke che'58

BASIC FEEDBACK CONTROL SYSTEM DESIGN

By C. J. Savant, Jr.
McGraw-Hill $9.50

This book is an addition to the McGraw-Hill series in control systems engineering featuring a new approach to automatic control. Instead of using only the frequency analysis method, the book bases the design on a combination of the root-locus method and the frequency method. It emphasizes linear servo-mechanism design but also has a chapter on non-linear servo analysis.

Most of the book is developed by means of practical, numerical examples. Theoretical derivatives are included where necessary. Components are discussed from the point of view of how to use them in designing systems rather than just how the components work.

Here are the most recent advances in the field including the latest information on components, a section on gyroscopes and force-balance transducers, the first presentation in a book of this kind of inertial navigation, and the latest information on analysis of non-linear systems—such as the describing function technique and phase plane analysis. Many special tables permit the design of certain components; such as bridged and parallel-T notch networks. There are numerous appendixes for handy reference.

* * *

THE 1954–1955 BIBLIOGRAPHIC SURVEY OF CORROSION

Compiled By A. Irene Humphrey
Published by National Association of Corrosion Engineers
Non-members NACE $20.00

A selection of 4287 abstracts of articles on corrosion and corrosion prevention published in 1954-1955 are compiled in this volume. Also included are a number of abstracts published from 1945 to 1953 which were not available for use in earlier bibliographies.

Abstracts are arranged topically according to the NACE Abstract Filing Index, formulated over several years by experts in the field of corrosion, which divides the literature into eight main groups: General, testing, characteristic corrosion phenomena, corrosive environments, preventive measures, materials of construction, equipment and industries. Each main group is subdivided and topical cross-references are appended.

The subject index, in addition to terms in the NACE Abstract Filing Index, lists many metals and alloys by trade name and indexes them as to specific properties and to behavior in specific media. An author index is included. Referencing is to classification and serial numbers of abstracts for ease in searching. An appendix has been included to aid the user in locating and obtaining copies of unfamiliar foreign or domestic journals.

This is the sixth in a series of NACE bibliographies on corrosion literature. The preceding five volumes, covering 1945 through 1953, contained 15,758 abstracts.

* * *

THE EVALUATION INTERVIEW

By Richard A. Fear
McGraw-Hill $5.50

The interview is the basic core of personnel procedures and plays an increasingly important part in employee selection and promotion. In this timely and practical book, the author develops and explains the techniques of the interview. He includes an Employee Evaluation Form and discusses the ways in which it can be skillfully applied to increase the usefulness of the interview to the point where it will rank with other personnel aids in effecting the full utilization of manpower. While the book is of special interest to all personnel people and to administrators and supervisors on every level of management, it is also of value to those interviewing for jobs.

* * *

NEW BOOKS RECEIVED IN THE ENGINEERING LIBRARY

April, 1958

Bellman, Richard. Dynamic Programming. Princeton, Princeton Univ. 1958.

British Plastics Convention. Plastics progress 1957. New York, Philosophical Library, 1957.

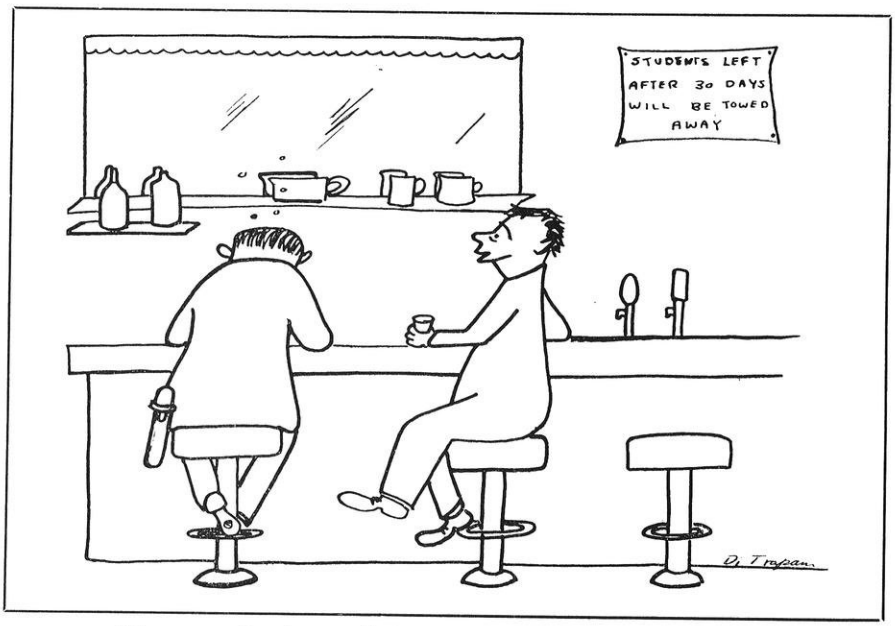
Collier, Charles. Catalysis in practice. New York, Reinhold, 1957.

Cooke-Yarborough, E. An introduction to transistor circuits. London, Oliver, 1957.

Edison Electric Institute. Transmission and distribution committee. New York, Author, 1957.

THE FERROUS WHEEL

exhumed and cartooned
by Tony DiTrapani



. . . and he never dismisses us before the end of the period 'cause he's afraid we'll wake the other classes.

In the Fourteenth Century there was a king who liked very much to hunt wild game. This selfish ruler wanted all the wild game for himself, so he issued a proclamation that made hunting a crime, punishable by death. The poor starving peasants soon got tired of this setup so they kicked the king out of office. And so, this became the first instance on record where the reign was called on account of game.

How about the scissors and knife grinder who announced so happily, "I never saw things so dull."

* * *

A draftee after his first night in an Army barracks was shaken by his platoon sergeant.

"It's four-thirty," bellowed the Sgt.

"Four-thirty," gasped the draftee. "Man, you better get to bed. We got a big day tomorrow."

And then there was the place that served martinis so dry that they took out the urinals and put in dustpans.

* * *

Disappointed first-grader after first day in school: "I'm not going back. I can't read or write and they won't let me talk."

* * *

M. E.: "So you worked your way through college? Your father must be proud of you."

E. E.: "Not much. He's the man I worked."

* * *

If all the coeds in the world who didn't neck gathered in one room, what would we do with her?

* * *

The teacher was quizzing the class.

"Now, who can tell me who gave us our nice schoolhouse?"

"President Eisenhower, teacher."

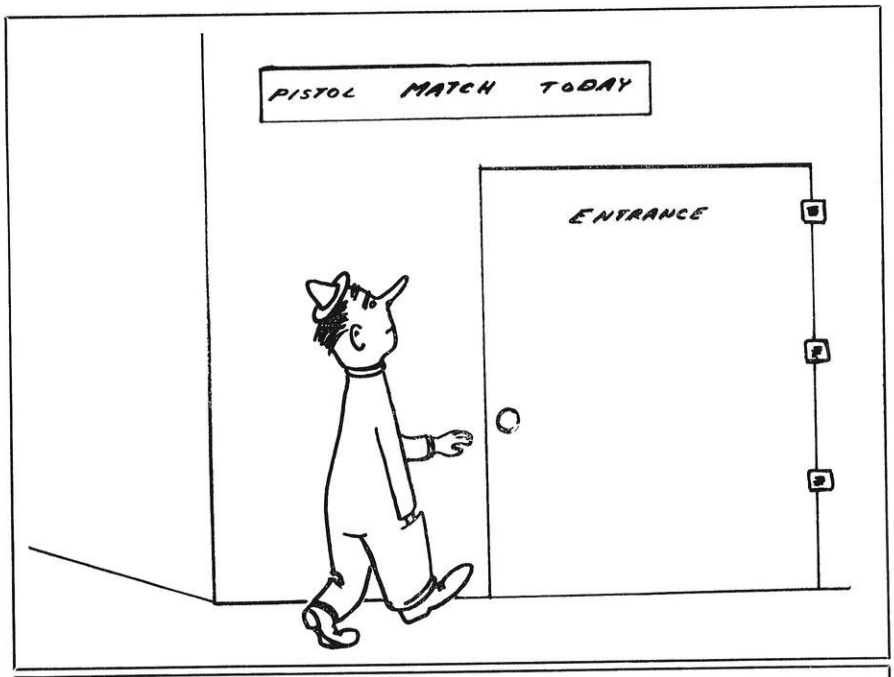
"That's right, Tommy. Who knows who gave us our beautiful parks?"

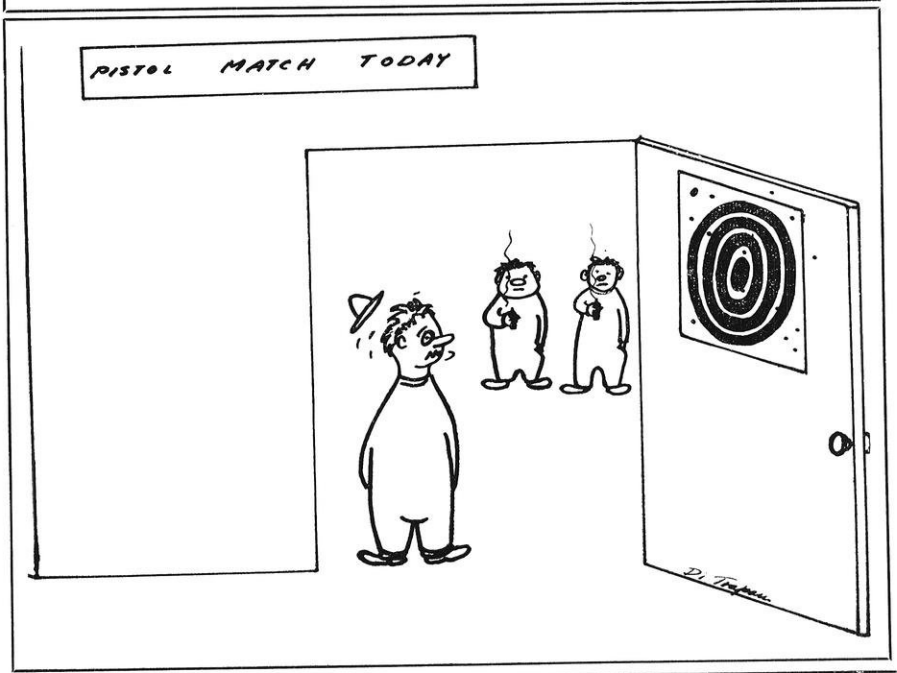
"President Eisenhower, teacher."

"That's right, Mary. And who gave us the birds and the bees, the flowers and the trees?"

"God did, teacher."

Voice from the back of the room. "Throw that Democrat outa here!"





The reason for the yellow light on traffic signals: It gives Scotchmen a chance to start engines.

* * *

1st E. E.: "Take hold of that wire."

2nd E. E.: "This one? Okay."

1st E. E.: "Feel anything?"

2nd E. E.: "Nope."

1st E. E.: "Then don't touch the other one. It's carrying 3000 volts."

* * *

It seems to me that a lot of enterprising young engineers are spending much of their valuable time tinkering with misses in their motors.

* * *

Engineer: "How much is this paper?"

Clerk: "Seventy-five cents a ream."

Engineer: "It sure is."

* * *

Doctor: "How's the engineering patient this morning?"

Nurse: "I think he's regaining consciousness. He tried to blow the foam off his medicine."

* * *

"I've got the greatest act in the world," he declared to his magician friend. "I pull 200 lighted cigars from nowhere, puff on each of them, and then swallow the entire 200."

His friend was amazed. "You swallow 200 cigars!" he gasped. "How on earth do you manage to do it?"

"Very simple," he replied. "I have connections in Havana and I get the cigars wholesale."

* * *

The first day in history class, a collegian leaned to the pretty girl sitting next to him and remarked, "I'm majoring in history."

"So am I," she replied.

"Great!" he shouted, kissing her cheek. "We'll have to get together and talk over old times!"

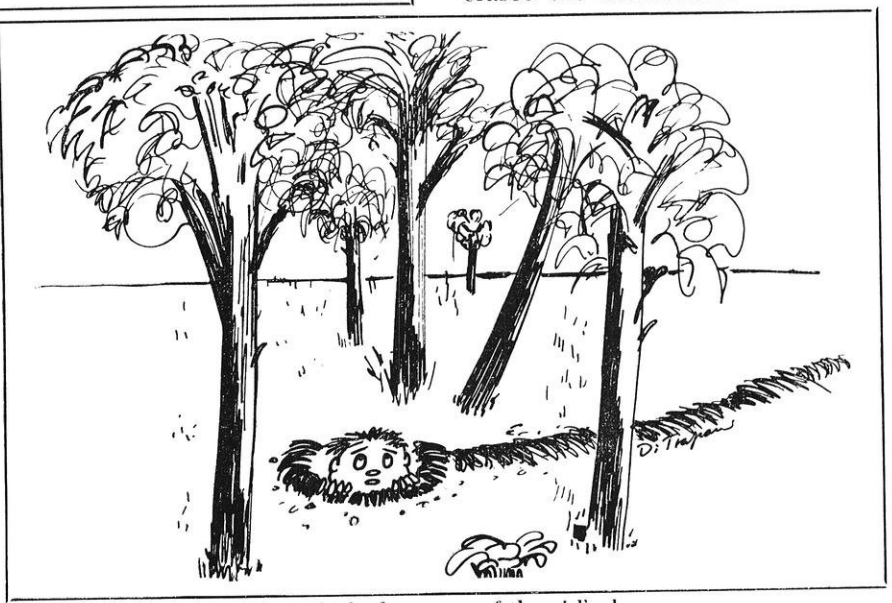
* * *

Newlywed: "I'm so glad that you like it, dear. Mother says that chicken salad and strawberry tarts are the only two things that I make correctly."

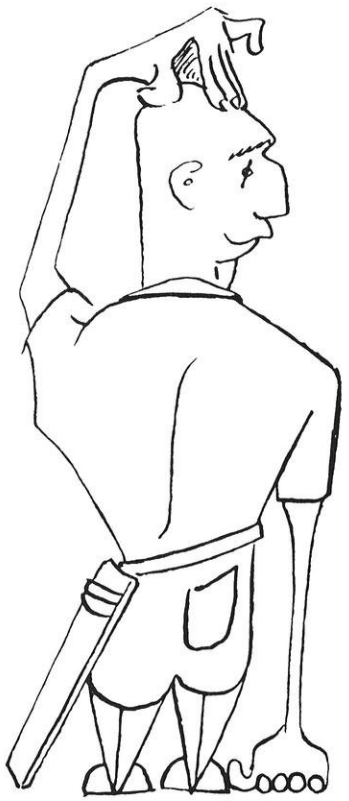
Hubby: "Which one is this, dear?"

* * *

"I will now illustrate what I have in mind," said the EE prof as he erased the blackboard.



Hey, this isn't the basement of the girl's dorm . . .



So You Think You're SMART!

by Sneedly bs'61

IT'S getting to that time of year again when Old Sneed gets mighty lonesome, Everyone is busy cramming for finals, doing long-past-due lab reports and Sneed can find no one to play golf, go sailing, and etc. He went into a well known student hangout, the Hotsy-Totsy and the place was full of slide rules and busy little men studying by the light of dim lamps. Some are reported to have been in there for days subsisting only on cigarettes and coffee. Sneed has no such difficult period because he has (as you know, if you've been reading his delightful column) all the answers.

* * *

1. Let u equal the number of articles any husband bought.
   Let v equal the number of articles his wife bought.
   Let u^2 equal the cost of the husband's articles.
   Let v^2 equal the cost of the wife's articles.
   Then: $u^2 - v^2$ equals 63
   or (u plus v) (u — v) equals 63

Now 63 can be factored as follows (63, 1); (21, 3); (9, 7)

Then solve the following sets of equations:

(1)	u + v = 63	u + v = 21	u + v = 9
	u — v = 1	u — v = 3	u — v = 7
	u = 32	u = 12	u = 8
	v = 31	v = 9	v = 1

Now, since A bought 23 more than B*, A must have bought 32, and B* bought 9.

And, since B bought 11 more than A*, B must have bought 12 and A* must have bought

Hence:	Husband	Wife	
A	32	31	C*
B	12	9	B*
C	8	1	A*

1. Hence, the answer is A → C*, B → B*, C → A*.

* * *

2. Let x = the amount of money he started with
   Then 4 [3 (2x — 30) — 54] — 72 = 48
   4 [6x — 144] = 120
   x = 29

* * *

3. Since $7^4 = 2401$, the last two digits of $(7^4)^n$ will be 01, while the preceding digit will be the last digit of the product of n by 24. Therefore the last three digits of $7^{10,000} = (7^4)^{2500}$ are 001.
Now dividing $7^{10,000} = 10^3 k + 1 = 1001 + 10^3 (k - 1)$ by 7, we have 7^{9999} 143 + 10^3 (k — 1)/7. Thus the required last digits are 143, as (k — 1)/7 is evidently an integer.

* * *

Well here are this month's problems. If you have any use for $10.00, why not get busy and try your hand at them?

1. When two numbers are multiplied together, is it possible for the first digit in the answer to fall between the first digits of the multipliers?

2. A man enters a bank and has a check cashed. The teller mistakes the figures and pays cents for dollars and dollars for cents. The man then pays a bill for $24.11 after which he finds he has twice as much money as the face of the original check. Is it possible to determine exactly the face value of the original check?

* * *

3. Find the smallest number (x) of persons a boat may carry so that (n) married couples may cross a river in such a way that no woman ever remains in the company of any man unless her husband is present. Also find the least number of passages (y) needed from one river bank to the other. Assume that the boat can be rowed by one person only.

* * *

Again, Sneedly is indebted to Litton Industries, Beverly Hills, Calif., for supplying this month's problems. If you want to win the $10.00 prize, send your solutions to:

SNEEDLY
c/o The Wisconsin Engineer
Mechanical Engineer Bldg.
Madison, Wis.

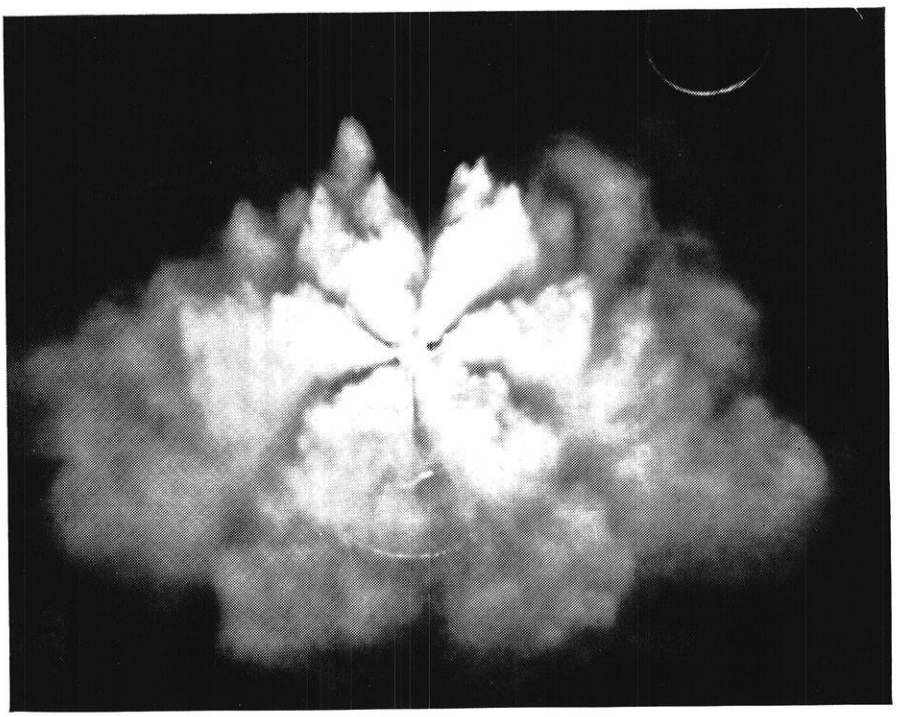
Earliest postmark breaks any tie so don't delay.

* * *

The winner of March's $10.00 prize was Don Lenschow, an EEII. Nice work, Don.

PHOTOGRAPHY AT WORK
No. 33 in a Kodak Series

The Army's first operational rotor-tip propelled jet helicopter—built by Hiller.



The camera has caught the fuel spray pattern within the rear end of the ram-jet engine even though passing by at about 450 miles per hour.

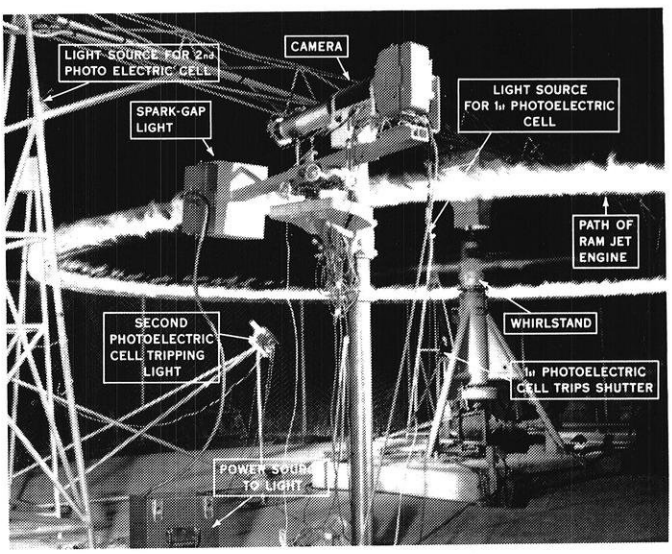
Project: Inspect rotor tip jets for a whirlybird

Hiller Helicopters wanted facts on the fuel spray pattern of a ram-jet engine whirling at speeds up to 700 feet per second. Photography got the job.

WHEN HILLER HELICOPTERS of Palo Alto, Cal.—a pioneer in vertical take-off aircraft—developed a rotor-tip ram-jet engine, they knew the fuel spray would be subject to high air velocity and centrifugal force up to 1200 G's. Would the fuel spray be deflected outward and cause the jet to lose thrust? They wanted to know. So they set up the camera with its fast eye to catch what otherwise couldn't be seen. And they learned the right angle of air intake and nozzle to obtain the greatest power.

Using photography in research is an old story with Hiller—just as familiar as using it for improving public relations. It's an example of the way photography plays many important roles in modern-day industry.

In whatever work you do you will find that photography will play a part in improving products, aiding quality control and increasing sales.



This is all the human eye could have seen of the whirling ram-jet engine as camera takes its picture.

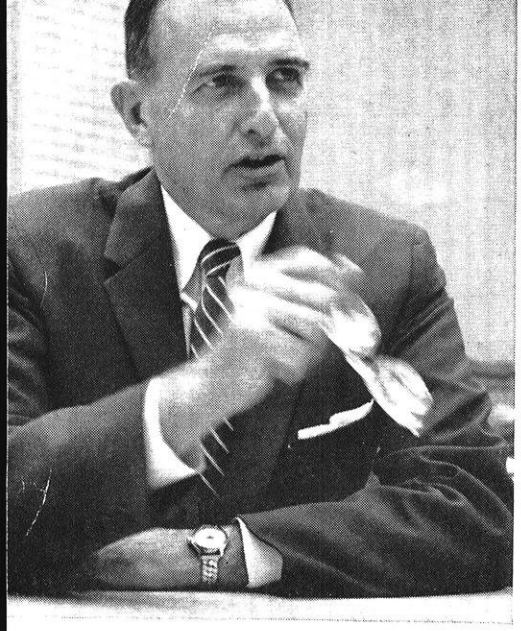
CAREERS WITH KODAK

With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design and production.

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Kodak
TRADE MARK

EASTMAN KODAK COMPANY, Rochester 4, N. Y.



One of a series*

Interview with General Electric's W. Scott Hill Manager—Engineering Recruiting

Qualities I Look For When Recruiting Engineers

Q. Mr. Hill, what can I do to get the most out of my job interviews?

A. You know, we have the same question. I would recommend that you have some information on what the company does and why you believe you have a contribution to make. Looking over company information in your placement office is helpful. Have in mind some of the things you would like to ask and try to anticipate questions that may refer to your specific interests.

Q. What information do you try to get during your interviews?

A. This is where we must fill in between the lines of the personnel forms. I try to find out why particular study programs have been followed, in order to learn basic motivations. I also try to find particular abilities in fields of science, or mathematics, or alternatively in the more practical courses, since these might not be apparent from personnel records. Throughout the interview we try to judge clarity of thinking since this also gives us some indication of ability and ultimate progress. One good way to judge a person, I find, is to ask myself: Would he be easy to work with and would I like to have him as my close associate?

Q. What part do first impressions play in your evaluation of people?

A. I think we all form a first impression when we meet anyone. Therefore, if a generally neat appearance is presented, I think it helps. It would indicate that you considered this important to yourself and had some pride in the way the interviewer might size you up.

Q. With only academic training as a background, how long will it be before I'll be handling responsible work?

A. Not long at all. If a man joins a training program, or is placed directly on an operating job, he gets assignments which let him work up to more responsible jobs. We are hiring people with definite consideration for their potential in either technical work or the management field, but their initial jobs will be important and responsible.

Q. How will the fact that I've had to work hard in my engineering studies, with no time for a lot of outside activities, affect my employment possibilities?

A. You're concerned, I'd guess, with all the talk of the quest for "well-rounded men." We do look for this characteristic, but being president of the student council isn't the only indication of this trait. Through talking with your professors, for example, we can determine who takes the active role in group projects and gets along well with other students in the class. This can be equally important in our judgment.

Q. How important are high scholastic grades in your decision to hire a man?

A. At G.E. we must have men who are technically competent. Your grades give us a pretty good indication of this and are also a measure of the way you have applied yourself. When we find someone whose grades are lower than might be expected from his other characteristics, we look into it to find out if there are circumstances which may have contributed.

Q. What consideration do you give work experience gained prior to graduation?

A. Often a man with summer work experience in his chosen academic field has a much better idea of what he wants to do. This helps us decide where he would be most likely to succeed or where he should start his career. Many students have had to work hard during college or summers, to support themselves. These men obviously have a motivating desire to become engineers that we find highly desirable.

Q. Do you feel that a man must know exactly what he wants to do when he is being interviewed?

A. No, I don't. It is helpful if he has thought enough about his interests to be able to discuss some general directions he is considering. For example, he might know whether he wants product engineering work, or the marketing of technical products, or the engineering associated with manufacturing. On G-E training programs, rotating assignments are designed to help men find out more about their true interests before they make their final choice.

Q. How do military commitments affect your recruiting?

A. Many young men today have military commitments when they graduate. We feel it is to their advantage and ours to accept employment after graduation and then fulfill their obligations. *We have a limited number of copies of a Department of Defense booklet describing, in detail, the many ways in which the latter can be done. Just write to Engineering Personnel, Bldg. 36, 5th Floor, General Electric Company, Schenectady 5, N. Y.* 959-8

*LOOK FOR other interviews discussing: • Advancement in Large Companies • Salary • Personal Development.

GENERAL ELECTRIC