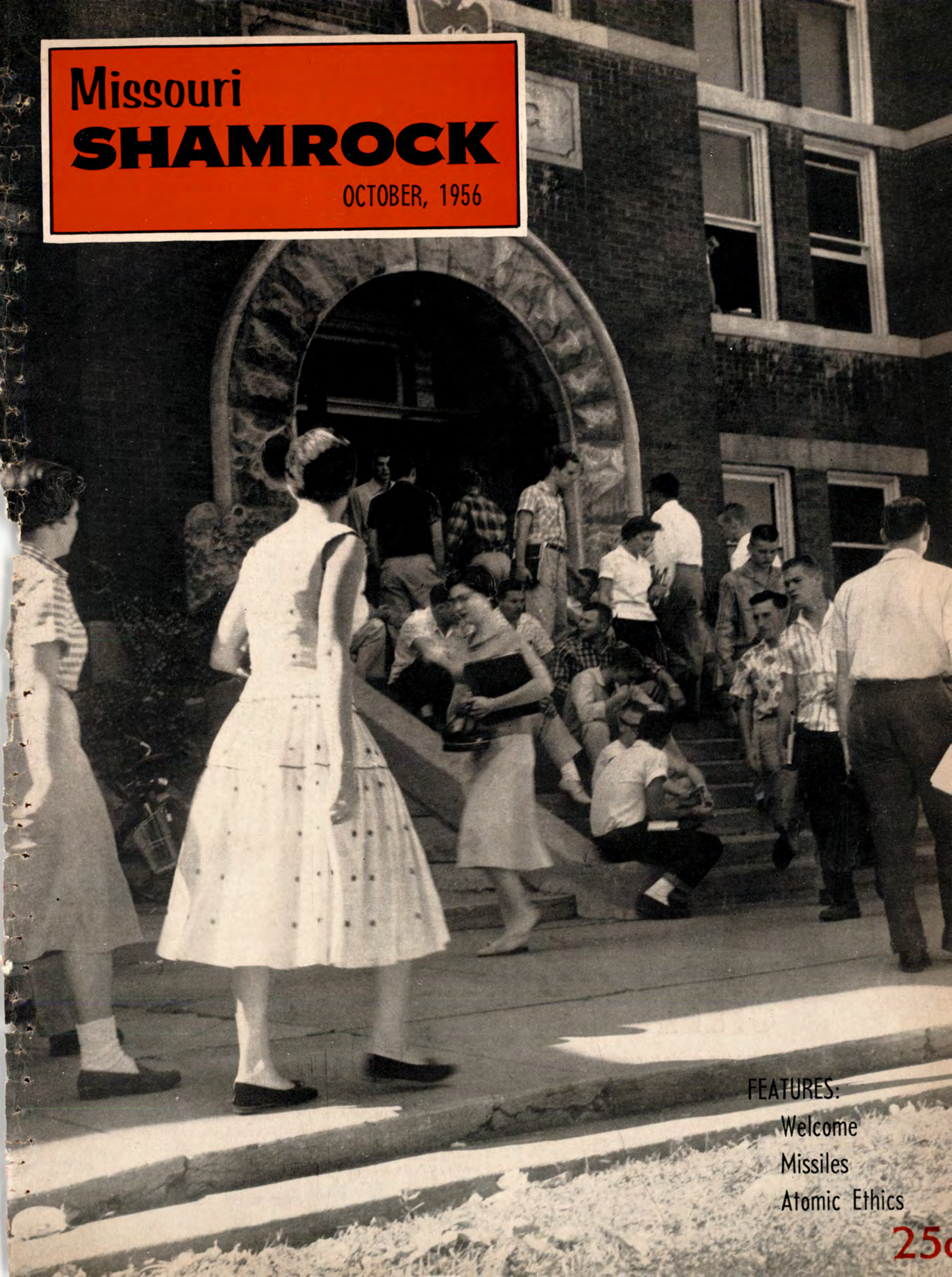
Missouri SHAMROCK

OCTOBER, 1956



FEATURES:

Welcome

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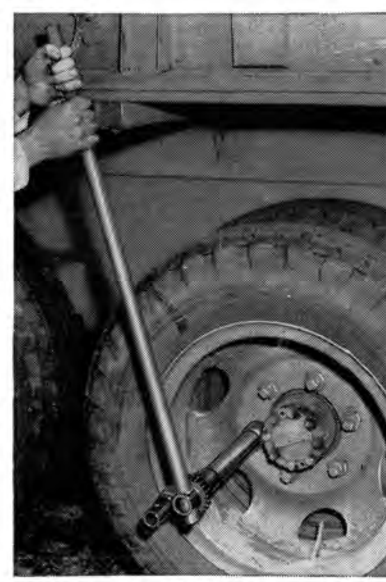

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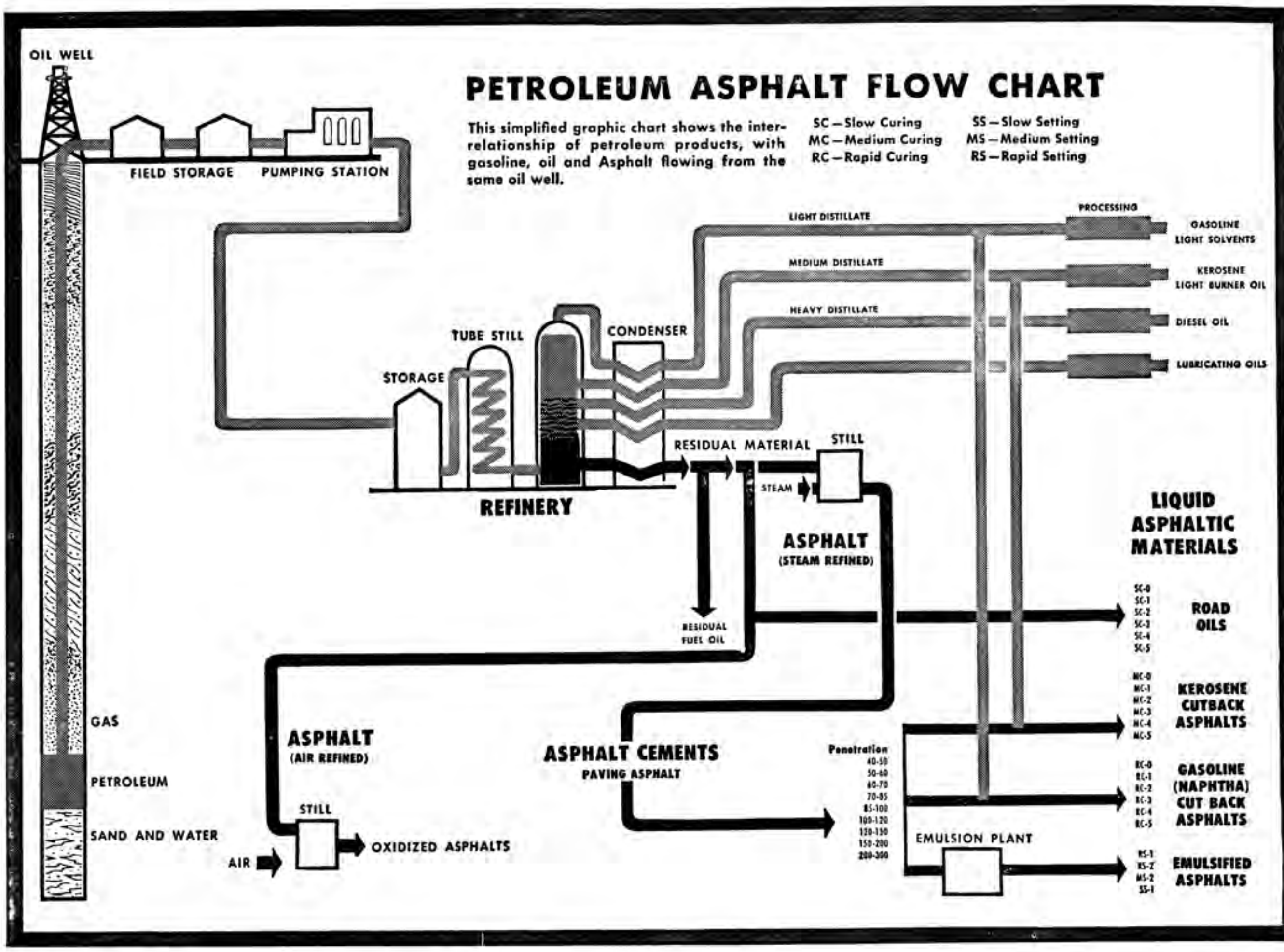

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Asphalt is a natural constituent of most crude petroleums. From them, it is separated by various distillation processes that also yield gasoline, lubricating oil and other refinery products. ***Asphalt is a petroleum product and is not to be confused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

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

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

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ON THE COVER:

Back to the hallowed halls—some old faces, some new but always the books. Photo—Jerry Herdan

MISSOURI SHAMROCK

VOL. XXIII OCTOBER, 1956 No. 1

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DEPARTMENTS:

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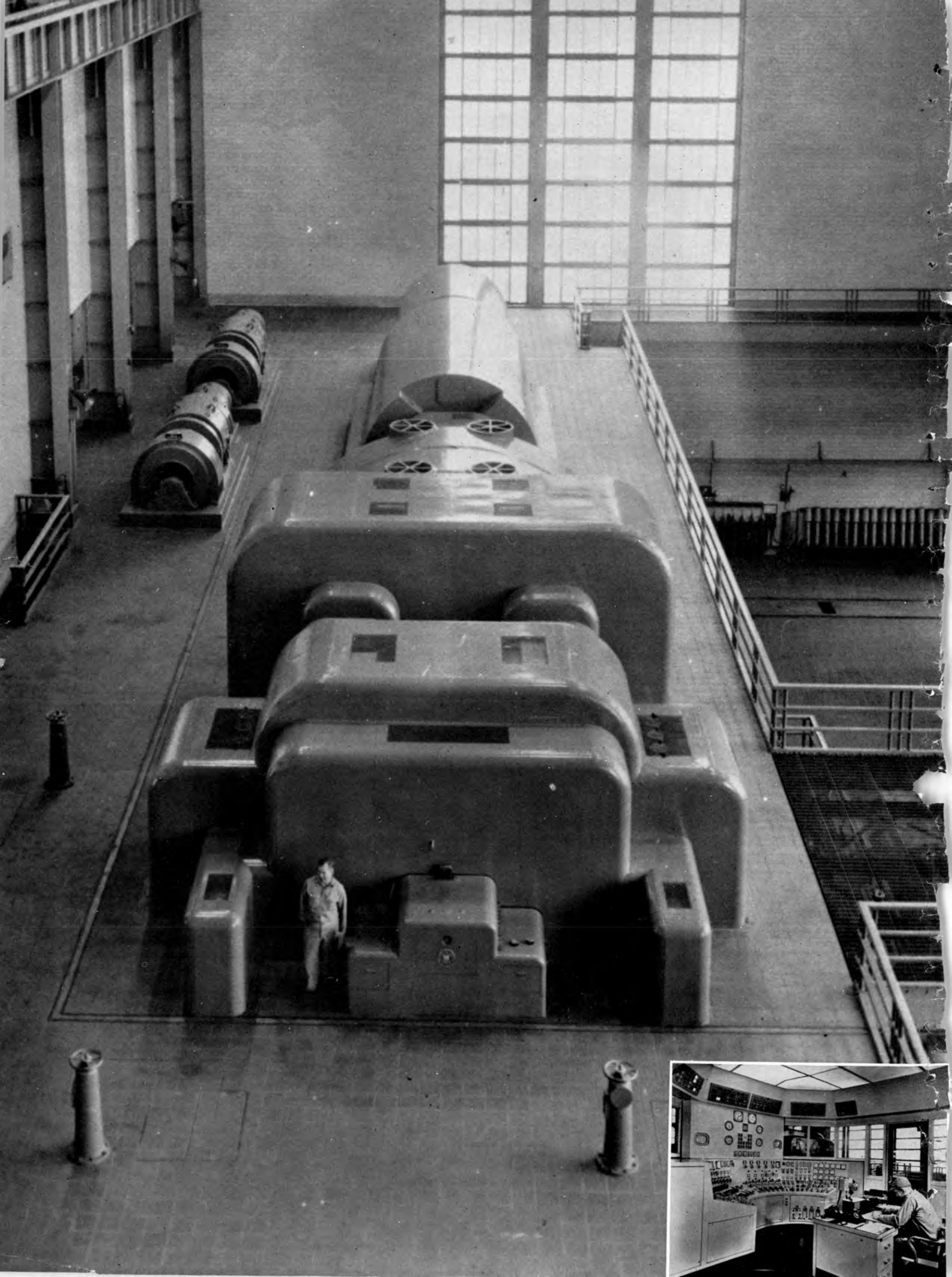


Editorial

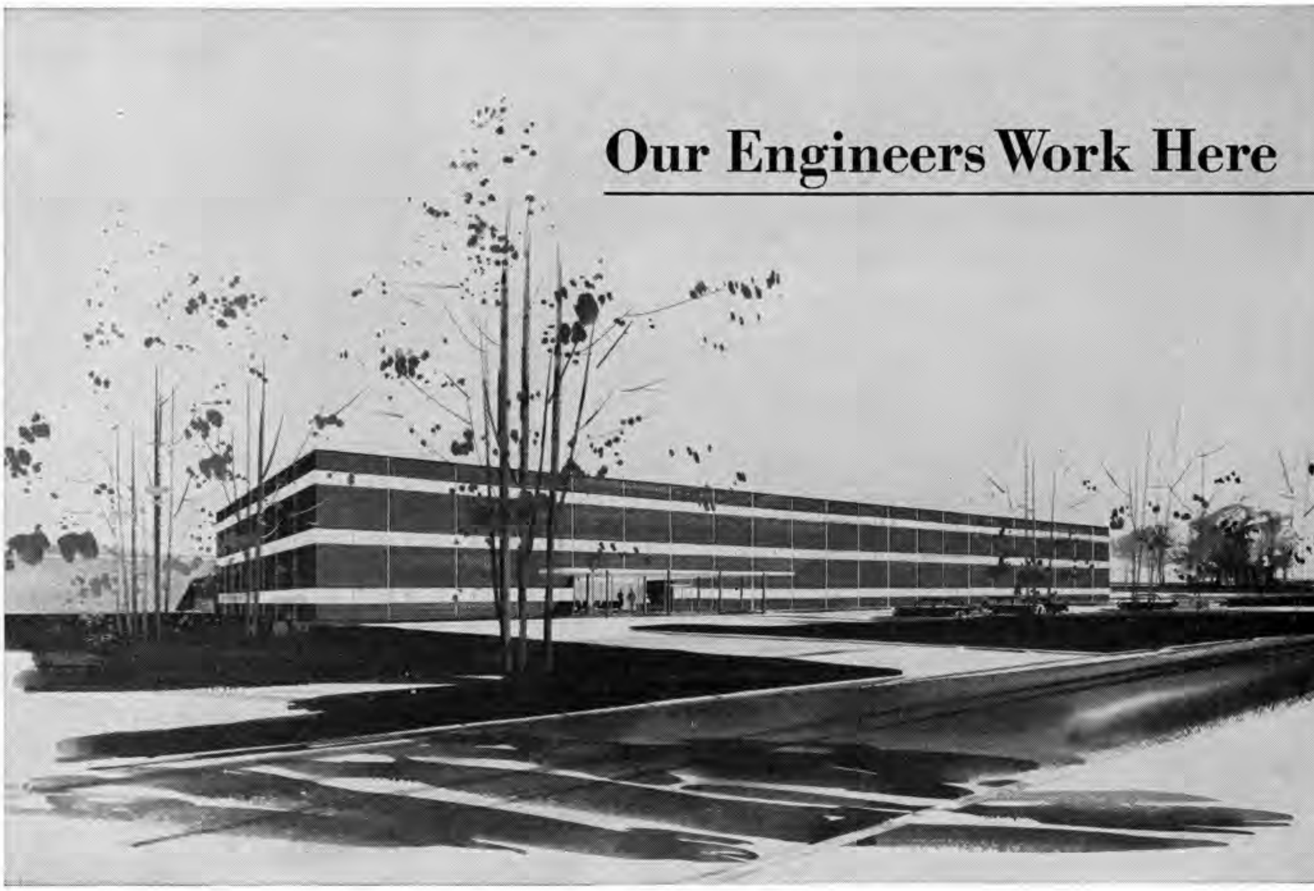
To provide its students with the highest level of scientific and technical education is the duty of the engineering college. For upon graduation they will be expected to cope with problems of size and complexity not to be found in the textbook. However, more than technical excellence is necessary in the make-up of a well-rounded engineer. An elusive quality which might best be described as pride in his profession is quite essential.

Much of this ever important characteristic must be developed during the four or five years spent in formal education. This pride is not something to be learned from a book or demonstrated in the laboratory nor is it fostered by being continually buried under a pile of work and not having time for extra-curricular activities. Rather from the encouragement, enthusiasm, and attitude of his instructors the engineer-to-be must see that he is preparing for a profession which holds the key to the material progress of civilization—indeed something of which he can be proud to be a part.

If the engineer would rather be an engineer than anything else, then he is proud of his profession. This pride will be carried forth into his personal life as a member of society as well as into his daily work. The engineer, increasingly more influential in our modern world, must not be merely a designer of machines and builder of bridges, but a leader who will guide and direct man along the path of progress.

M.L.C.

FRONTISPIECE: this 200,000-kw turbine-generator unit was recently put into service by the Public Service Electric and Gas Company in their Burlington, N. J. station. The turbine is a tandem-compound, triple-exhaust, 3600-rpm machine. One of the highest temperature machines in service today, inlet steam temperature is 1100 degrees F, reheat temperature 1050 degrees F. The generator is hydrogen-cooled, with the rotor inner-cooled by hydrogen flowing through hollow field conductors. From the curved console the operator has complete control of the boiler, turbine-generator unit, and other auxiliary machinery.



THIS is the new Administration Building which is the focal point of the Allison engineering Research and Development Center in Indianapolis.

The Allison expansion and development program in engineering represents an expenditure of $75 million and includes the newest and finest facilities for the development of new, high performance turbo-prop and turbo-jet engines.

Our engineers are working with the best "tools" available. For instance, the fuels system laboratory, which is just one part of the overall expansion and building program, represents the scope of the center. The amount of fuel that must be supplied to jet engines can be compared to the amount of water flowing through a regulation size fire hose, and at the rate the average fire hose puts out water to extinguish a fire. Should all test cells in the Allison Laboratory be operating at the same time, they would be pumping fuel at a rate that would empty 45 railroad tank cars per hour.

Other facilities include chambers, cells, equipment and devices for testing engines at higher altitudes and faster speeds. And, newest research and development facilities for testing components—such as compressors, turbines and combustors—will make the Allison Research and Development Center one of the most complete in the world.

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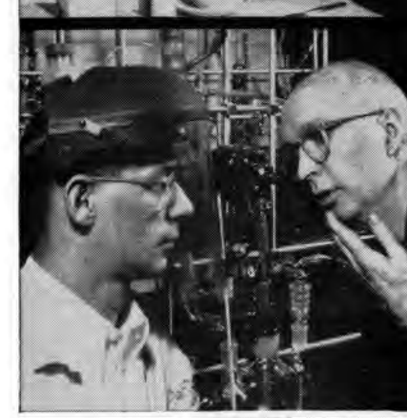

YOUR FUTURE–
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If yours is the inquiring mind . . . the mind that never rests until it has an answer to every "why" . . . then perhaps research is your future.

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

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

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

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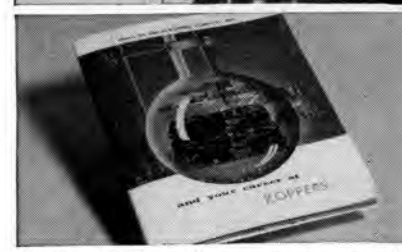

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WELCOME

From Your Engine Club President

EDITOR'S NOTE — Jim Buell is a Senior in Electrical Engineering. He is a member of Eta Kappa Nu, Pi Mu Epsilon, AIEE-IRE, Mystical Seven, Omicron Delta Kappa and the Engineers Club. He is 20 years old and comes from Lee's Summit, Missouri.

JIM BUELL

Welcome to the University of Missouri, College of Engineering. I think you have made two wise choices. First, in choosing engineering as a profession, and second, in picking this school as the place to get your education. We have here a school which offers a curriculum that would be hard to beat, no matter where you go. Missouri graduates are respected throughout the country, and you will find a great many of them holding top positions in industry.

One thing you should remember! Not all your education is coming from textbooks. An engineer must know more than just what is in the book. You will be expected not only to get along well with other people, but to be a leader as well. One big criticism of engineering colleges today is that they do not do enough to develop personalities and leadership traits. This is where the Engineers' Club can help you!

First of all, what is the Engineers' Club? It is an organization of engineering students here on campus formed "for the purpose of fostering a professional spirit and promoting the interests and activities of the members of the student body of the College of Engineering and its constituent organizations".

Through the Engineers' Club, and by participating in its many activities, you will have a chance to meet and work with fellows from all the engineering departments, many of whom you might not meet otherwise. You will have an opportunity to participate in St. Pat's Week, a tradition which originated on this campus over fifty years ago, and has since spread to engineering colleges throughout the country. All the planning and preparations for this occasion are handled by members of the Engine Club. Freshmen as well as upperclassmen help make this one of the most successful student events on campus.

This organization also sponsors dances, parties, movies, and gives you a chance to hear many excellent speakers from industry. It offers you this magazine, the SHAMROCK, which is one of the finest

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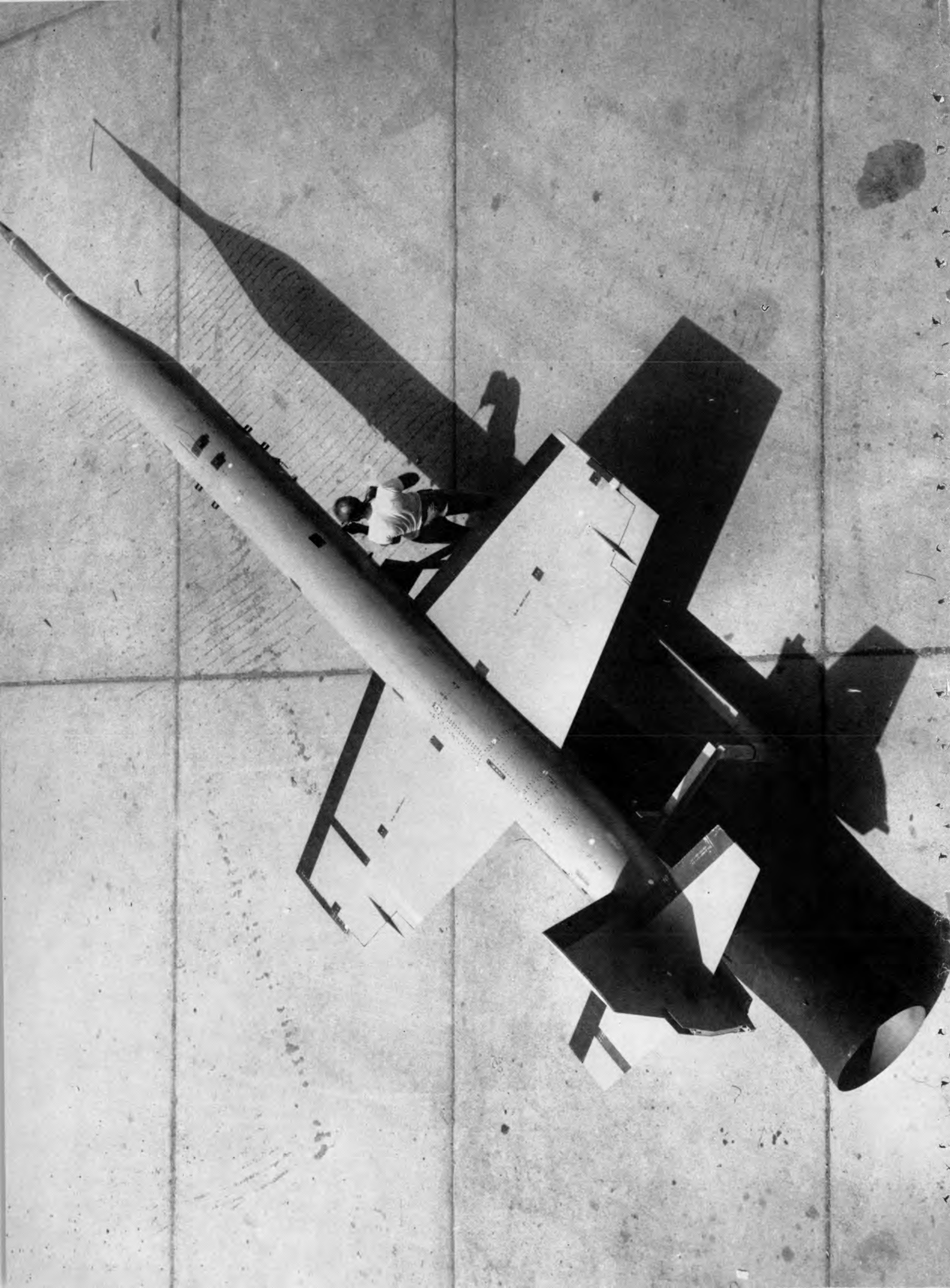

MISSILES- -

Research and Development

M. L. CRENSHAW

A new hypersonic missile with which Lockheed scientists are probing critical problems of the Air Force's intercontinental ballistic missile (ICBM) program, has been disclosed by Brig. Gen. D. R. Ostrander.

The new Lockheed vehicle, whose very designation is still classified, was revealed in a speech before the Air Force Association in convention in New Orleans by General Ostrander, assistant for guided missiles, Headquarters Air Research and Development Command. The USAF described it as a "key link" in the nation's vital ballistic missile program which includes the intercontinental vehicles Atlas and Titan and the intermediate range missile, Thor.

The Lockheed missile, rocket powered for hypersonic speeds and altitudes of undisclosed height, spearheads research into the critical problems of bringing the intercontinental ballistic missile back into the earth's atmosphere from outer space.

The missile is a product of Lockheed's Missile System division and the USAF Western Development Division (ARDC), which has direct responsibility over all ballistic missile development for the Air Force. Lockheed, in the missile field for the past ten years, is a prime contractor in the program which encompasses the efforts of a score of aircraft and scientific companies.

Supersonic Lockheed vehicle—designated the X-7 is used in development of powerful new engines for USAF ramjet missiles. Designed and built by Lockheed's Missile Systems division, it was revealed after several years' secrecy that the X-7 flashes through the stratosphere under ramjet power at speeds well beyond the velocity of sound. The needle-nosed X-7, launched from a B-29, is parachute recovered to be flown again, representing an important saving in test program costs.

"Results of our work on this project should provide long-sought solutions, heretofore unobtainable, to many mysteries surrounding outer space flight," said Hall L. Hibbard, the Lockheed division's general manager, commenting in Los Angeles on General Ostrander's announcement.

The test missile hurtles out through the earth's atmosphere at speeds far in excess of the velocity of sound. Within seconds after it is fired, the missile blasts through the sonic barrier and pierces the ionosphere — a layer of very thin air starting some 50 miles above the earth and extending to about 250 miles. Lockheed's missile scientists designed the vehicle to plunge at tremendous speeds from the ionosphere into the earth's heavy blanket of air.

Although the results of the project cannot be disclosed, it was revealed that the missile division's scientists and engineers are investigating atmospheric heating effects, suitability of various metals, and other important factors contributing to the design of missile nose shapes. Lockheed's missile division has been working on the project at its present plant in Van Nuys, Calif. Launchings of the Lockheed missile are done at Patrick Air Force base in Florida, the Air Force's long-range missile firing area.

A supersonic Lockheed test vehicle, which has played a major role in the development of powerful new engines for Air Research and Development Command ramjet missiles, was also disclosed. It is the X-7, designed and built by Lockheed's Missile Systems division.

Details of the needle-nosed vehicle were revealed by Brig. Gen. Marvin C. Demler, deputy commander for research and development of the Air Force's Air Research and Development Command.

Although exact performance is classified, it was revealed after several years of secrecy that the X-7 flashes through the stratosphere in level flight at speeds well beyond the velocity of sound.

"In our ramjet development program," General Demler said, "We have used the X-7 as a high speed test bed to get test and design information in actual flight. Through this research and testing program, we are developing successful ramjets for operational use.

"Also," Demler added, "this supersonic vehicle has served as a test bed for the development of other important missile components."

According to Lockheed's missile scientists, the X-7, while not the first to use ramjet engines, is making important contributions to the development of the ramjet principle as a dependable new source of missile power.

Ramjets, considered the ultimate in ducted-jet engines for guided missiles, are comparatively simple devices that give tremendous power at high speeds. Unlike conventional jet engines, the "flying stovepipes" have no compressors or other moving parts and depend upon their own high speed to compress their air intake. Generally speaking, the faster they go the better they operate — without the limiting factors, such as compressor speeds and heat, that limit conventional jets.

Much of the electronic gear car-

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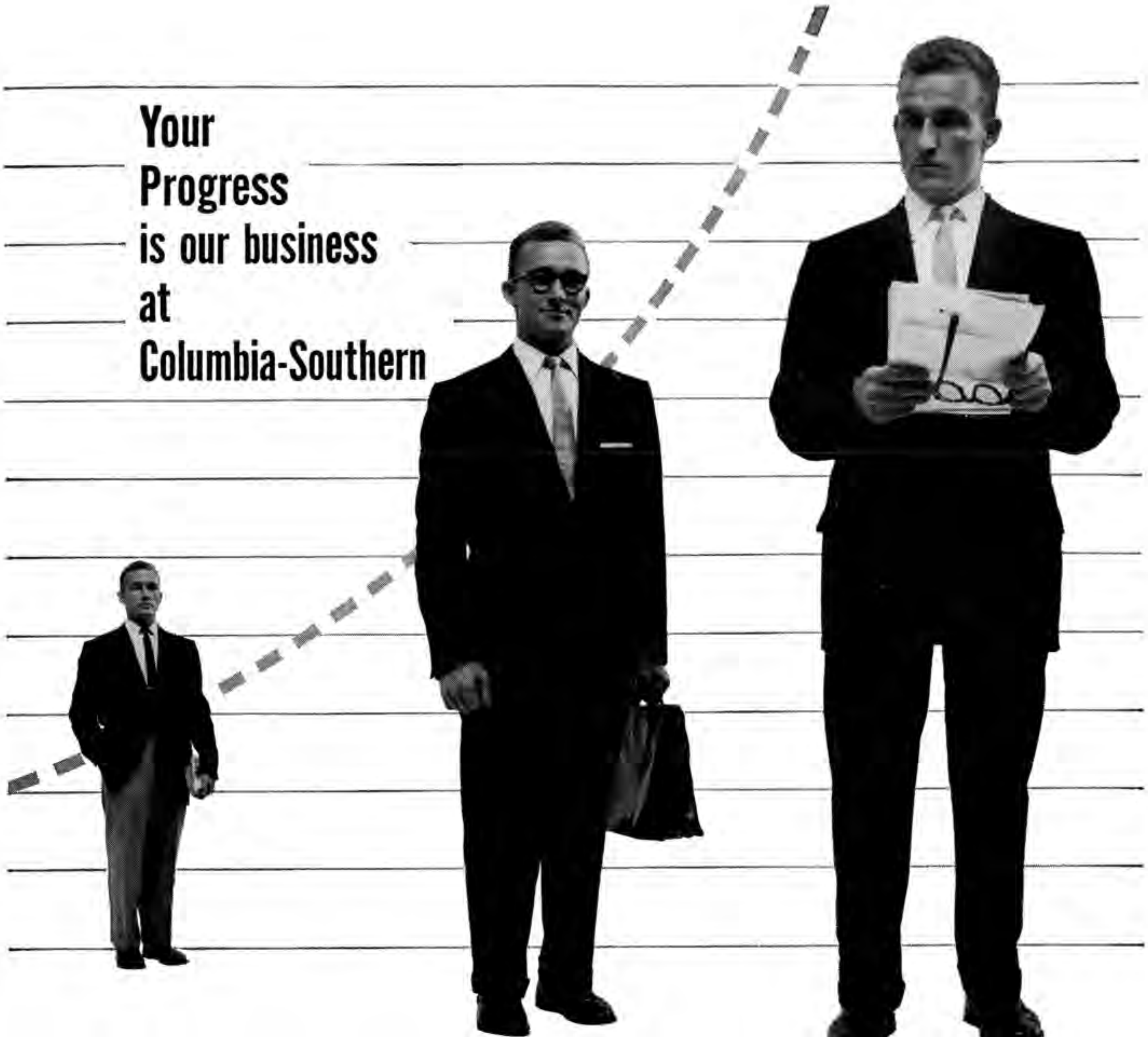

Naturally, the reason for hiring any man at Columbia-Southern is that we believe he is qualified to fill one of the initial assignments available.

But what we want most are men for whom the first job is merely a starting point. We expect Columbia-Southern to keep up its impressive growth record and we want men who can not only grow with the company, but who can help make that growth possible.

Ultimate advancement at Columbia-Southern does not depend on any particular type of specialized training. Because the company's operations are centered chiefly around chemical production and research, more chemists and chemical engineers seek employment than people with other kinds of training, and more are hired for initial assignments. But numerous other abilities in a wide variety of fields are needed—and in consideration for advancement, the important thing is not what kind of degree a man has but how much responsibility he can handle.

It is not unusual for a college man to be uncertain as to just what type of work he will find most interesting. That's why our new employees are given "on the job" training. It affords new employees the opportunity to perform various assignments so that the employee, as well as the company, will discover the job in which he will be happiest and for which he is best suited.

Columbia-Southern offers qualified graduates a liberal starting salary. More important, each employee's progress is reviewed periodically to insure that salary level keeps pace with demonstrated professional growth and responsibilities.

Columbia-Southern has a need for promising young graduates *now*. If you would like more information, write today to Personnel Manager at our Pittsburgh address or any of the plants.

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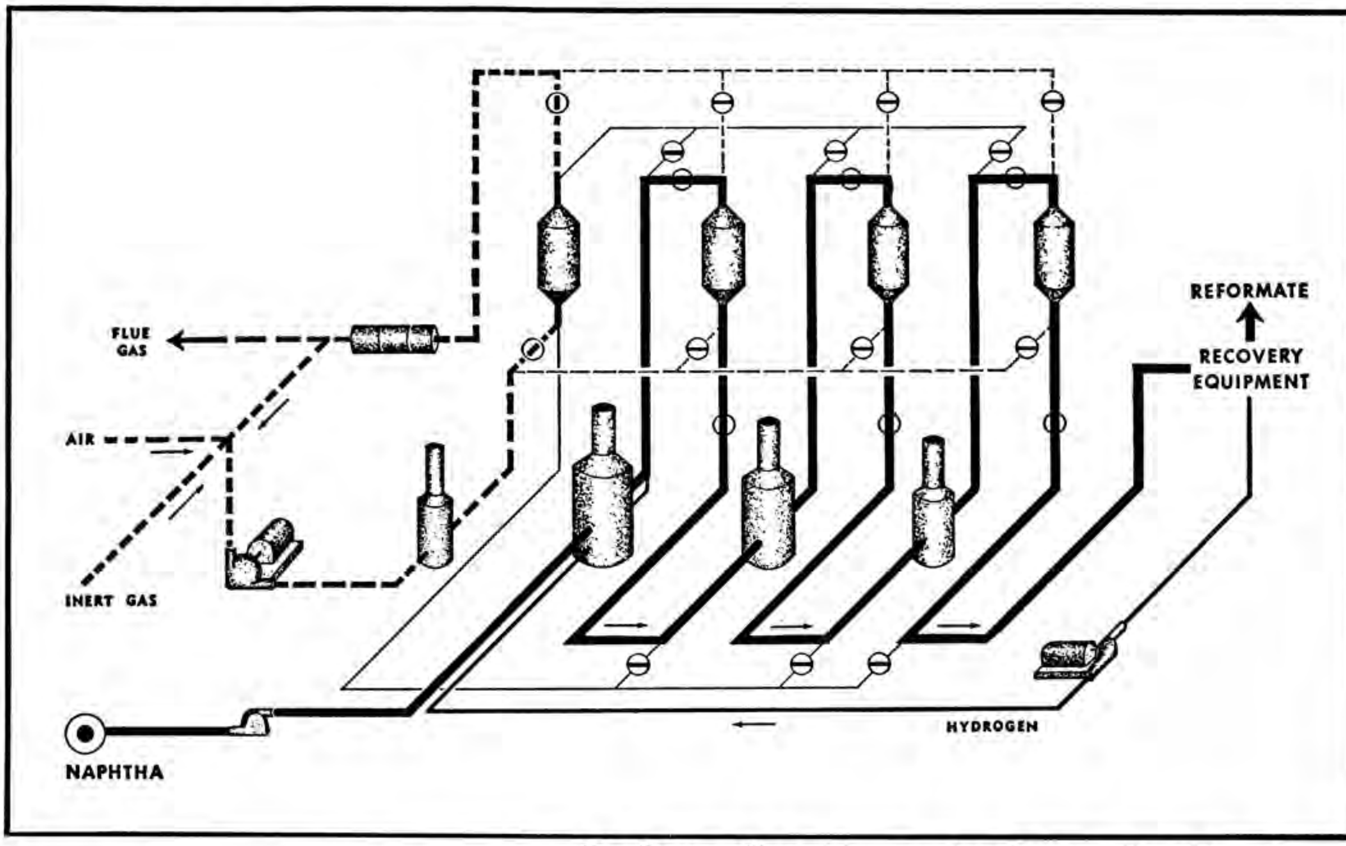

The diagram, with a minimum number of reactors, illustrates cyclic regeneration. Piping arrangement permits the swing reactor to substitute for any other reactor in the system. High activity of catalyst is maintained —without interrupting production—in the ULTRAFORMING process.

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

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

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

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

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

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

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

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

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

ATOMIC ETHICS

CHARLENE KORANDO, Ch.E. '58

Editor's Note:—

This article is the first of a series on atomic energy and its utilization for the betterment of mankind. This introduction traces international policies which have guided the release and use of knowledge.

ATOMIC ENERGY

The atom bombs dropped on Hiroshima and Nagasaki have come to symbolize the unlimited power man has acquired. Will he use this tremendous power to blot out the civilization he has slowly and painfully developed, or will he use the atom to raise this civilization to undreamed of heights and to end the threat of war?

You ask, and rightly so, how the atom can be used to end the threat of global destruction when all attempts to establish a system of international control of the atomic bomb have failed dismally.

Let us go back and briefly trace the policy of the United States on the control and use of atomic power, and the efforts made to safeguard the world against the danger of sudden obliteration.

Even before the first atomic bomb had been made and exploded, the scientists realized that a world war waged with uranium-235 or other fissionable material could be suicidal. On the basis of information supplied by these scientists, Secretary of War Henry L. Stimson in 1945 appointed an Interim Committee to study this problem. The findings of the committee convinced Mr. Stimson that international control of atomic energy was essential.

The report of the Interim Committee was followed on August 6, 1945, by the first public statement of the atomic bomb. President Truman made it clear that the United States would keep the secret of the atom until methods of protecting us and the rest of the world could be initiated. He also emphasized the direction of atomic energy "toward peaceful and humanitarian ends." Out of discussions with Britain and Canada, associates in this discovery, came the Truman-Attlee-King declaration of November 15, 1945.

In addition to endorsing President Truman's plan, the declaration further proposed that a United Nations commission study the problem and devise ways of safeguarding the world against the hazards of surprise attacks.

UNITED NATIONS ATOMIC ENERGY COMMISSION

The Truman-Attlee-King declaration was accepted by the U. S. S. R. at the December, 1945, Moscow conference of the Big Three foreign ministers and the United Nations Atomic Energy Commission was established on January 25, 1946. Since only general principles had been discussed heretofore, some mechanism had to be devised for applying them. The findings of two special groups were incorporated into the "Acheson-Lilienthal Report," and were submitted on March 28, 1946," as a foundation on which to build."

The report accepted the principles of inspection and of outlawry of the atomic bomb as a military weapon. It was suggested that these principles be supplemented by the international ownership and management of fissionable material from the mine to the factory, power plant and laboratory by an Atomic Development Authority under the United Nations. While the Authority was to carry on atomic research of military importance, the peaceful development of atomic energy was to proceed under licenses which it would grant.

But how could the world make peaceful use of atomic energy when the United States alone knew how to exploit atomic energy? The Acheson-Lilienthal report provided for the release of information in stages. It stated that if the plan failed or the international situation collapsed the United States would still be safer than any other nation because of its monopoly of unrevealed knowledge.

Out of the Acheson-Lilienthal report came the proposals that Bernard M. Baruch presented to the United Nations Atomic Energy Commission on June 14, 1946. He broadened the recommendations of the report by a threat of "condign punishment" for evasion of international control. The Baruch proposals would have done away with the veto power that any one of the five could exercise in an hour of atomic peril.

The Baruch proposals were accepted in principle by all the members of the United Nations Atomic Energy Commission except the Soviet Union and Poland. The failure of three successive efforts to reconcile the opposing views of the Soviet Union and the Western world made it manifest from the first that the Soviet Union had no intention of yielding one jot of its sovereignty to any international authority.

On June 19, 1946 the Soviet Union came forth with its first set of proposals framed to preserve its sovereignty. The proposals insisted that the United States must agree to stop the production of atomic weapons and destroy what atomic weapons it had before international control was to be exercised. Mr. Baruch's proposed abridgement of the veto power of the Security Council was rejected. Thus a permanent member who had violated the international regulations could veto any measure taken to punish him.

Since it was obvious that the

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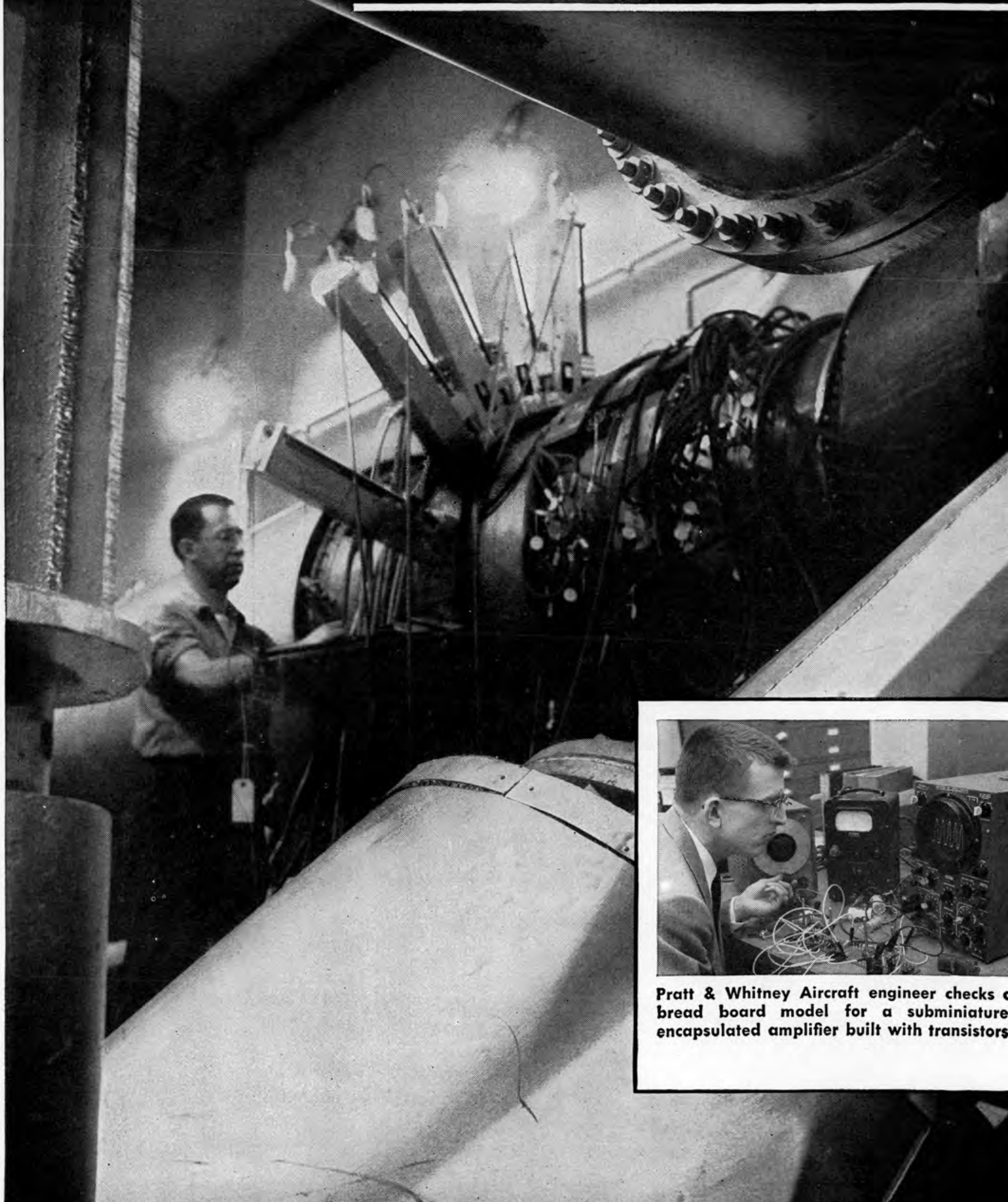
WHAT'S DOING at Pratt & Whitney Aircraft . . .



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

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

. . . in the field of INSTRUMENTATION

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

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

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

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

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

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

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

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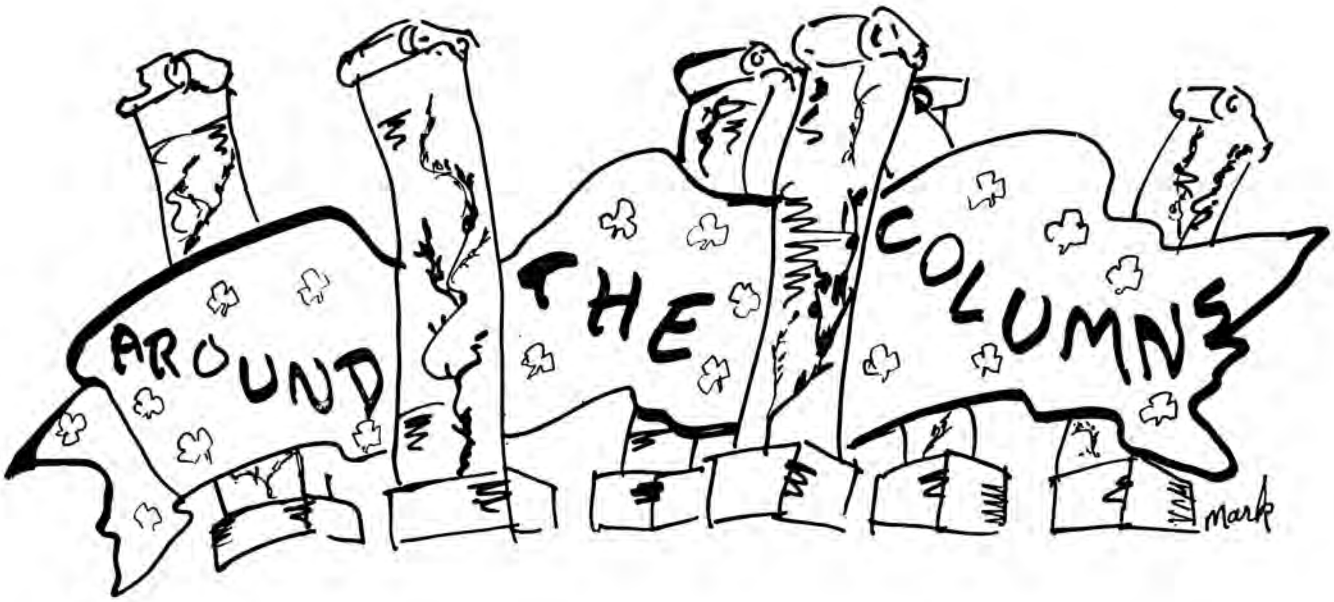

JOE WOLF, M.E. '58

Time marches on, and here we are again, around the columns, watching all the girls go by, and getting into the swing of a new college year. With the fervor of enrolling in school, buying supplies, finding classes, switching sections, et cetera, et cetera, et cetera, all over, committees are being organized, plans are being formed, and the scheduling and programming of that all important first meeting of each society and organization in Engine School are being made. Be sure and find out the time and place of that first meeting of the organization you are already in or are interested in joining. (The dates, places, and times will be posted on bulletin boards.) By joining early and taking part in the engineering activities regularly, we can make this year another prosperous and successful year.

On October 22, an engineering conference of college presidents will be held at the University of Missouri. Each of the twenty-four or more institutions engaged in engineering and pre-engineering education, including several junior colleges, is being asked by President Ellis to send one or more officials to the conference. The conference will be held from 10 a.m. to 4 p.m. in the Memorial Student Union.

The prime objective of this conference will be to study the number of engineering students in the colleges of the state.

"The national and state need for more engineers," President Ellis said, "makes it highly desirable that students in colleges other than engineering colleges be given every opportunity to select engineering as a field of specialization."

In addition to seeking ways to increase engineering enrollment, the conference will consider means of coordinating more effectively pre-engineering programs of study in non-engineering colleges with the programs of regular engineering colleges.

A third objective of the conference will be a wider use of the combination program of three-year liberal arts and two-year professional engineering. Also to be considered are one-year and two-year pre-engineering courses in junior and senior colleges.

"Better coordination of work among the various colleges of the state," according to President Ellis, "will in itself increase our resources for training engineers and it will offer opportunities to students in general curricula to elect engineering, even though they have not begun their education in an engineering college.

"The demand for engineering training on the part of students and on the part of industry already is overtaxing the facilities of the engineering schools, and it is essential that pre-engineering courses be available in non-engineering colleges and that such courses dovetail properly into the students' programs when they transfer to regular colleges of engineering."

The conference will be opened by President Ellis with a discussion of the general problem and the needs it creates. Dean Miles Blim of Junior College, Kansas City, Mo., will speak on the pre-engineering curriculum in the junior college. President J. W. Jones of Northwest Missouri State College, Maryville,

(*Continued on page* 44)


UNITED STATES

CAREER OPPORTUNITIES WITH *HERCULES*

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

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

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

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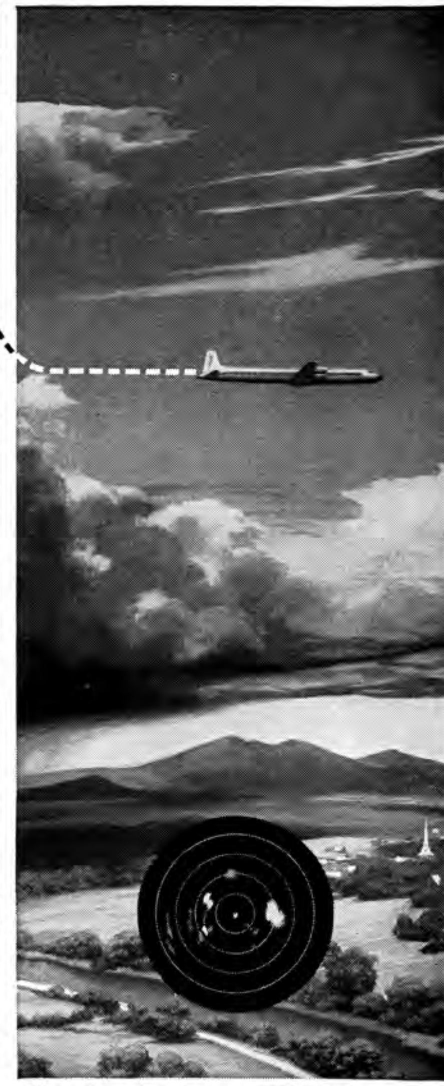
SYNTHETIC RESINS, CELLULOSE PRODUCTS, CHEMICAL COTTON, TERPENE CHEMICALS, ROSIN AND ROSIN DERIVATIVES, CHLORINATED PRODUCTS, OXYCHEMICALS, INDUSTRIAL EXPLOSIVES, AND OTHER CHEMICAL MATERIALS

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

GR56-1

RCA Weather Radar screen shows approach of storm.

Screen guides pilot around turbulent area.



All's well as plane leaves storm behind.

How RCA Weather Radar adds comfort and speed to your flight

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

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

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

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

WHERE TO, MR. ENGINEER?

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

RADIO CORPORATION OF AMERICA

ELECTRONICS FOR LIVING

ATOMIC ETHICS

(*Continued from page* 23)

deadlock between the Soviet Union and the Western world would never end, the United States decided from the outset to safeguard the monopoly of knowledge and skill it had acquired.

While it was recognized that the sudden release of atomic energy could do immense good for mankind, military thinking dominated the minds of the legislators who framed the Atomic Energy Act of 1946. The government was given despotic control of all fissionable material. It was made the only purchaser of that material. It fixed the price and controlled research in atomic physics. It suppressed applications for patents that disclosed methods for the more effective extraction of fissionable material from ores and for the better exploitation of atomic energy of possible military importance. Contracts were made by the commission with universities, industrial firms and institutions to carry out research for the government. Radioisotopes were widely distributed by the Atomic Energy Commission at cost and less than cost to scientists who were engaged in medical, biological and agricultural research, and the results of the research thus conducted were freely published for the benefit of the world. All in compliance with the provisions of the act.

There can be no doubt that immense progress was made under this system. But there is also no doubt that it gave little opportunity for the private industrial development of atomic power. Although the commission had built experimental reactors which might be used for research and the development of power, advance in the large-scale industrial uses of atomic energy was slow. In fact, the United States lagged behind Britain.

The announcement of President Truman on September 23, 1949 that the Soviet Union had exploded an atomic bomb changed the whole situation. With the collapse of our monopoly of knowledge came the determination to pursue a more active policy in fostering the peacetime uses of atomic energy. To give private enterprise the rights and privileges it had long demanded it was necessary to liberalize the Atomic Energy Act of 1946. This was done in 1954.

In addition the Atomic Energy Act of 1954 had to be amended to satisfy opposition to the Dixon-Yates contract. This contract which would have left in the hands of a group of southern utilities the production and distribution of additional electric power sidetracked the Tennessee Valley Authority which had been supplying power in that area. Thus the liberalization originally contemplated was lost.

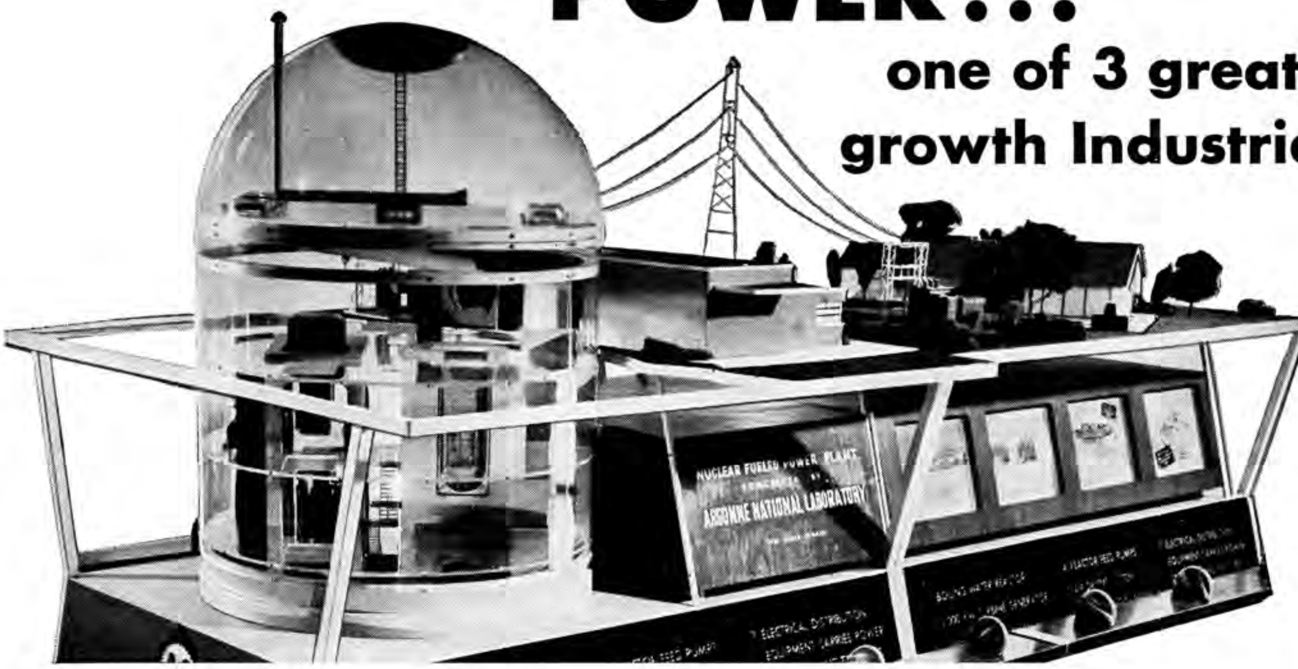
The act of 1954 still gave the Atomic Energy Commission monopolistic ownership of all mined fissionable material. But licenses would be granted to industrial firms which wanted to make use of fusionable or fissionable material provided the commission thought well of their plans. When atomic energy is released in a reactor, the production of plutonium as a by-product is inevitable. Because plutonium is a good atomic explosive, all the plutonium that may be produced by a power company becomes the property of the commission at a fair price.

Under the act of 1954 the President could give limited information on our own developments in atomic physics and engineering, even in military matters, to some allies and friends. The Atomic Energy Commission could give or sell materials for power production as well as equipment. These liberal provisions made it possible for the United States to enter into agreements with about thirty nations for the exchange of atomic information. It also made possible the International Conference on the Peaceful Uses of Atomic Energy, held at Geneva in August 1955.

Because of the change in technology and the possession of atomic bombs by the Soviet Union, the formulas laid down in the Acheson-Lilienthal report and the Baruch

(*Continued on page* 38)

POWER...
one of 3 great growth Industries



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

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

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

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

Electric power generation will double by 1965.

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

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

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

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

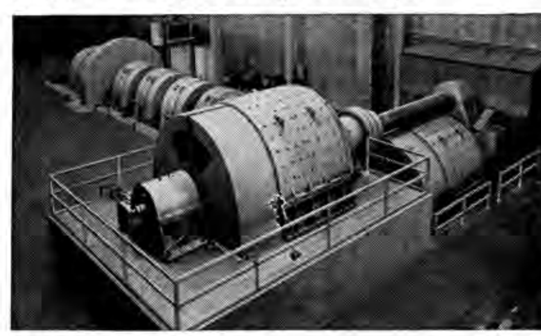
A graduate training course that has been a model for industry since 1904. You have access to many fields of engineering: electric power, hydraulics, atomic energy, ore processing.

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

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

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

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

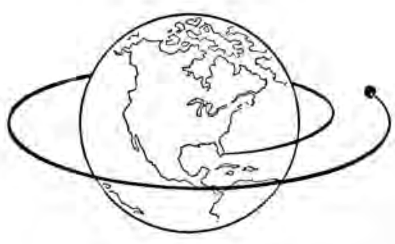


MANUFACTURING depends upon the reliable power of electric motors—like these 5000 hp Allis-Chalmers giants powering a rolling mill.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

4977



Challenging new projects

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

The latest in scientific equipment

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

Inside Honeywell

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

Outstanding associates

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

Choice of location

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

Send for free booklet

To learn more about Honeywell opportunities, see our representative when he next visits your campus. And write today for our booklet, "Your Curve of Opportunity." Write H. T. Eckstrom, Personnel Administrator, 2753 4th Avenue South, Minneapolis 8, Minnesota.

MINNEAPOLIS
Honeywell

First in Controls

NEWSTUFF

JIM WILHELM, M.E. '57

SULPHUR HEXAFLUORIDE —AN ELECTRON 'SPONGE'

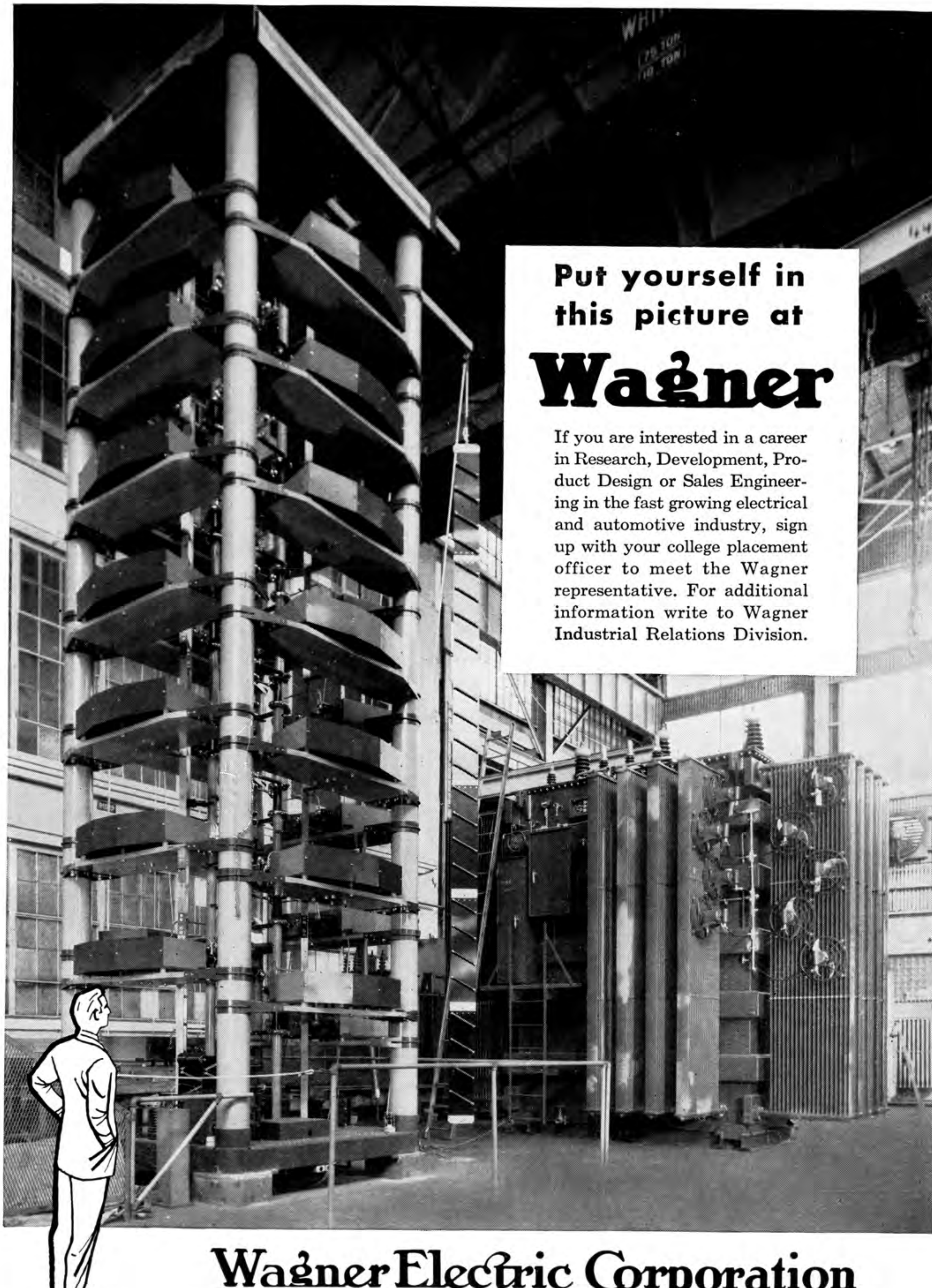
Why is sulphur hexafluoride such a good insulating gas? Present studies at the Westinghouse Research Laboratories of this and other gases to determine their insulating properties are finding the answer.

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

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

WESTINGHOUSE MAKES KEY TUBE FOR AIR FORCE 'CAT EYE'

A key tube is under development at the Elmira, N.Y., plant of the Westinghouse Electronic Tube Division for the U. S. Air Force's "Cat Eye" system. The "Cat Eye", as announced recently by the Air Force, is approximately a thousand times more sensitive than the standard television camera, and permits pilots to "see in the dark with daylight clarity." The development work at the Physics Branch, Aeronautical Research Laboratory of the Wright Air Development Center, Dayton, Ohio began 30 months ago, and the tube is being perfected under contracts with the Westinghouse Electric Corporation.



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G56-I

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS–AIR AND HYDRAULIC

ATOMIC ETHICS

(Continued from page 32)

proposals are outmoded. President Eisenhower is the leader in a new approach. He places his hope of insuring world peace on cooperation rather than on stiff rules. If the statesmen of the great powers can be induced merely to sit down and talk over world peace, something constructive is bound to emerge.

GENEVA

The Eisenhower method was first tested at the summit conference held at Geneva in July 1955. Persuasively, the President stated the case for general disarmament, which, in turn, would include the prohibition of atomic warfare. He even went so far as to propose the exchange of blueprints of military establishments and aerial photographs of fortifications, cities and anything else of military interest.

It was manifestly for the purpose of preventing a surprise attack that President Eisenhower declared his willingness to exchange military information, permit aerial reconnaissance of fortifications throughout the world, inspect industrial plants and monitor communications systems. In fact the plan included the essentials of the Baruch proposals and more, with voluntary cooperation taking the place of an international police. With such a voluntary international system for the exchange of information a surprise attack would be impossible, and with surprise thus disposed of, the likelihood of making use of atomic bombs would disappear. Retaliation would be inevitable if a surprise attack were made. Attack and counterattack would be suicidal. Hence there would be no atomic war.

The President's plan is impressive, but is it feasible? It is hard to imagine the United States revealing the size of its stockpile of atomic bombs or throwing its defense system open for inspection by any power when it has more to lose by a surprise attack than the Soviet Union. Although it is not likely that the Soviet Union will relinquish this advantage, Premier Nikolai A. Bulganin in September 1955 declared his willingness to meet President Eisenhower part of the way.

ATOM-FOR-PEACE

The Eisenhower plan for achieving international cooperation merely by an exchange of views was applied again in a second conference, the International Conference on the Peaceful Uses of Atomic Energy, held in Geneva in August 1955. This "atoms-for-peace" conference grew out of a speech which President Eisenhower delivered on December 8, 1953, before the United Nations General Assembly, and in which he invited the nations of the world at least to pool their knowledge of atomic energy for peaceful

(Continued on page 40)

ATOMIC ETHICS

(*Continued from page* 38)

purposes and thereby help one another to ease the lot of mankind. Nations with stockpiles of fissionable material were to contribute some of it to less fortunate nations for scientific research. This proposed exchange of knowledge and these contributions of atomic material would not only put to work atomic power where it was needed, but would advance the development of agriculture, medicine and industry.

As evidence of its faith in the President's plan, the United States offered first 100 kilograms, then an additional 100 kilograms of fissionable material, to serve as "fuel" in experimental reactors to be erected in various countries. Britain followed by pledging 20 kilograms. India promised "considerable quantities" from its important deposits of thorium.

Seldom has a proposal calling for world cooperation been received with the enthusiasm that greeted President Eisenhower's atoms-for-peace plea. The United Nations at once planned an International Atomic Energy Agency and made arrangements for the International Conference on the Peaceful Uses of Atomic Energy, which was held in Geneva August 8 to 20, 1955. This conference proved to be the most important scientific meeting in history.

Scientists of 73 nations came to Geneva not only as scientists but as official delegates of their countries. The plans formulated by the United Nations were carried out in both letter and spirit. There was the utmost frankness in revealing what each nation had accomplished. Only information of military importance was withheld. Even the Russians, regarded as particularly secretive, disclosed what they had been doing with atomic energy in the development of their country.

It turned out at Geneva that discoveries in the use of atomic energy for peacetime purposes which had been regarded as deadly secrets were not secrets at all. Britain, the U.S.S.R., France and other countries had been carrying on research independently along the same lines, arriving at similar conclusions but saying nothing about them until the Geneva Conference. Thus the folly of atomic secrecy was exposed.

The Geneva conference achieved its purpose. Politics and bombs were not mentioned. No recommendations were made; no resolutions were passed. Knowledge was exchanged in the traditional spirit of science. The world's scientists departed from Geneva convinced that they had participated in a momentous gathering. World attention was turning increasingly toward peacetime uses of the atom.

In which of these

3 activities does **YOUR**

FUTURE *lie?*

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

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

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

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

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

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

Scientific Staff Relations

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Research and Development Laboratories
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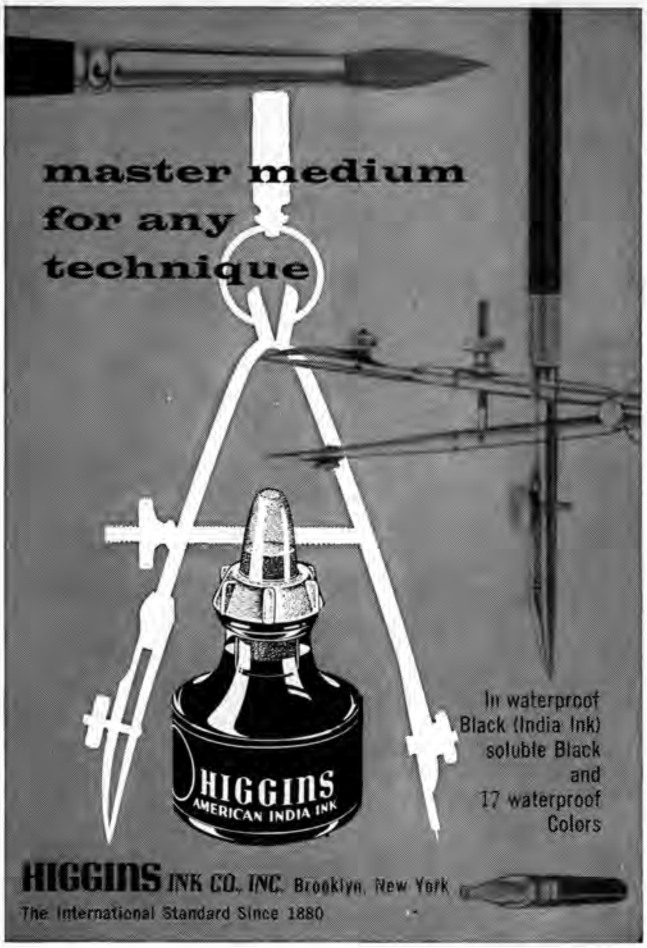


WELCOME

(*Continued from page* 15)

student publications of its kind in the nation. A scholarship fund has been established for those who need financial aid. Seniors who have distinguished themselves during their college careers are honored by being "dubbed a Knight of St. Pat".

There is no end to what the Engineers' Club can offer you! It is the official voice of the student engineers. Naturally, to realize the numerous benefits available to you it is necessary that you first become an active member. No matter what the organization, the more you put into it, the more you will gain in return. This promises to be one of the best years in the history of this college. With your cooperation, the Engineers' Club will accomplish more than ever before. Each one of you has something to contribute to this organization, just as it has something to offer you. Let's share that something! I'll see you at the next meeting.

AROUND THE COLUMNS

(*Continued from page* 26)

will discuss "Partial Programs in Engineering in the Four-Year Non-Engineering College." Don Fischer, acting dean of the Washington University College of Engineering, St. Louis, will speak on the problems of the regular college of engineering in respect to transfer students.

MISSILES

(*Continued from page* 19)

ried by the X-7, and related data reduction equipment to decode flight information, was developed by Lockheed scientists. The X-7 is being built at Lockheed's Missile Systems division, Van Nuys, Calif. The ramjet engine mounted on the X-7 was developed by Marquardt.

In describing the operation of the X-7, General Demler told an Air Force Association audience that the test vehicle is taken aloft by a B-29 and then launched.

"A rocket booster drives it up to the speed where the ramjet operates efficiently and takes over to accelerate the vehicle," Demler declared. "The vehicles are recovered by parachute and will be used again for future test flights."

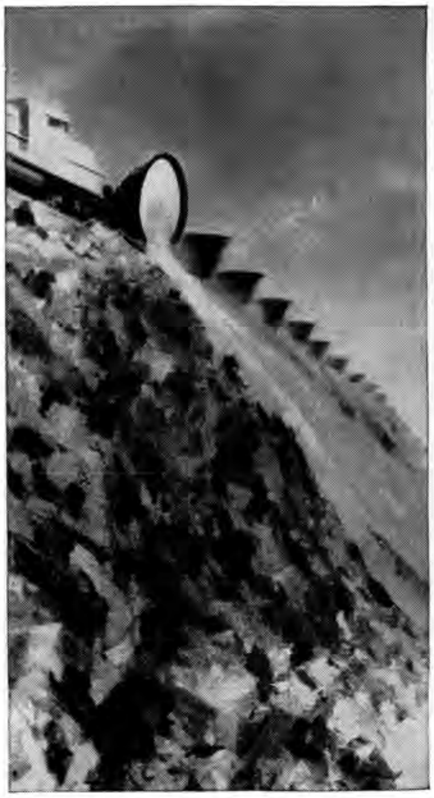
"This," Demler stressed, "represents quite a savings in our testing program."

Lockheed's Missile Systems division is working on about a dozen major contracts and a number of minor ones for various branches of the armed forces.

The company's growing missile business has led to the construction of $12 million in expanded facilities including new research laboratories in Palo Alto, Calif., and manufacturing, engineering, and administrative buildings in Sunnyvale, seven miles from Palo Alto. The research laboratories, the missile division said, will be occupied by this fall and the balance of its facilities in early 1957. The division will also keep in operation its present Van Nuys plant where it now employs some 4000 people.

Inco Nickel Progress Report

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



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

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

Now Inco saves iron in Nickel ore from the slag heap

ALSO RECOVERS NICKEL

There's iron in Nickel ore.

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

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

Saves the iron—

Nickel is recovered, too!

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

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

More from the ore

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

• • •

"Mining For Nickel"

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

INCO TRADE MARK

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

BULLARNEY

LEROY ANDERSON, M.E. '57

Ralph and Jack were being hooked at the same time by Anne and Betty respectively. May we repeat, Anne belonged to Ralph and Betty belonged to Jack. The four newlyweds spent their honeymoon together at Niagara Falls; they occupied adjoining rooms, sat at the same table and became inseparable —well, almost inseparable. After dinner one evening, they started upstairs and as they neared their rooms, lightning struck a transformer and out went the lights! They were in pitch darkness!

Groping around, they made their way into their rooms and quietly undressed for bed. Ralph, a religious fellow, knelt to pray. Just as he completed his prayer, the lights came on and he saw much to his astonishment that it was Betty there in his bed instead of his own wife Anne. He jumped up and dashed for the door.

"Too late to hurry now," cooed Betty. "Jack never prays."

♣

CONFESSION

Half of these jokes I've seen before, and the other half I don't see yet.—

The Editor.

♣

A young school teacher said to her best student, aged seven, "Tommy, if I lay one egg on the table and two on the chair, how many will I have altogether?"

"Personally," answered Tommy, "I don't think you can do it."

♣

Thermometers: Something else graduated with degrees without having brains.

♣

Joe: "That college turns out some great men."

Bill: "When did you graduate?"

Joe: "I didn't graduate—I was turned out."

♣

Dr. McLean: "I will not begin today's lecture until the room settles down."

Voice from the rear: "Have you tried tomato juice?"

♣

He: "Why do the most important men on campus always get the prettiest girls?"

She: "Oh, you conceited thing you."

♣

A young father was shopping at a department store with his daughter, when the little girl suddenly said,

"Daddy, I gotta go."

"Not right now," replied the father.

"I gotta go now," shouted the girl.

To avoid a crisis, a saleslady stepped up and said:

"That's all right sir, I'll take her."

The saleslady and the little girl went off hurriedly, hand in hand. On their return, Tony looked at his daughter and said: "Did you thank the nice lady for being so kind?"

"Why should I thank her?" retorted the little girl, "She had to go, too."

♣

The young, inexperienced druggist was asked by a young lady for some cough medicine. Looking on the shelf he could find none.

"Please cough cough you've got to do something cough for cough cough me."

So he gave her his own idea of a remedy. Soon the owner returned and asked how business was. He reported that he had just cured a woman's cough. "I gave her a malted with 4 oz. of mineral oil and 5 oz. of castor oil. She doesn't dare cough."

♣

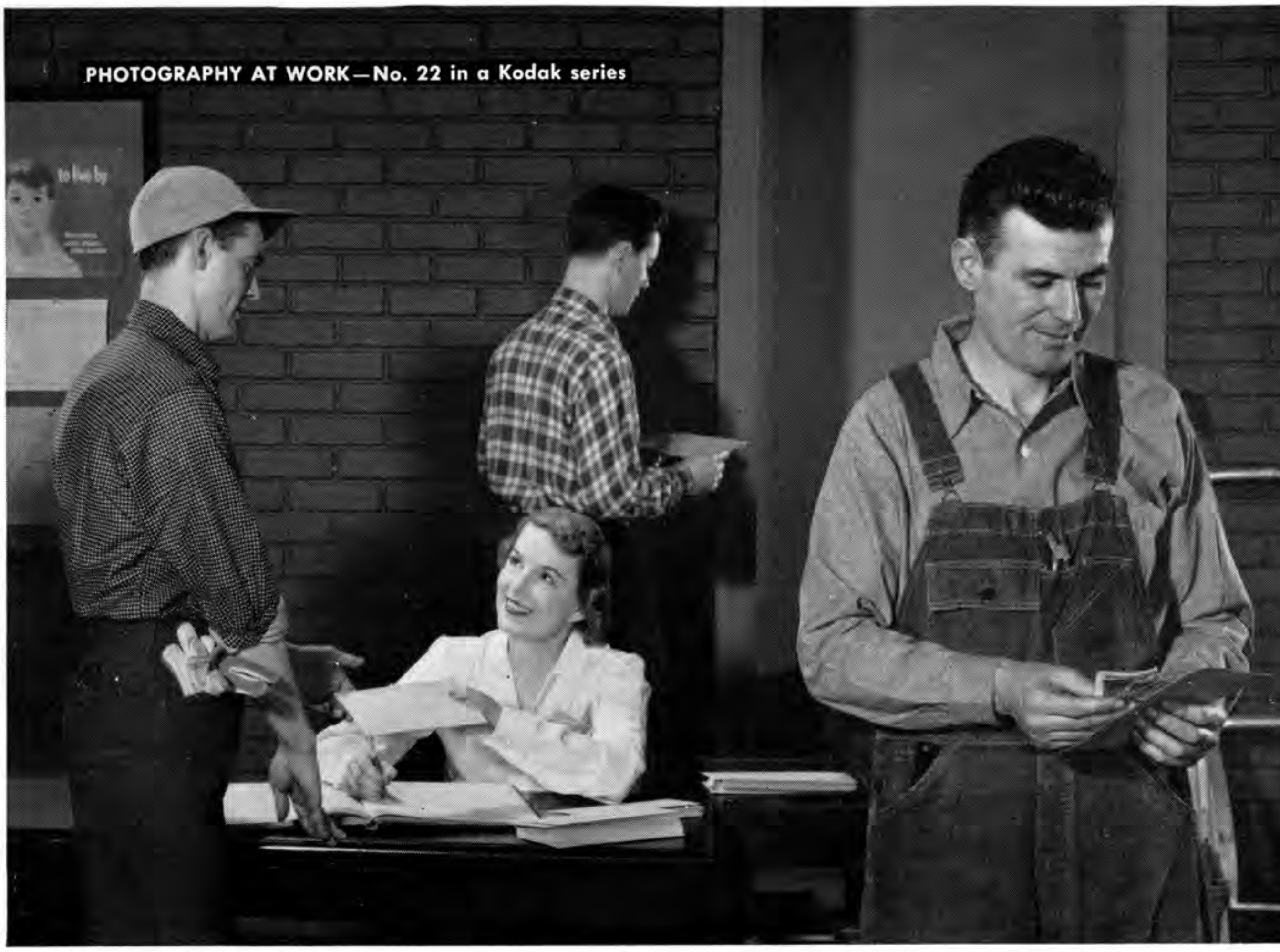
There was a young lady named Ramson
Who was loved three times in a hansom.
But when she asked for more
Came a weak voice from the floor.
My name is Simpson—not Sampson.

♣

Some of the girls were seated on the porch of the club-house at the golf course. Somehow, the locker room was partly open and the girls could not help but notice a nude man whose head and shoulders were covered by a bath towel.

After studying the body, so to speak, one of the girls reported that it was not her husband. A second girl gazed at the man and said, "No, it isn't my husband." The third girl, who was a life-of-the-party type, shifted her chair, peered intently at the masculine torso and blurted, "Why, he isn't even a member of the club!"

♣



Photography moved in, and...

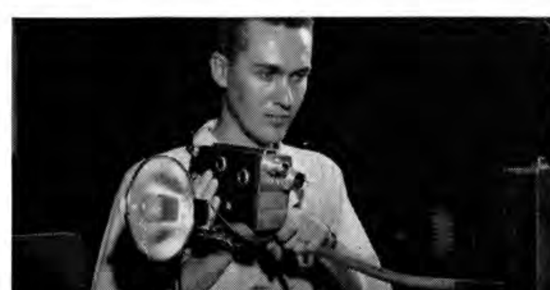
Out went the Doubts about Payroll Arithmetic

With some 2000 counters on their looms, the Fulton Bag and Cotton Mills faced the task of fast and accurate readings. Camera and film do the job in a fraction of former time and provide a conclusive record.

At Fulton Bag and Cotton Mills, employees are paid according to hand and pick "clocks" on their looms. It used to take 24 man-hours daily to read those meters. And there was always the chance of human error that could not be confirmed or denied at a later date.

So photography was put to work. Now the click of a camera shutter gets an accurate permanent record. No more doubts—no room for suspicion—everyone is happier. And "reading time" has dropped two-thirds. What's more, this has given Fulton a daily loom-by-loom check on the efficiency of its machines.

Building employee morale, checking efficiency, saving time and money are just samples of what photography is doing for business and industry.



A motion picture camera, adapted for single shots with "strobe" flash, snaps thousands of readings on a roll of film.

Behind the many photographic products becoming increasingly valuable today and those planned for tomorrow lie challenging opportunities at Kodak in research, design, production, and business.

If you are interested in these interesting opportunities—whether you are a recent graduate or a qualified returning serviceman, write to the Business and Technical Personnel Dept.

Eastman Kodak Company, Rochester 4, N. Y.

Kodak
TRADE MARK

ATOMIC RESEARCH at General Electric complements Paul Hess' Honors Program Studies.

MASTER'S STUDY at nearby college helps contribute to Hess' professional growth.

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To help outstanding engineers and scientists improve their technical competence in the face of industry's increasingly complex engineering problems, the General Electric Company has inaugurated a new Honors Program for Graduate Study. The Honors Program offers high calibre technical graduates the opportunity to complete the requirements for a Master's Degree in one and one-half years while working part-time on a G-E engineering assignment.

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GENERAL ELECTRIC

Missouri SHAMROCK

NOVEMBER, 1956

FEATURES:
- Uranium
- Engineering Survey
- Network Analyzer

25c

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Write: Mr. R. H. Thach, Regional Educational Co-ordinator, Westinghouse Electric Corporation, 411 North Seventh Street, St. Louis 1, Mo.

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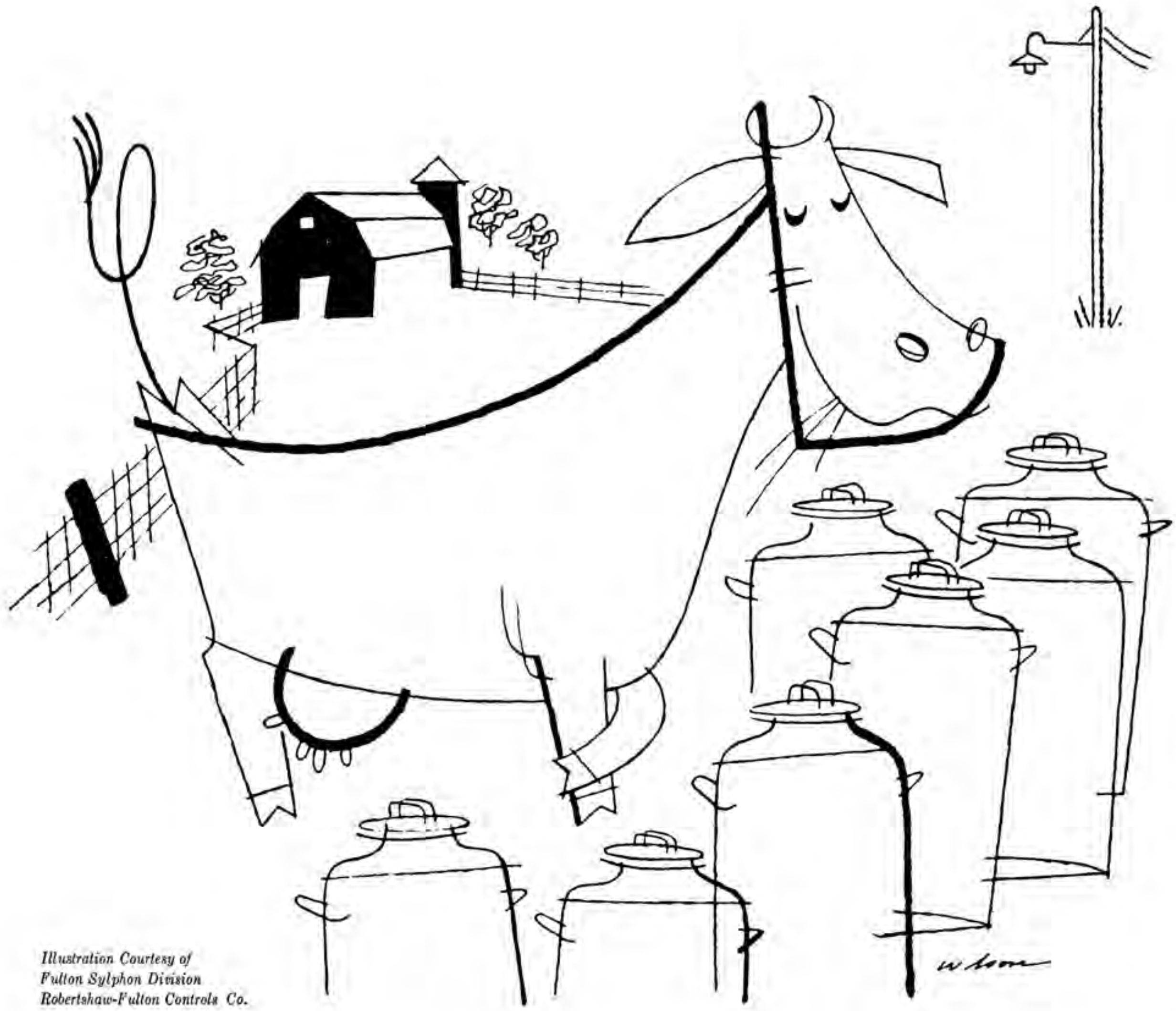

Illustration Courtesy of
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ON THE COVER:

Opportunity Knocks! This month's cover was suggested by the theme of the Survey article (page 21)
—JGH

MISSOURI SHAMROCK

VOL. XXIII NOVEMBER, 1956 No. 2

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MEMBER
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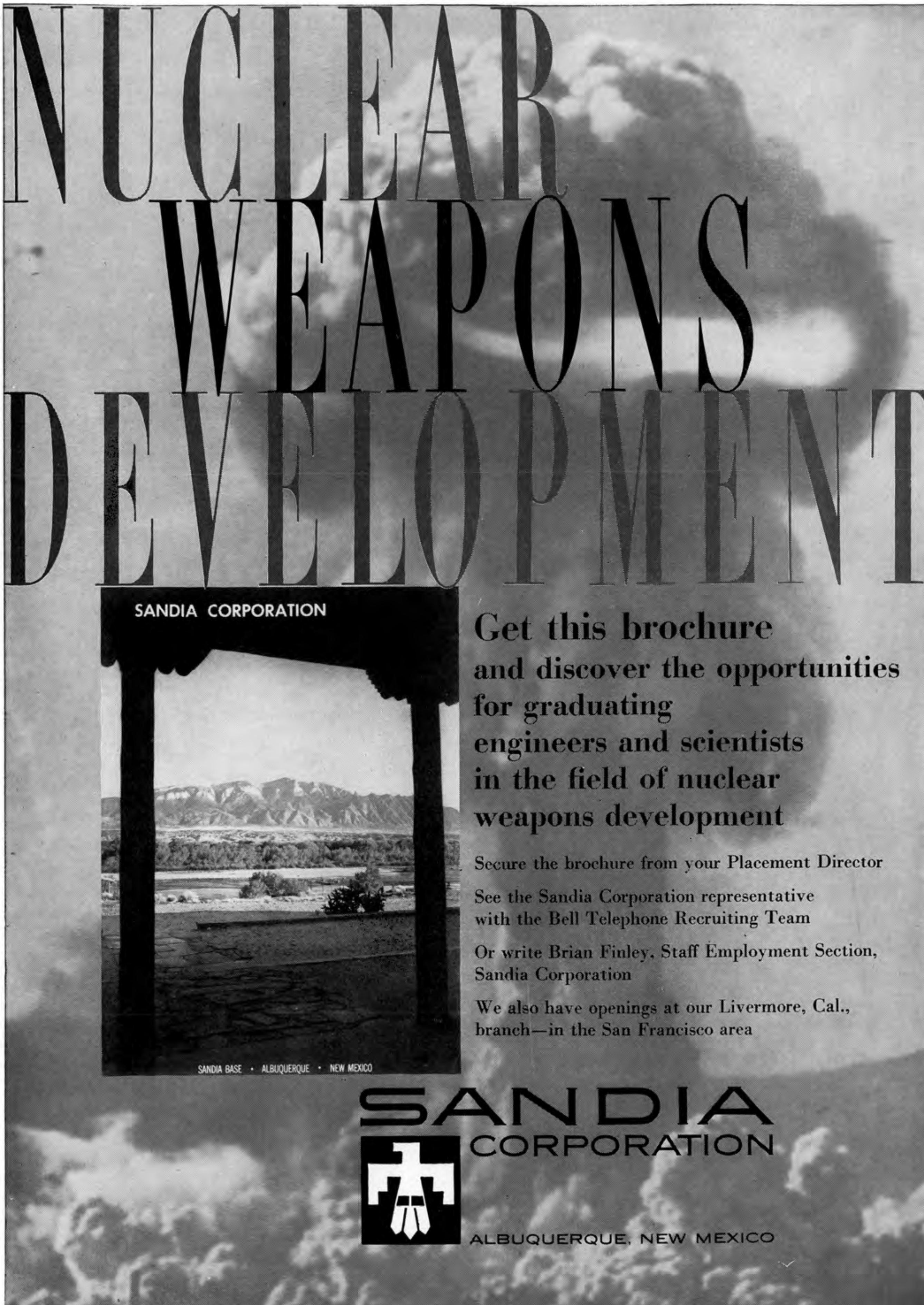
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John Nettleton wants to know:

How would a graduate degree affect my chances for advancement at Du Pont?

John C. Nettleton expects to receive his B.S. in chemical engineering from Villanova University in June 1957. He has served as president of the student chapter of A.I.Ch.E., and as secretary of Phi Kappa Phi fraternity. John is now wondering about the pros and cons of advanced study in his field.

Bob Buch answers:

Robert J. Buch, M.S., Ch.E., came to the Engineering Development Section of Du Pont's Grasselli Research Division from the University of Louisville four years ago. Since then, he has engaged in many kinds of chemical engineering work, from pilot-plant operation to evaluation of the potential of proposed research programs. Within the last year, Bob has taken the responsibility of procuring B.S., M.S., and Ph.D. technical graduates in all phases of chemistry and chemical engineering for the Grasselli Research Division.

An advanced degree would undoubtedly have a *favorable* effect in technical work, John, but let me enlarge on that just a little. In your own field (and mine, too) a higher degree is considered to be evidence of ability in carrying out original research. It is therefore helpful in obtaining work in research and development, where that skill is definitely important. You might say that it gives a man a head start in proving his ability in those areas.

It's less important in some other areas, though. For example, in production or sales work ability for handling human relationships is just as important for advancement as technical competence. If an engineer is sold on production work or sales, a graduate degree in marketing or business administration might be more helpful to him than advanced technical training in getting started.

But I've noticed this at Du Pont. Once a man lands a job in his chosen field and actually begins to work, his subsequent advancement depends more on demonstrated ability than on college degrees. That's true throughout the entire company—in scientific work, administration, or what not.

So an advanced degree is not a royal road to anything at Du Pont, John. But when coupled with proven abilities, it is unquestionably helpful to a man in research and development work. It often gets him off to a faster start.

Are you interested in research work?

About 2,000 Du Pont scientists are currently engaged in research, aided by some 3,500 other employees. Laboratory facilities of the highest quality are available at the Du Pont Experimental Station near Wilmington, and elsewhere throughout the country. Information about research at Du Pont is given in "Du Pont Research." Write for your copy of this free 28-page booklet to the Du Pont Company, 2521 Nemours Building, Wilmington, Delaware.

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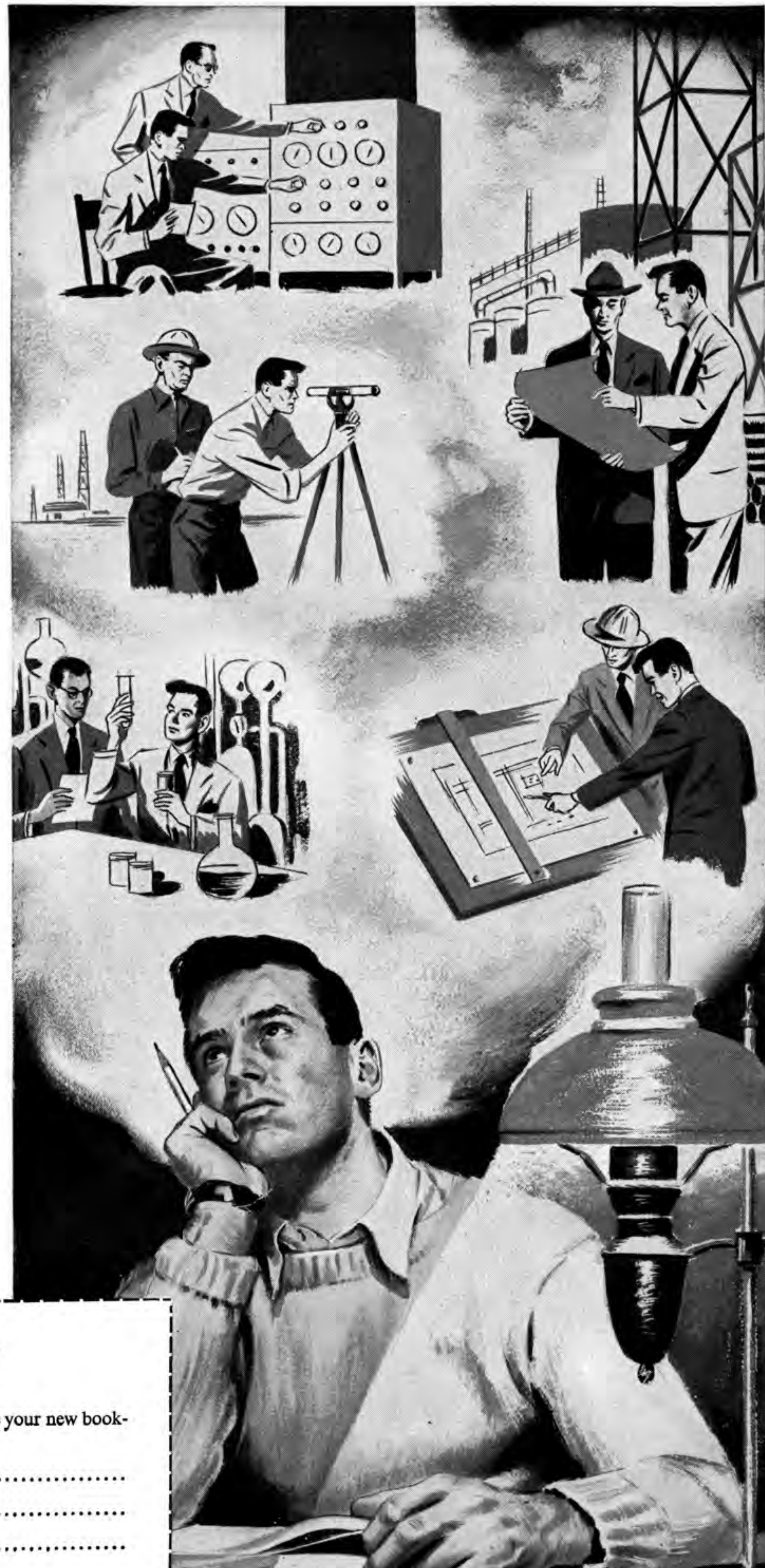

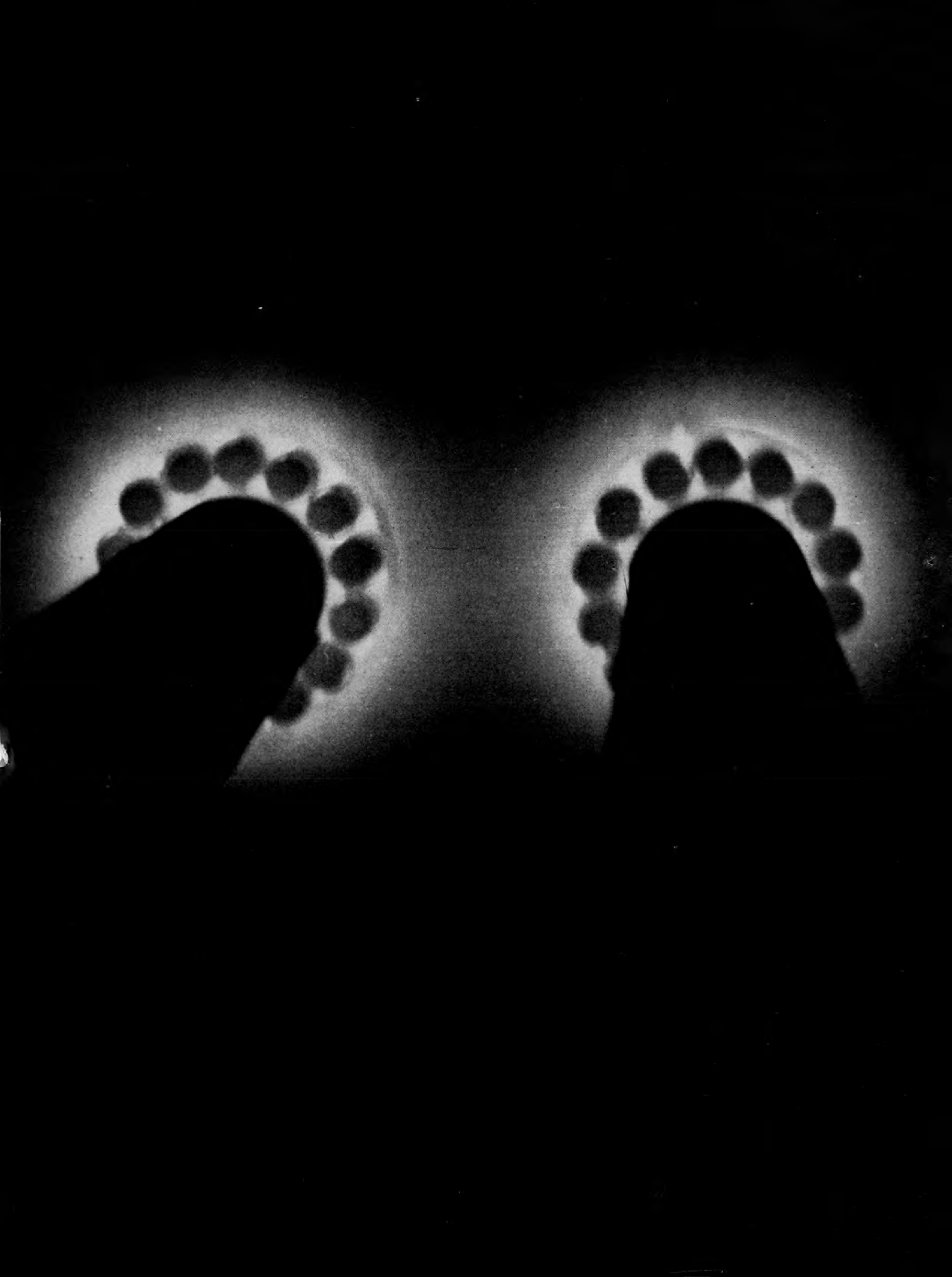

Editorial

The purpose of this magazine is to please as many of its readers as much of the time as possible. With a readership which ranges from high school students to presidents of corporations, this presents something of a problem. One which the editor alone cannot solve.

In reading this magazine, you may notice something which you believe could be improved. It might be an article, a department, the cover or the jokes. You may find an error or a point on which you disagree. There is even a slight chance that you will find something especially interesting to you. We cannot know what your feelings are unless you tell us. We can guess but we cannot always guess correctly.

Therefore, we invite you write us, telling us what articles you like and those you don't like, departments which are interesting and those which aren't. Tell us about you, your job or school and your interests.

You are our readers—because of you, we exist.

J.D.C.

FRONTISPIECE — resembling atomic field pieces blasting away in the night, these tubes extend into 20-foot water-storage pool for highly radioactive fuel elements. They permit General Electric scientists at the Hanford atomic plant to study effects of atomic radiation on various materials.

Four top scientists discuss creative thinking before fellow research men and engineers at a Joint Technical Conference held in French Lick, Indiana, by Standard Oil and its affiliates. Panel members were, left to right above, E. L. d'Ouville, G. W. Ritter, P. C. White, and T. A. Abbott. Moderator was Joseph K. Roberts, left inset, general manager of research and development for the parent company.

The Very Idea!

PETROLEUM scientists and engineers have a habit of coming up with the *very* idea to solve a problem at the very moment it is needed. They have created hundreds of new products and have improved others, putting the petroleum industry in the van of American industrial progress.

The contributions of Standard Oil scientists, working in extensive laboratories and with the finest equipment, have been outstanding. To give them even greater opportunity to exchange and develop ideas, Standard Oil uses the most modern techniques for stimulating creative thinking.

Groups of our scientists now meet in informal and relaxed creative sessions. Through "brainstorming" and similar devices, they contribute fresh, new thinking to the solution of specific problems. These men are creative by nature, and they "pop" even more ideas, faster, at sessions where one idea stimulates another.

In such an atmosphere of progress, young scientists and engineers find great opportunities to make positive contributions and build interesting careers.

Standard Oil Company

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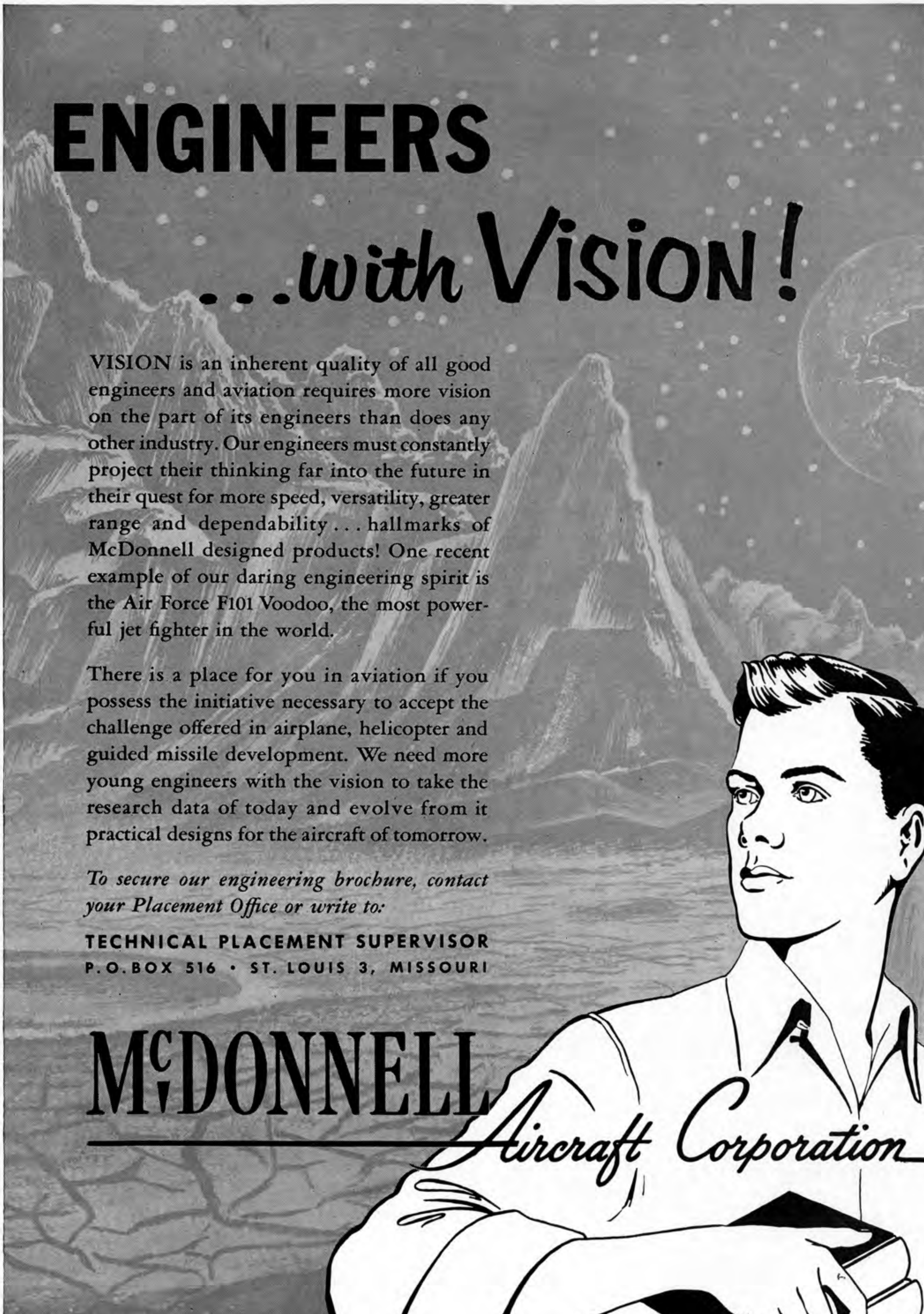
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The Story of

URANIUM

M. L. CRENSHAW

Editor's Note—

This article, second of the series on the subject of atomic energy, tells the story of uranium—where it is found, how it is mined, and refined.

Just west of the Rockies, where Utah, Colorado, New Mexico and Arizona come together, is one of the last frontiers in America—a rugged tableland of some hundred thousand square miles known as the Colorado Plateau. It is a colorful land, dotted with flat-topped mesas and deep walled canyons.

Here and there one finds the crumbling remains of the cliff dwellers who lived a thousand years ago, sluices and piles of placer rock left from the more recent gold-rush days. Here at the turn of the century, men searched for radium ores which Marie and Pierre Curie were to use in their famous experiments. World War I brought new bustle

Cores recovered by an exploratory diamond-drilling operation are being examined by a geologist to see if there are any traces of uranium ore.

to the plateau as vanadium for strengthening steels became critical. Early in World War II plants in the area were redesigned in conjunction with the Manhattan Project of the U. S. Army Engineers.

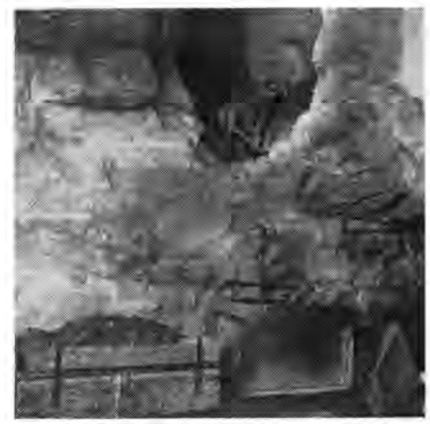
In 1948 the Atomic Energy Commission, concerned over the nation's supply of uranium, decided to encourage exploration and mining. Then began a rush not unlike that caused by the discovery of gold at Sutter's Mill in 1848. People began to pour in from all parts of the country.

The prize lay buried here and there in the mesas—encrusted in the logs and stony beds of petrified rivers that flowed in an ancient age when our planet was still quite young.

THE PETRIFIED RIVERS

The history of these petrified rivers and the uranium that they hold began more than two hundred million years ago, before the Coloradio Plateau and the Rocky Mountains existed.

A great inland sea covered almost all of the southwest. Along its ever-changing shores lay endless wastes of sand dunes stretching thousands of miles. As the centuries passed, the land slowly rose and the waters receded leaving behind them vast beds of salt. Beyond these flats were highlands, over which the winds carried moisture-laden clouds that drenched the land with torrential rains day after day. Rushing streams cascaded down from the highlands, carrying silt and mud and gravel, which finally buried the sand dunes — forming a wide gentle plain across which flowed meandering rivers.



This is the interior of one of the larger uranium mines, which opens up into a number of caverns and bays, known as drifts and stopes.

Some geologists believe that about this time hot solutions began to bubble up from deep within the earth's crust. These solutions containing uranium and other metals mingled with the rivers and as the waters flowed over the plains, decaying logs and vegetation along the way entrapped the uranium. Then a burning sun dried up the rivers and left the logs to bleach on the sand. Gradually, wind-blown sands buried the logs and river beds.

Other geologists believe that the uranium came much later. The solutions bubbled up from the earth in the same areas in which the ores are found today and then spread through fissures in the rock into the ancient river beds.

At any rate, as ages passed, many changes occurred. Sometimes ice gripped the highlands, at other times, swamps and bayous provided refuge and lush pasturage for dinosaurs and other pre-historic reptiles.

(Cont'd on page 16)

URANIUM

(*Cont'd from page* 15)

And with all these changes the uranium was buried deeper and deeper.

Suddenly the whole Southwest buckled and spewed fire and brimstone. To the east rose the Rockies and to the west the Sierras.

Once again the land between the mountains became arid. It was chopped into mesas and deep gorges by the whistling winds and rushing rivers.

Thus, is the Colorado Plateau as we see it today—its canyon walls revealing some two hundred million years of history. The dunes of the great inland sea are preserved as sandstones, the ancient plains lie frozen in bands of red and gray rocks. There are traces, too, of those winding pre-historic rivers, and hidden along their petrified beds lies the uranium.

PROSPECTING

Although the plateau had passed through periods of boom and bust, exploration has never ceased since the first search for gold. However,

This Geiger counter is used to check drill cores that the geologists think promising.

those gray-bearded prospectors who forged through the hills with their burros, some hundred years ago, are nearly forgotten. Jeeps, rugged little pick-up trucks, bulldozers, and airplanes have replaced the burro. Virtually no place is inaccessible for today's prospectors. Their tools are the Geiger counter and scintillometer-sensitive instruments that detect the rays emitted by uranium ores.

Claims are staked in a manner similar to that for gold, copper or any other valuable mineral. First the land is surveyed, a discovery cut made and then corner posts are set to locate the boundaries. Each claim is six hundred by fifteen hundred feet, with a notice of the claim posted somewhere along the center line to identify the owner.

If a claim looks promising after a preliminary survey, the land is then drilled to determine the extent of the ore bodies. The cutting or cores obtained by drilling are then examined by a geologist with a radiation counter and assayed to find out if substantial amounts of uranium exist. If encouraging signs appear, additional holes will be made in the surrounding area so that the quantity of ore present may be estimated.

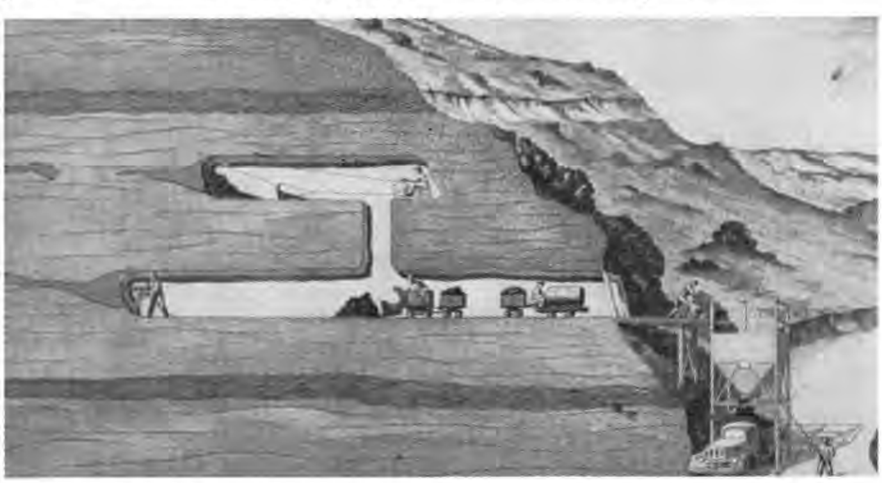
Truckers travel this narrow winding road through Unaweep Canyon between Grand Junction and the uranium mining country. It is now being widened under the AEC access road program.

MINING

About a thousand uranium mines now honeycomb the rich underworld of the Plateau. Although several relatively large deposits have been recently discovered, most of the mines are just small tunnels dug into the face of the hills.

The miner's job is not an easy one. Many tons of waste rock must be drilled and blasted away to reach the ore. In a small mine the tools will probably be an air compressor, a jack hammer and jackleg drill, either a wheelbarrow or a one-ton ore car, and, of course, picks and shovels. In a larger mine, a big jumbo drill will be used to pierce the ore faces; mucking machines and slushes and frequently Diesel-powered loaders and locomotives.

The uranium mine generally covers not more than 20 to 40 acres, following the ore vein in its wanderings through tons of waste rock. Since drilling is done through solid rock, little timber is required. Water, however, is needed in large quantities and has to be either hauled from streams miles away or obtained from deep wells.



Here is a cross-section of a typical uranium mine. There are many such mines in the Plateau area. Operations are small because ore bodies are small and spotty.

As he follows the meandering underground deposits, the miner often comes upon evidence of the petrified rivers' past. Perhaps it is a log encrusted with uranium or ripples of long-vanished waters preserved on the face of stone. He may even find traces of pre-historic plants or the footprints of a giant dinosaur that once roamed an ancient plain.

TRANSPORTING

Ore is transported from the mines to the processing mills largely by truck. Truckers often have to forge up the sides of steep cliffs on roads sometimes no wider than the old wagon trails. Yet, even on the most desolate roads, several trucks may pass one another in less than five minute's time.

REFINING

Ceaseless streams of trucks scurry through the busy mesa country carrying ore to buying stations and to more than a dozen processing mills scattered throughout the Plateau. Careful milling and refining are required to recover the precious

(*Cont'd on page* 40)

The POWER NETWORK ANALYZER

News Release—
office of public information,
University of Missouri

The University of Missouri held public dedication ceremonies in the Engineering Laboratories here at 11 o'clock Saturday morning, October 6, accepting a gift of an electronic Power Network Analyzer donated to the College of Engineering by a group of Missouri industrial firms.

And with the acceptance and dedication of the complex instrument, the University inaugurated an unusual new service, power system analyzing, for industry of Missouri and the Midwest, as well as a new research and teaching program for the further advancement of engineering science.

The Network Analyzer with the two operating supervisors at the control desk. Seated in foreground is Prof. James R. Tudor, at his right is Prof. Joseph C. Hogan at the master controls. Standing at rear is Prof. C. M. Wallis, chairman of the department of electrical engineering, and in right foreground is Huber O. Croft, dean of the College of Engineering. Several open spaces in shelves at right show how cabinets are built to hold drawers of electronic equipment, and the numerous dials are in the facing panels of drawers already in place. The panels behind Prof. Wallis are plug "jacks" and receptacles for use in inter-connecting various parts of the equipment.

President Elmer Ellis accepted the analyzer equipment for the University from a representative of the group of eleven utility and engineering companies who contributed to its cost.

Presidents, vice-presidents and other executives of these companies, along with their wives, were guests of the University at the dedication and at a luncheon in Memorial Student Union after the ceremonies. They were guests at the Missouri-Southern Methodist football game that afternoon.

The network analyzer is a complex electrical device of the type popularly called an "electronic brain," and is designed to solve, quickly and accurately, some of the most complicated and time-consuming problems in the power transmission field. It is said to be especially valuable to power companies and to engineers in figuring electrical transmission line loads and regulation, and capacities and limitations, and in making short circuit and fault studies.

Many of the baffling problems which confront engineering companies contemplating either installation of new systems or extensive expansions of old systems can be solved by the machine in a small fraction of the time it takes the engineers to figure it out on paper.

The utility company can set up a model of its electrical system on the control board. With this, they can determine proper methods of expansion, the most economical ways to inter-connect with systems of other companies, and what will happen if a stroke of lightning or some other accident deprives them of a part of their system.

For instance; suppose a utility company is contemplating expansion involving an additional two-hundred-mile network of lines with a probable number of consumers. It may take their corps of engineers many months, sometimes a year or more, to figure line loads, line losses, capacity of wires needed in various localities, types and sizes of transformers, voltage, wattage, and ohms, and many other normal factors. Then they must anticipate emergency overloads, short circuits, transformers struck by lightning, and unpredictable faults. These are some of the things over which they may labor for many months, and at great expense.

But with the network analyzer, the engineer brings his preliminary plans to the laboratory, where he and the analyzer operators can set up a simulated system duplicating all known and estimated conditions of the proposed line by plugging in a series of electrical contacts. They press a control button, and PRESTO — They have their new system in full operation before their eyes in a single room, with answers to many problems.

It isn't quite that simple, of course; and it may take as much as a week or ten days for the engineers to set up and test all factors concerning the system on the network analyzer. But the resulting solutions are equivalent to those formerly requiring the complete engineering corps to labor over for months.

Dr. Joseph C. Hogan, right, associate professor of electrical engineering and supervisor of the analyzer, is explaining to Ralph Mayer of Kansas City, left, and Donald Bixler of Springfiled, Mo., seniors in electrical engineering who will assist in the operation of the equipment, what to look for on the meters as they adjust dials.

The analyzer also has other valuable advantages. Suppose there has been a miscalculation in the preliminary plans, and facilities in some part of the system are inadequate. The analyzer discovers the error and shows where it is. Suppose consumer use is unexpectedly doubled in some community on the system and the transformers are inadequate for the load. The analyzer warns of this when such a condition is set up. What will happen if the power pant is suddenly disabled and it is necessary to switch onto the line of a neighboring utility supply. The analyzer has the answer. Thus, it is conceivable that use of the analyzer for a week or ten days may save a power company many months and thousands of dollars of costly delays and rebuildings to correct errors in original specifications.

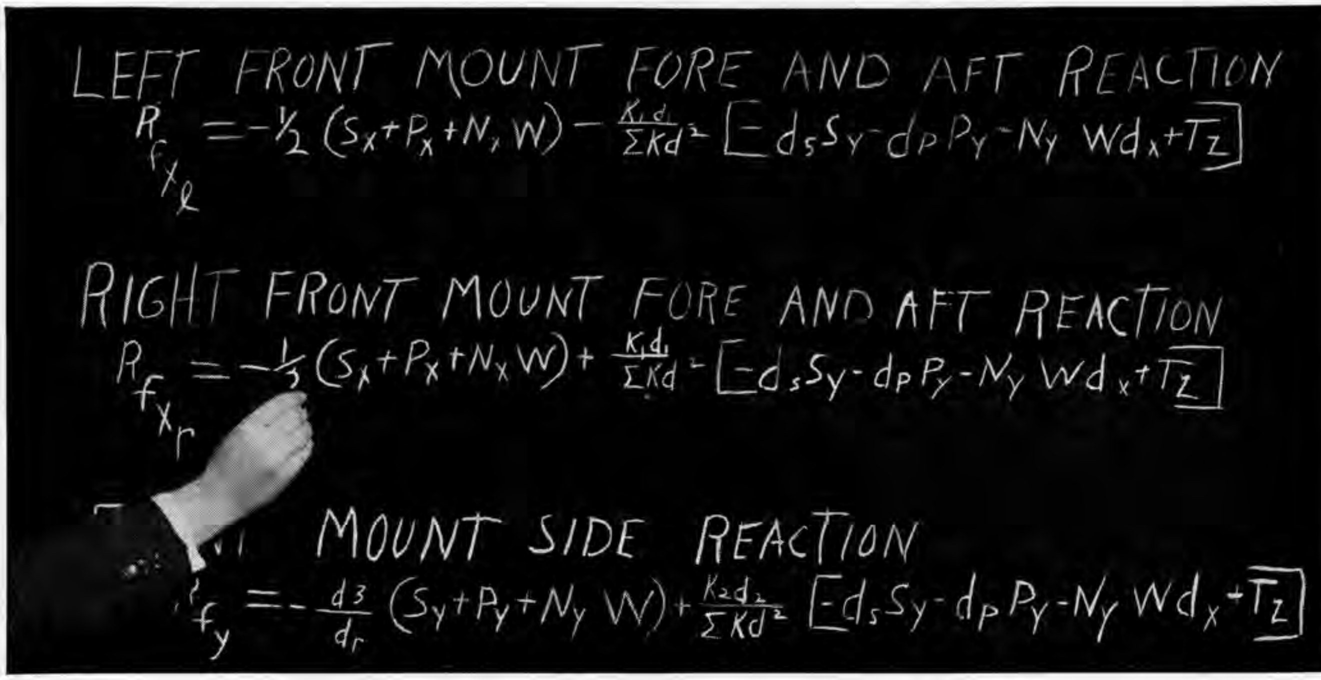
The decision to install a network analyzer program in the University's College of Engineering was made about three years ago, and nine utility and engineering companies agreed to contribute to the cost of purchasing the intricate analogue computer; and also to sign contracts as participating companies who would utilize the services thereby available through the University, paying a per diem rate for these services.

These nine participating companies, all of whom operate in Missouri, include: the Arkansas-Missouri Power Company of Blytheville, Ark., Central Electric Power Cooperative, Jefferson City; Empire District Electric Company, Joplin; Kansas City Power and Light Company, Kansas City; M. and A. Electric Power Cooperative, Poplar Bluff; Missouri Public Service Company, Warrensburg; Missouri Utilities Company, Cape Girardeau; St. Joseph Light and Power Company, St. Joseph; and Sverdrup and Parcel, Inc., St. Louis.

The A. B. Chance Foundation of Centralia, Mo., and the Union Electric Company of Missouri at St. Louis also made donations toward the purchase of the equipment.

The contract for building the

(*Cont'd on page* 34)



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This is our new Administration Building, hub of the new Allison engineering Research and Development Center in Indianapolis.

SURVEY—

Attracting and Holding Engineering Talent

Editor's Note—This article is reprinted by special permission of the PROFESSIONAL ENGINEERS CONFERENCE BOARD FOR INDUSTRY, INC. because it was felt to be of general interest to all concerned in the fields of engineering. —JGH

IN THE FACE of a diminishing supply of young graduate engineers, American industry today is confronted with an unprecedented demand for technically-trained personnel.

It is a demand which cuts through every field of engineering —manufacturing, heavy industry, governmental services, public utilities, teaching, research—weighing more heavily on some than on others, but affecting all to a serious degree.

The dilemma is one for which the engineer himself is partly responsible, for he has developed new processes and inventions which in turn have created a demand for more, and still more engineers.

Also responsible is the fact that many engineering college graduates have been used by industry in work where lesser-trained personnel could perform the work satisfactorily.

It is a habit that still lingers despite the presently pressing demand for engineers for *engineering* work.

SOME PROGRESS

A considerable segment of industry, however, is beginning to look at the situation in a more realistic light, and already, many plants have begun to relieve their engineers of routine duties by the assignment of non-professional supporting personnel to jobs where an engineering training was helpful but not a requirement and which did not utilize to the fullest degree the abilities of the engineer.

This is in line with the recommendations contained in Executive Research Survey Number Two, *How to Improve the Utilization of Engineering Manpower*,* which showed how, by better utilization of those it already has on its payroll, industry could gain the equivalent of thousands of new engineers almost overnight.

There are many thousands of plants, however, which still are using their engineers for only a fraction of their time on purely engineering duties. Sixty-three per cent of the engineers who participated in this survey said they were engaged partly or wholly in non-engineering activities, while the executives reported only 68.9 per cent of their engineers are employed seventy-five per cent or more of the time on engineering duties.

There still are many executives who view the situation as a "shortage" and hope for a new crop of engineers to fill the increasing number of engineering jobs. It is a vain hope, however, at least for the next few years.

NO RELIEF IN SIGHT

Not only is it unlikely that there will be any appreciable closure in the gap between supply and demand, unless that closure is made from within, but industrial leaders and personnel experts are of the opinion that the situation as regards new engineers will become even more serious.

This is because of two factors. The first is the gradual decrease in college enrollment, the result of the sharp drop in the birth rate during the depression thirties. Since the peak year of 1950, when 52,000 engineering students were graduated, the number has dwindled each year to less than 21,000 in 1953. It is estimated the total will be only 17,000 to 19,000 in 1954 . . . no hopeful sign for those who look for aid from outside their own organizations.

The second factor is the growing complexity of the products of industry. Of the two, the latter is likely, in the long run, to be the more serious.

Almost everything we produce in the fields of mechanics and electronics has become vastly more complicated with a subsequent multiplication of engineering man-hours in the designing, planning and manufacturing processes.

EVOLUTION INCREASES PROBLEMS

The field of aviation furnishes many striking examples of this trend toward more and more complicated machines. The F-86 Sabre Jet fighter, for instance, requires twenty-seven times more engineering man-hours in the manufacture than were required for the P-51 Mustang of World War II.

Similarly our automobiles, radios,

(*Cont'd on page* 22)

* Available from The Professional Engineers Conference Board for Industry. Single copies, $2.00.

SURVEY

(Cont'd from page 21)

television sets, heating and air conditioning units—everything, indeed, that we use—are becoming more complicated and are requiring more engineers to make them.

Not only have the goods themselves grown more complicated, but the means of producing them also are becoming increasingly complex as industry edges closer toward the goal of automatization.

Significant progress already has been made toward this end in the oil, chemical and fluid-handling industries; and in other fields, servomechanisms and automatic electronic controls are coming into increasing use. The Ford Motor Company, for instance, now uses automatic machining operations to turn rough castings into finished cylinder blocks with machines performing the 532 broaching, milling, boring, honing, drilling, and tapping operations automatically.

A NEW TREND

The effect of this trend toward the reduction of the human hand in manufacturing has been to increase tremendously the number of engineers needed.

The ratio of engineers to total personnel has increased, according to the United States Department of Labor, from one in two-hundred and fifty at the turn of the century to little more than one in fifty today with the bulk of this increase taking place in the period since immediately before World War II. What the immediate future holds can only be guessed at, but W. M. Pease, Director of the Servomechanisms Laboratory at the Massachusetts Institute of Technology, said recently, in reference to automatization:

"The automatic machine units of the future will be fantastically more complex than anything we know today."

Which means still more engineers.

ENGINEERS IN MANAGEMENT

The growing technological complexity of industry has had another effect, too—the abandonment of the myth that engineers do not make good administrators; that the engineering concept is too narrow to be able to embrace the broad view and the compromises required of industrial management.

But industry has found that as the machine grows more complicated, the non-technical administrator works under increasingly greater handicaps. As a result, a definite trend has developed toward the selection of engineers for top management posts, thus adding to the demand for more engineers.

Sales departments, too, are making increasing inroads in the engineering force as the complexity of the merchandise increases to the further depletion of the reservoir of engineering talent available to the manufacturing operation.

What, therefore, is industry to do to help close the gap between supply and demand? Or even to hold its own in the face of forces which seem to point toward an even greater widening of that gap?

WHAT INDUSTRY IS DOING

Since the publication of the Professional Engineers Conference Board for Industry of Executive Research Survey Number Two, *How to Improve the Utilization of Engineering Manpower,* many plants, both large and small, have by careful, factorywide job analyses, been able to shift many semi-technical functions formerly being performed by engineers to non-professional employees, releasing their engineers for purely engineering duties.

(In the questionnaire sent to industrial executives in connection with this survey, each was asked (a) if he had seen the previous surveys, and (b) if they were helpful to him in increasing the engineering operations of their companies. Of those who replied, eighty-two per cent said the surveys had been of benefit in increasing the efficiency of their engineering forces.)

Many other devices have been resorted to in an attempt to meet the problem. Among them are (1) rapid upgrading of young talent to positions of maximum responsibility, (2) elimination of waste motions by time studies of engineering duties, (3) improvement of engineer-management communications (see Executive Research Survey Number One), (4) employment of engineering students for part-time work, (5) relaxation of compulsory retirement age standards for engineers currently employed and for older engineers who may be available, and (6) employment of outside consulting firms for special projects wherever practicable.

REDUCING TURNOVER

Reduction of engineering turnover is one area where large savings in manpower can be made, and it was to learn how best that end might be realized that the present survey was undertaken.

The Conference Board started with the assumption that if management can provide a climate in which engineers can work happily and effectively in an employee-employer relationship while still retaining their professional attitudes, a large part of the problem will be solved.

To learn what makes such a climate, the Board sent researchers out to interview leaders in the industrial field, professional personnel directors and individual engineer-employees.

It also sent several thousand questionnaires to leading employers of engineers and to engineer-employees in all parts of the country, covering all types of engineering activity from manufacturing to pure research.

RESULTS REVEALING

Two different types of questionnaires were used, one for employers and one for employees, but both covered the same areas so that, taken together, the answers provided checks against one another. The results, therefore, were far more revealing than those from either group, taken alone, would have been.

A comparison of those answers made it instantly apparent that both

(Cont'd on page 24)

SURVEY

(Cont'd from page 22)

employee and employer are laboring under many misconceptions about the attitudes and goals of the other — misconceptions which, in many cases, could be eliminated with a minimum of difficulty.

The questionnaire provided clues not only to the identification of those points where friction is most likely to occur in the relationship between industry and its engineer-employees, but also to possible methods of lubricating those friction points to help bring about the desired end result.

WHO WERE SURVEYED

Who replied?

- More than 200 companies employing nearly 1,000,000 persons in 1,428 plants.
- More than 1,300 engineers employed in all fields of engineering activity.

What do they do?

- The executives' questionnaire went to top management officials of large and small firms throughout the United States.
- The engineer-employees' questionnaire went to professional workers in job categories ranging from field clerk to supervisor.

What fields of activity were covered?

- The questionnaires went to both employers and employees in all fields in which engineers are normally engaged. They include manufacturing, from which came forty-five per cent of the replies; construction, heavy industry, public utilities, government service, teaching and research.
- Those surveyed work in plants ranging from a two-man shop to a great corporation employing nearly 800,000 persons in countries scattered throughout the world. Forty-seven per cent are employed in plants with more than 1,000 workers; thirty-three per cent work in small shops, with less than 200 employees, and twenty per cent were from medium size organizations with 200 to 1,000 employees.

THIS SURVEY is a composite of the opinions of both management and engineer-employees in nearly 1,500 companies which operate not only in the United States but in many other corners of the globe as well, and which represent an accurate cross-section of American industry.

The industries represented included aircraft and automobile manufacturing, chemicals, petroleum, steel and other heavy industries; construction, consulting, design, and teaching, with manufacturing occupying the top place. Forty-eight per cent of the executives who responded, and forty-two per cent of the engineer-employees, were in the last-mentioned industrial category.

THE TYPICAL EXECUTIVE

The typical executive among those who responded to the questionnaire is the vice-president of a manufacturing company in the northeastern part of the United States. His firm operates seven major plants, in which 5,000 persons are employed, 200 of them engineers.

The engineers in his firm's employ are steady, conscientious workers who are considerably less likely to fall down on the job, or to leave the company for greener pastures, than are the non-engineering employees. Fifty-five per cent said the rate of turnover among engineers was lower than that for non-professional employees, and twenty-eight per cent said it was about the same.

This would be a very pleasant picture, but—our executive has not been able to find enough qualified engineers on today's labor market to meet his company's requirements. He can still take up some slack in his own organization, for about thirty per cent of his engineers are spending more than a quarter of their time on non-engineering tasks, and there are many who are ringing up a much higher percentage of time on clerical and sub-professional duties. But there is not enough leeway to solve his problem; he needs help.

THE TYPICAL ENGINEER

Although the engineers surveyed range in age from twenty-one to eighty, the bulk of them were chosen from the lower age group because it is the younger men whom industry now seeks to attract . . . and hold.

Our typical engineer, therefore, is thirty-five years old, has been an engineer for nine years (with time out for military service), and has worked for his present employer, a large manufacturing company, for six years. He is one of more than two hundred members of the firm's engineering force; he does most of his work in an office, but gets into the field occasionally, and he supervises five other persons.

He is not a "drifter"—he wants to stay with his firm. He likes his work, but he is inclined to be unhappy about his salary and his chances of advancement. He does not know quite how he stands with his company, and he feels it is not making as effective use of his training and abilities as it could. He is employing only a part of his working day on purely engineering tasks, and he likes it that way . . . but he wants recognition as a professional and does not think he is getting it to the degree he should.

THEY ANSWERED FRANKLY

Complete and frank responses to the survey questions were elicited from both groups because the Conference Board granted them complete anonymity where they desired it.

Permission to quote was asked of the executives, and in many cases it was granted, but where such explicit permission was not given, the replies were treated confidentially.

In the case of the engineers, the questionnaire bore no identifying signatures or other marks, so the employee was protected completely and could answer freely many questions to which he might not otherwise have responded for fear of reprisals or other unpleasantness.

As a result, the report following

represents a true and comprehensive cross-section of the opinions of both groups — opinions which, at first glance, often seem to diverge sharply but which, on analysis, appear to be reconcilable with some not-too-drastic modification of personnel relations techniques.

THE RAW MATERIAL

Are graduates properly prepared?

- Most employers say they aren't
- Scientific background good . . . but
- They need the humanities, English

Preparation brings contentment

- Poorly trained engineers unhappy
- They know it, but can they say it?
- Social adaptability

What can industry do?

- Participation in curriculum-making
- Industry executives as teachers
- Orientation after employment

THAT THE BUSINESS of keeping engineers happy and contented in an employee capacity should properly begin in the schools is indicated clearly by the survey results. That the schools are not now doing their part to a maximum extent is indicated just as clearly.

On that point, both management representatives and engineer-employees are agreed . . . emphatically.

Eighty-eight per cent of the executives felt that the engineering schools are turning out graduates with an adequate background of knowledge of scientific fundamentals, but a majority (62 per cent) felt that these newcomers to the engineering ranks were sorely deficient in other areas of study.

INADEQUATE TRAINING?

The engineers themselves indicated a recognition of that deficiency. Twenty-eight per cent of those who replied said they did not feel that their collegiate training prepared them adequately for a career in engineering, and most of those indicated a need for "more work in English, the social sciences and business administration."

The importance of this feeling of lack of adequate preparation as a factor in their subsequent adjustment as employees was emphasized by the fact that this group made up the bulk of those who expressed dissatisfaction with their lot in industry, particularly as regards their prospects of future advancement.

Thirty-four per cent of the engineer respondents indicated they were not satisfied with their prospects at their current places of employment, and into that group fell 90 per cent of those who felt inadequately prepared academically.

This would seem to indicate a vineyard in which industry's management might work with considerable profit to itself, as well as to the schools and to the engineering profession.

In considering the comments made above, it might be well to remember that the correlation between the criticism and the dissatisfaction may also have a correlation with the attitudes of the individuals.

MORE ENGLISH NEEDED

English stood high in the list of the subjects on which the executives felt more emphasis should be laid by the colleges.

"We are getting too many young men whose narrow training fits them for nothing better than technicians' jobs," said one. "They know the engineering principles thoroughly. They can analyze a problem and come up with the right solution. But they do not know how to put their ideas into words, either orally or on paper.

"Such a man can be valuable in a subordinate capacity, but he isn't going very far, in the long run, and it usually doesn't take him long to discover his own inadequacy, and to resent it. And, unfortunately, he frequently directs that resentment toward his superiors or his fellow workers, and the first thing you know, we have a morale problem."

EDUCATION vs. TRAINING

The criticism was echoed time after time in the questionnaires, and from management representatives who were interviewed in person. "More English," they said, "more humanities, more economics and business administration."

"Too many of our engineering schools," said William J. MacReynolds, vice president for industrial relations of the Philadelphia Transportation Company, "have become so over-specialized as to be not much better than trade schools.

"The so-called 'streamlined' curriculums will produce researchers and contractors, but they will not give to the graduate the well-rounded background without which he cannot hope to progress very far up the professional ladder.

"This, in my experience, does not make for a happy or well adjusted employee."

McReynolds, who is himself an engineer, feels that industry should maintain a closer liaison with the colleges and assist faculty and administrators in the preparation of curriculums which will produce the kind of graduates industry wants.

FULL TIME JOB

"We're all very much interested in the schools every spring, a few months before a new batch of graduates is turned out and made available to industry, but we ought to be interested for 12 months every year.

"The colleges are the factories which produce our raw material, and if we don't draw up specifications, we have nobody to blame but ourselves if we get an inferior product."

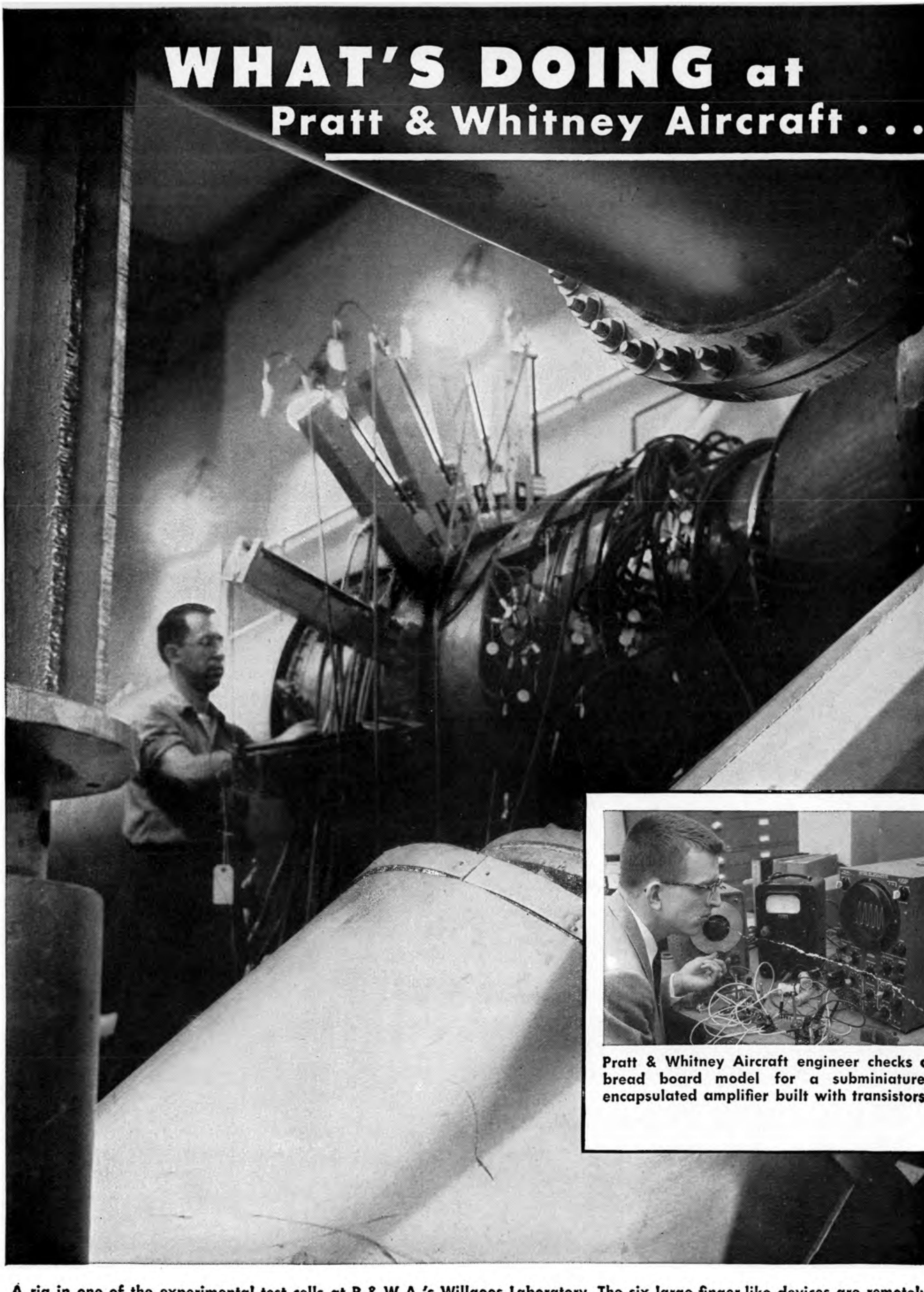
Said Paul J. Grogan, chairman of extension engineering at the University of Wisconsin, Madison:

"If the degree requirements contained more of the elements of scholarly ability other than vocational aptitudes, a new professional spirit would develop naturally."

He feels that the recent crops of engineering graduates are lacking not only on the cultural side but also in "both a thorough knowledge of engineering fundamentals and in professional attitudes." He would

(*Cont'd on page* 44)

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



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

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

...in the field of INSTRUMENTATION

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

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

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

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

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

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

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

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SOCIETY NEWS

GENE JOHNSON, Ag.E. '57

ENGINEER'S CLUB

The first meeting of the 1956-57 school year of the Engineer's Club was held in room 201 of the Student Union on October 2nd. Membership at the time of the meeting totaled 159.

The speaker for the evening, Dean Croft, talked to the club about enrollment in Engine School, plans for improvement and expansion of facilities of the Engine School, and Engineering placement.

The club voted to have a semi-formal Fall Dance and set the admission price at $1.00 per couple. Fred Alexander was appointed chairman of the committee to make arrangements for the dance. Another committee was appointed to repaint the Shamrock in the sidewalk North of the Engine Building.

Officers for the school year are Jim Buell, president; Francis Martin, vice-president; Roy Wagner, chairman of St. Pat's Board; Roger Pape, secretary; Paul Baumgardner, treasurer; Gordon Brunkhorst, business manager; Don Kay Kirby, secretary of St. Pat's Board; Dr. Luebbers and Dr. Hogan, faculty advisors.

Dr. Hogan will give a talk about the Network Analyzer recently acquired by the EE department. He will speak at the November 13 meeting. On December 4, Mr. John Raffone from the General Electric Co. will give a talk entitled "Technical Writing."

Officers of the combined societies are chairman, Bill Nichols; vice-chairman, Bill Barber; treasurer, Jack Shultz; recording secretary, Roger Pape; A I E E secretary, Charles Butler; IRE secretary, Jim Fitzgerald.

CHI EPSILON

Officers of Chi Epsilon, the national honorary Civil Engineering fraternity, are president, Jack Moberly; vice president, Susan Brady; secretary, John Creal; treasurer, Bob Angerer, associate editor, Bob Farmer; faculty advisor, Professor Karl Evans.

The first meeting was held Wednesday, October 24 in the Engineering Building. A list of students eligible for membership was reviewed and it was decided to invite them to a smoker within two weeks after the first meeting before asking them to join. Chi Epsilon plans to have an initiation sometime near the last week in November.

One of the main projects of Chi Epsilon, besides their professional activities, is to take the guest speakers of the ASCE meetings out to dinner before the meeting. Chi Epsilon works with ASCE on many activities, including Engine Week exhibits.

ASCE

The University of Missouri Student Chapter of the American Society of Civil Engineers held its first meeting of the new school year on October 23. President John Endebrock introduced the following officers of the organization for 1956-57: vice-president, Willis Graven; secretary, Earl Holtgraewe; treasurer, John Trost. Professor Wm. Sangster is the faculty advisor.

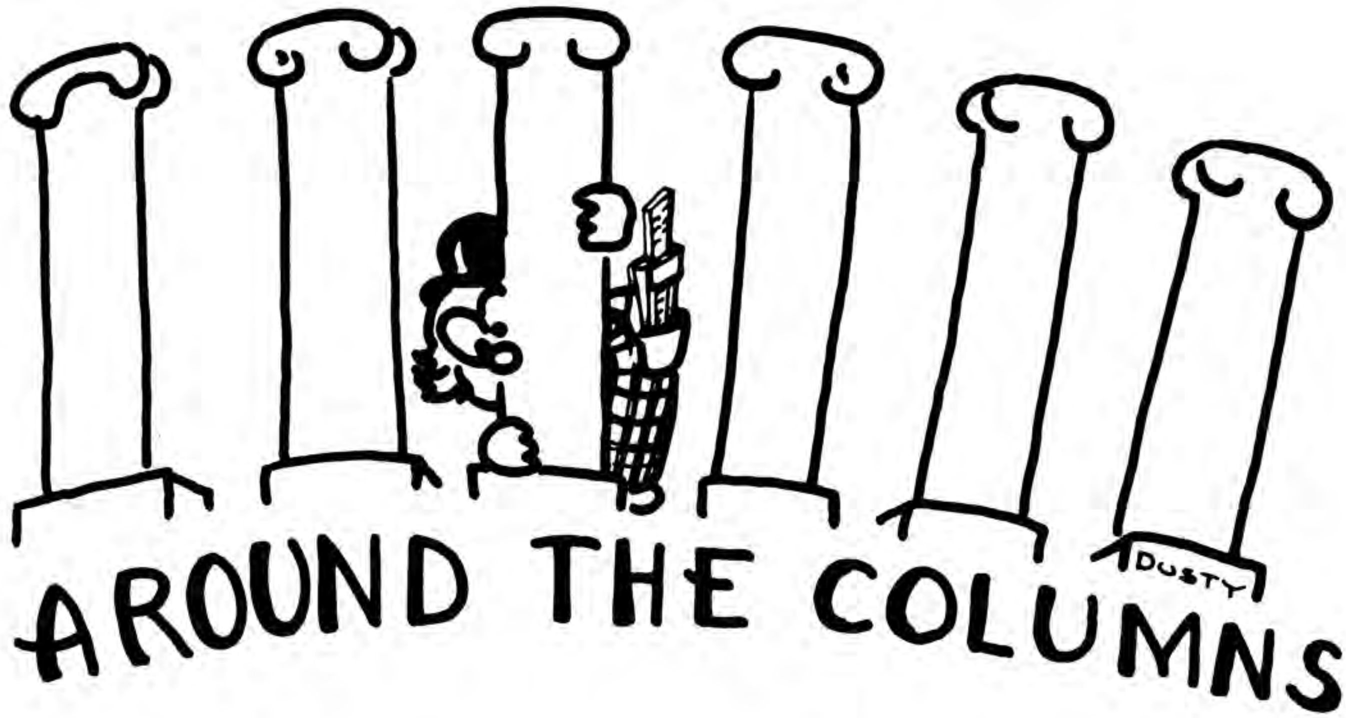
The Program Chairman, Bill Presson, introduced Professor Karl Evans of the Civil Engineering department. Professor Evans showed slides of his experiences in India during the past year. His account of the higher education system in India was especially interesting.

It is the custom of the A.S.C.E. to display their chapter flag several days previous to meetings. This flag is hung in the main hall of the Civil Engineering Building. The next meeting of the A.S.C.E. is on Thursday, November 29. The program will be "General Aspects of Engineering in the Petroleum Industry", presented by the Tidewater Oil Company.

ASME

The M.U. student branch of the American Society of Mechanical Engineers started off the year in a great way. The first meeting, held on October 9, was a smoker with free cigarettes and entertainment. The entertainment was furnished by the members of the Gamma Phi Beta sorority. The girls gave a skit entitled "St. Pat for President". The girls stayed around to chat, etc. with the A.S.M.E. members and guests after the skit. Membership in the

(*Cont'd on page* 32)



JOE WOLF, M.E. '58

ESPRIT DE CORPS

As some of you may have heard, Phi Sigma Delta, a social fraternity at Mizzou, is sponsoring a Pep Trophy this year, mainly for the purpose of raising the spirit of the campus and the University of Missouri in general. The engineers in particular could stand to have greater enthusiasm and pep on more days of the school year, rather than just during Engine Week. We should be happy, if for no other reason than that we are going to become engineers (I hear it's not a bad profession). By just looking happy and being cheerful, we will not only feel better ourselves, but at the same time, we will be adding liveliness and pep to everyone we see and to the Engineering School as a whole.

SOCIETY OF WOMEN ENGINEERS

On October 23, 1956, a new and quite different engineering society was organized at the University of Missouri, a student chapter of the Society of Women Engineers (SWE).

SWE is the national professional organization of graduate women engineers and women with equivalent engineering experience. Women enrolled in an accredited engineering college are eligible for student memberships.

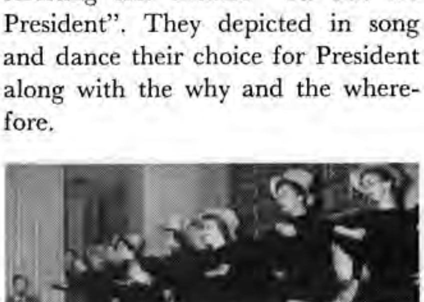
Five women students from the University of Missouri College of Engineering attended the meeting along with eleven regular SWE members. Dean Huber O. Croft of the College of Engineering also was present.

The five women students were Letsy Mae Amidei, Ann Blaser, Susan Brady, Beverly Gamble, and Eleanore Schroeder. Other women students enrolled in the College of Engineering are Charlene Korando, Patricia Ann Donaldson (who is already a member of SWE), Betty Gollahon, Barbara Lamb, and Marie Ann Rabyer.

Miss Brady was chosen chairman of the University chapter, Miss Schroeder, vice-chairman, and Miss Korando, secretary.

GAMMA PHI'S FOR ST. PAT

The first meeting of the American Society of Mechanical Engineers in October was highlighted by Gamma Phi Beta Sorority with their presentation of a very amusing and interesting skit entitled "St. Pat for President". They depicted in song and dance their choice for President along with the why and the wherefore.



The co-chairmen and originators of the skit were Genie Phog and Kathie Hinkley. Carol Camp accompanied them on the piano.

The following talented Gamma Phi's participated in the presentation: Nancy Hanna, Phyllis Elle-

(Cont'd on page 32)

AROUND THE COLUMNS

(*Cont'd from page* 30)

bracht, Judy Whitesides, Nora Ann Baldwin, Connie Claiborne, Kathie Hinkley, Barbara Marshall, Barbara Craig, Vera Eiler, Anita Sellenschutter, Margot Engle, Sylvia Johnston, and Jaireen Anderson.

The skit was thoroughly enjoyed by all who attended the meeting and as the Gamma Phi's are for St. Pat, the engineers are for the Gamma Phi's.

AIR AND WATER POLLUTION CONFERENCE

A State Conference on Air and Water Pollution will be held at the University of Missouri on November 29, the second such conference here to study problems of contamination menacing public health, sponsored by the College of Engineering, in cooperation with the State Division of Health. Dr. Lindon J. Murphy, professor of civil engineering and widely recognized authority on sanitary engineering will be directing the program. All sessions will be held in the Memorial Student Union.

Dr. Murphy said the departments of civil and chemical engineering are cooperating with governmental and industrial organizations to bring the best possible program presenting latest developments in treating wastes and abating pollution.

The program committee will present outstanding speakers from Federal, state, and municipal government, from large industrial firms and oil companies, and from engineering consultants, to lead discussions concerning the principal problems of air and water pollution and their possible solutions.

Topics for discussion will include; Direct Federal aid for abatement of water pollution, reducing wastes at the source, handling oil refinery wastes, research in treatment of industrial wastes, present status of legislation on water pollution control, spray irrigation of milk plant wastes, use of lagoons for industrial waste treatment, the contribution of exhaust gases to atmosphere pollution,

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SOCIETY NEWS

(*Cont'd from page* 28)

student branch is open to all undergraduates enrolled in Mechanical Engineering.

Four faculty members were introduced at the first meeting; Professors M. M. Bolstad and C. M. Sneed, and two new instructors, C. J. Kessler and F. D. Harris.

The A.S.M.E. usually meets once a month. The second meeting is scheduled for November 13. No definite date has been set for the December meeting, but something good is promised for that month, possibly another skit.

The society officers are chairman, Ed Duke; vice-chairman, Robert McCann; treasurer, Jim Wilhelm; secretary, Tom Harper; advisor, Dr. Ralph A. Burton.

About 52 new members were signed up at the October meeting.

A.S.A.E.

Officers for the M.U. student branch of the American Society of Agricultural Engineers during the Fall semester of 1956 are president, John Arms; vice-president, Bill Delaney; secretary, David Blinne; treasurer, Leroy Hahn; and scribe, Glen Thompson. The faculty advisors, who were elected at this year's first meeting are Prof. Donald B. Brooker, and Mr. R. Bruce Curry.

Meetings are held the second and fourth Tuesdays of each month at 7:15 p.m. in room 103 of building T-12. Regular membership is open to undergraduate students enrolled in the curriculum for a professional degree in Agricultural Engineering. Associate memberships are open to all undergraduates interested in the field.

There were two meetings in October. On October 9, Dean Croft showed slides of his recent trip to Mexico. In his remarks he told of the great advances made by Mexico during the last twenty years. The chapter decided at this meeting to have a party on November 2. The party featured a square dance and a student-faculty apple-ducking contest. The faculty won.

The speaker for the October 23rd meeting was Mr. Paul N. Doll, a member of the Executive Committee of the Missouri Society for Professional Engineering. Mr. Doll spoke on the advantages of Professional Engineering and about the various phases of Agricultural Engineering. He also gave a reminder that the Engineer-in-Training examinations will be given at M.U. on April 27, 1957.

A.I.E.E.-I.R.E.

The first meeting for the school year of the combined student branch of the American Institute of Electrical Engineers and Institute of Radio Engineers was held October 9th. Chairman Nichols explained the organization of the society and outlined the tentative program for the semester. Dr. Wallis made a few comments on the national societies and introduced the faculty members present.

The speaker for the evening was Mr. Roger Lewis of Weston Electrical Instrument Corp. His talk, entitled "The Instrument Story", was accompanied by a display of instruments and instrument components.

On October 18, Mr. David Hargis from Southwestern Bell Telephone Co. presented a discussion of "The Bell Transistor". Mr. Hargis brought with him an interesting display of numerous devices such as a transistor radio and a solar battery.

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ELECTRONICS FOR LIVING

ANALYZER

(Cont'd from page 19)

equipment went to the Westinghouse Electric Company in February of 1955, and parts of it began arriving for installation early this summer. In the meantime, a suite of three rooms in the new Engineering Laboratories were remodeled to house the equipment, including installation of air conditioning and special indirect lighting fixtures.

Actual installation of the equipment has been under direction of Dr. Joseph C. Hogan, associate professor of electrical engineering at the University, and James R. Tudor, assistant professor of electrical engineering. They have been assisted in the work by seniors in electrical engineering, and two of these students will remain as graduate assistants to serve as operating personnel.

Profs. Hogan and Tudor estimate the cost of the analyzer installed at more than $200,000.

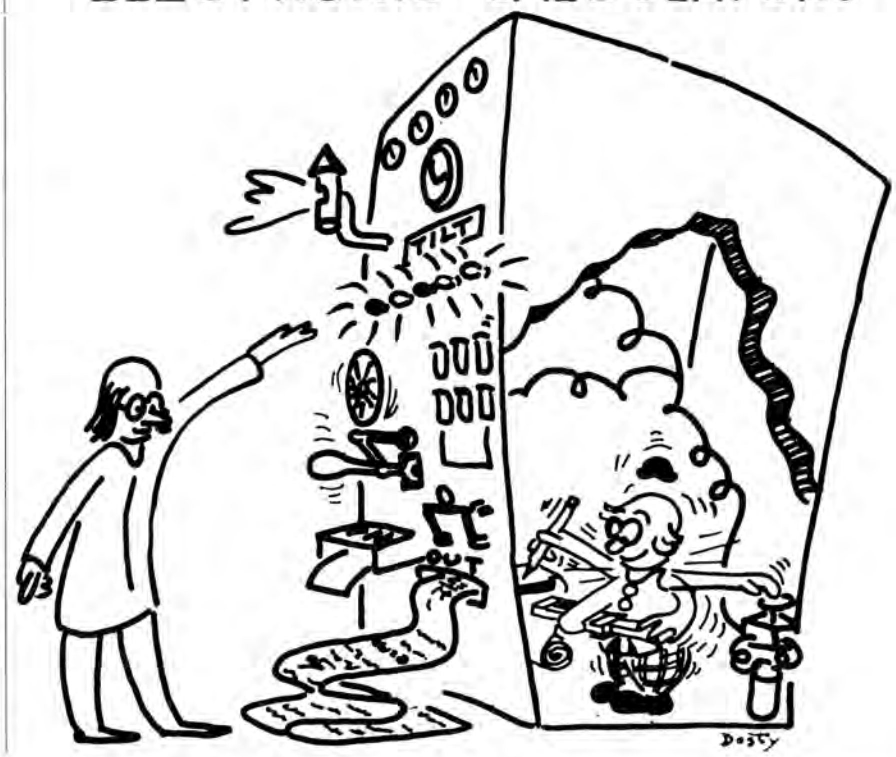
Only eight other universities have one of these commercially built devices. They are: Purdue, Illinois Institute of Technology, Georgia Tech, Texas A. & M. College, University of California at Los Angeles, Syracuse, Cornell, and Wisconsin universities.

Both Dean Croft and Dr. C. M. Wallis, chairman of the department of electrical engineering, emphasize that the network analyzer will be utilized primarily in teaching and research for specific benefit of students in engineering. The University's contract with participating and contributing corporations specifies that the University will use it exclusively in teaching for a minimum of nine weeks each year, and that it will be available to industrial companies on a schedule-in-advance basis.

They also point out, however, that even when the analyzer is being used by one of the utility companies, those operations may be observed by engineering students, and

(Cont'd on page 40)

PRESENTING M.U.'s LATEST IN ELECTRONIC CALCULATORS



Mizzou Memos

ELLIOT PUCKER, E.E. '58

This month's career sketch is of Cramer W. LaPierre recently elected vice president of the General Electric Company.

Mr. LaPierre has over-all responsibility for the Electronic, Atomic and Defense Systems Group. His headquarters are in New York City.

Under Mr. LaPierre's jurisdiction as a member of the Company's executive office are the Electronics division, which produces a wide range of defense and industrial electronics systems and components; the Aircraft Gas Turbine Division, which is a principal supplier of aircraft engines; and the Atomic Products Division, which includes General Electric's military atomic work as well as the promising peace-time energy activities.

A native of Jackson, Mo., Mr. LaPierre attended the University of Missouri's School of Engineering, following which he joined the staff of the General Electric Engineering and Consulting Laboratory at Schenectady, N. Y., in 1924.

In 1936, Mr. LaPierre was placed in charge of the electro-mechanical division of the laboratory, and a year later received his Company's highest honor, the Charles A. Coffin award.

In May, 1949, Mr. LaPierre became assistant general manager of the Aircraft Gas Turbine Division. In November, 1949, he was named general manager. In this position he had responsibility for the establishment of General Electric's massive aircraft engine production facilities at Evendale, Ohio.

In December, 1952, Mr. LaPierre was elected a vice president of the Company by the Board of Directors. In November, 1954, he was appointed to head up General Electric defense activities as group vice president in charge of the Atomic Energy and Defense Products Group, which, in November, 1955, was reformed and redesignated the Electronics, Atomic, and Defense Systems Group.

Mr. LaPierre is a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the Society of Automotive Engineers, the Institute of Aeronautical Sciences, and Eta Kappa Nu.

Jeanette A. Livasy, Che.E. '47 has become a member of the research department of Monsanto Chemical Company's Organic Chemical Division. She has been employed for the last three years in engineering production for the Mallinckrodt Chemical Works, St. Louis. Her present address is 3803 Manola St., St. Louis.

William C. Bluhm, M.E. '47 is with Shell Oil Company as an engineer. His current address is 460 California Ave., East Alton, Ill.

Allen W. Fore, C.E. '32 is now a Civil Engineer for the Secretary of Defense. His current address is room 3D754 Pentagon, Washington 25, D.C.

Warren H. Moore, E.E. '20 is now in Sales Engineering. His current address is 19815 Battersea Blvd., Rocky River 16, Ohio.

James W. Bartley, M.E. '49 is an engineer in Process Development Engineering, United States Rubber Company. 1316 Newport, Detroit 15, Michigan is his address.

Ira A. Cohn, M.E. '44 is a sales engineer for Schwarz and Cohn, Inc. of Brooklyn, N. Y.

Arthur H. Lippitt, M.S., Che. E., '41 is at present the Chief Process Engineer at Beech Aircraft Corporation. He has been employed there since 1942 and is at present in charge of the Chemical and Metallurgical and Process Laboratories with approximately fifteen technical people under his supervision. Prior to coming to Beech, Mr. Lippitt spent nine months with TVA.

N. J. Pfeiffer, M.E. '43 is working as a design Engineer at Beech Aircraft where he has been since March, 1953. Prior to coming to Wichita, Mr. Pfeiffer was employed as a design Engineer for the Harper Engineering Company of Dallas, Texas. At the present time, he is directing the design of a group of subordinate engineers on the canopy and operating sections of Beech's new Model 73 Jet Trainer.

Leigh S. Icke, E.E. '30, is at present a Staff Assistant in the Production Administration Department at Beech Aircraft. Mr. Icke had numerous duties since his original employment at Beech and has worked with the Industrial Engineering and the Manufacturing sections.

Walter J. Britton, M.A., I.E., '38 is at present a Mechanical Technician in the Outside Production Department of Beech Aircraft. Mr. Britton has been with Beechcraft since February, 1952.

Roger L. Boggs, E.E. '48, is field research engineer of the Caterpillar Tractor Company, Peoria, Illinois, and lives at 106 West Ridge Road, Valley View, Washington, Illinois. He was transferred to Birmingham, Alabama to be resident engineer for that section in September, 1954, but he contracted polio that month and was hospitalized for six months. He is now able to walk with the aid of braces and crutches and has been returned to the main offices. He tells us that he recently saw E.M. Wilson, M.E. '47 and Paul Poynor, M.E. '51, recently returned from the Navy, in Baltimore, Md. They are also associated with Caterpillar.

William R. McMillan, . . . '25, has been named to the position of superintendent of distribution by the Union Electric Company of Missouri. Employed in 1923 as a temporary student engineer, he was promoted to assistant superintendent of distribution a year ago. His current address is 24 Thorndell Dr., Richmond Heights, Mo.

Eugene J. McNeely, E.E. '22 has been appointed executive vice-president of the American Telephone and Telegraph Company, a post which puts him next in command to Cleo F. Craig, . . . '13, the president. He will assist the president in a business which employs 700,000 persons, furnishes 45 million telephones, and has 1,375,000 stockholders.

Chris H. Kraft, E.E. '14, formerly superintendent of transmission and distribution, has been appointed vice-president, production and distribution, Union Electric Company of Missouri. He has been with the company for more than forty years. In his new position Kraft will act as an adviser and consultant in major problems of engineering and organization development. He is a past president of the St. Louis Engineers' Club. His current address is 434 N. Harrison Ave., Kirkwood, Mo.

George S. Huddleston, Eng. '23 is now a civil engineer. His current address is 27 North Union St., Arlington 74, Mass.

Willard L. Irwin, Eng. '28 has been named Works Manager for Poinsett Lumber & Manufacturing Company at Pickens, S. C. He first came to the Pickens plant in 1940. Mr. Irwin was born in Pennsylvania and grew up in Trumann, Ark. where he worked in the engineering department of the Trumann Works during summer vacations from high school and college. Except for five years with General Electric after graduation, his career has been with the Poinsett firm. The plant journal, commenting on his promotion said "In the opinion of a vast majority of employees, few other people could have filled the place." He and his wife live on Baker Street in Pickens.

Introducing—

BLARNEY O'TOOLE

John Thomas Kemper, E.E. '40 is listed in the international edition of "Who's Who in Commerce and Industry," in "Who's Who in the East," and in "Who's Who in New England." He is New England branch manager for the Wagner Electric Corp., and lives on Rich Valley Road, Wayland, Mass.

Elmo E. Crump, E.E. '40 and his wife toured Europe last summer accompanied by their seven children, whose ages are 13, 8, 7, 6, 4, 2, and 1. They used a Volkswagon Muro bus. Sailing on the Queen Elizabeth August 3, they covered France, Spain, Italy, England, Belgium, Germany, Switzerland and returned September 22 on the Carolina. Crump is part owner of the Kay Electric Company at Pine Brook, N. J. and they live at 29 Grover Lane, West Caldwell, N. J.

AROUND THE COLUMNS

(*Cont'd from page* 32)

and reduction of air pollution by industry.

There will be no registration fee for attendance at the conference, and that representatives of all private and public organizations, industries, and health and welfare agencies, and all interested individuals are invited to attend the sessions.

brains regulating processes better than could be done by human hands or judgement. Honeywell instruments, for instance, are presently in use on every U. S. atomic reactor. Instrumentation holds sweeping potentialities as industry becomes increasingly complex and as automation is applied to more and more of its processes. Typical industrial products include indicating, recording and control types of potentiometers, pyrometers, pressure gauges, industrial thermometers and flow meters, electronic control panels, and thousands of other devices.

3. Aeronautical controls: In addition to extensive research, engineering and manufacturing facilities in Minneapolis, another complete plant is being built in St. Petersburg, Florida, expressly for the development and manufacture of inertial guidance systems. There is also a complete Engineering Development Center for aircraft and missile controls in West Los Angeles. Some challenging engineering interests include automatic flight control systems; hydraulic and pneumatic jet, ram jet, and rocket engine controls; instrumentation; and airborne digital and analog computers. Honeywell is a major supplier of automatic pilots, bombing systems, gyroscopes, and integrated weapons systems for aircraft and guided missiles. The Honeywell electronic fuel-measuring system is the standard of the industry, and Honeywell leads in developing transistorized instruments for aircraft.

4. Precision switches: Engineering and manufacturing in Freeport, Illinois; with additional plants in Warren, Illinois and Independence, Iowa; plus research facilities in Denver. Honeywell's 5000 variations of electrical MICRO SWITCH snap-action and mercury switches are used in countless ways. They permit a slight motion or a small physical force to control an electric motor or current. They are particularly useful where space or weight limitations are important—as in aircraft, missiles and rockets, automatic machine tools, dictating machines, and automatic transmissions for automobiles.

5. Ordnance: Engineering and manufacturing in Minneapolis; a complete new Engineering Development Center for missiles in Monrovia, California; and engineering laboratory facilities in Seattle, Washington. In this Division a great many vital defense products and systems—such as complete missiles and components, fire-control systems, and proximity fuzes are produced.

6. Servo components: Honeywell engineering and manufacturing plants in Boston produce precision synchro motors, gyroscopic instruments, and electro-mechanical servo components for standard use in jet fighters, guided missiles, and bombers. The newest development is a vital control device for the automation of manufacturing processes.

7. Oscillographic and Photographic equipment: The Honeywell plant in Denver produces high speed recording oscillographs, scientific laboratory equipment, and a complete line of Heiland photographic flash equipment.

8. Transistors: The Boston plant develops and manufactures high-output power-type transistors.

9. Research: In a complete Research Center in Hopkins, a suburb of Minneapolis, emphasis placed on fundamentals has led to comprehensive basic research programs in the fields of: solid state physics, metallurgy, ceramics, magnetic and dielectric materials, physical chemistry, electronics, heat transfer, and mechanics. Honeywell is continuing its steadily increasing expenditure for fundamental research.

AT HONEYWELL YOU WILL FIND ADVANCEMENT OPPORTUNITIES IN TECHNICAL AND MANAGEMENT FIELDS:

Research—Development—Production: One of Honeywell's great strengths is the specialized engineering knowledge we can concentrate upon each of many highly technical operations and products. A consistently growing investment in research and engineering projects has in the postwar period increased at a rate almost double that of sales increase. The aggressive policy of "engineering for tomorrow while producing for today" means one out of every ten Honeywell employees is engaged in some phase of our engineering activities.

Almost every type of technical college training can be utilized to advance the art of automatic control. Engineers, scientists, chemists, physicists, metallurgists, and sales engineers are particularly needed. You should possess an intellectual curiosity that compels you to think into and through and around a problem. Yet you should have something more: the faculty of working in close cooperation with fellow engineers on common problems.

Whatever scientific or engineering activity you choose at Honeywell . . . research, design, development, manufacturing, application, or sales . . . you will enjoy the satisfaction of knowing that you are vital to an organization whose growth has helped lead and will continue to lead our country's technical advancement.

Engineering Sales: Honeywell has a great need for the man who likes and wants to sell . . . who is able to find new product applications and expand markets . . . and who can cultivate those markets with consistent energy. You will receive up to five months of special training in one of Honeywell's well-equipped and expertly staffed divisional sales schools.

Honeywell's Training Program: Training at Honeywell is handled in various ways: organized programs for "Learning By Doing"; formal classes during and after working hours; orientation and development programs tailored to individual requirements; and outside study programs, on both undergraduate and graduate levels, with the Company sharing your tuition costs. Honeywell's various locations furnish access to the nation's best technical schools.

NOW, LET US HEAR FROM YOU!

If you would like to know more about the opportunities for you at Honeywell, contact your College Placement Office. Or please write directly to H. T. Eckstrom, Personnel Administrator, (Dept. C56), Minneapolis 8, Minn.

MINNEAPOLIS
Honeywell
First in Controls

URANIUM

(*Cont'd from page* 17)

mineral from its ore. Hundreds of tons of ore must be processed daily for each ton yields only a few pounds of uranium.

At the mill, the ore is weighed and then dumped into receiving bins. It is crushed and screened to small-sized particles in preparation for treatment.

The extraction of as few as two or three parts of uranium from a thousand parts of ore is not an easy job. First step is to add chemical reagents, such as salt. The ore is then fed into huge roasters, several stories high. After the roasting operation, it is treated in large wooden leaching tanks. In the leaching process acid is added to separate the valuable mineral from the other solids present, the final result being a uranium compound in solution. In further processing operations a compound is produced which is precipitated. Then in long filter presses the liquid is squeezed out—leaving behind a bright, clay-like material

(*Cont'd on page* 50)

ANALYZER

(*Cont'd from page* 34)

will certainly be of inestimable value as practical problems being studied and solved.

Dean Croft also notes that operation of the analyzer will promote close relationships between engineers in industry, members of the University faculty, and students in the College of Engineering. Both undergraduates and graduate students will have the opportunity to become closer acquainted with the practical problems of power transmission and modern methods of their solution, he said, and the interchange of ideas between practicing engineers, faculty and students will stimulate more interest in the power field among students and will foster discussion of important problems of mutual benefit to all.

Both the dean and Dr. Hogan also point proudly to the fact that both private and rural cooperative utility companies are working together in sponsorship and financing of the program, indicating that they are placing public responsibility and aid to education far ahead of any competitive business.

According to Prof. Hogan, use of the analyzer will not be confined to the contributing companies and the University. It will be available whenever the schedule permits to engineers of companies throughout the Mid-west.

Engineering and utility companies will pay a fee of $125 a day for the analyzer service.

To the average layman, the network analyzer itself, built in Room 77 of the Engineering Laboratories Building, might resemble a control room of a modern electric plant or a television station. Three walls of the room are occupied by orderly panels of dials, meters, control switches, connection receptacles, and colored lights.

The control "board," occupies the center of the room, and it is here that the operating engineers sit when a problem is being placed in the machine. One section of the board is a plotting table, with 400 electric connections to simulate the power system. The other section contains the necessary master controls, meters, and dials for reading results.

There are a number of panels of connection plugs, or "jacks," and receptacles resembling the old type telephone switchboard, and these contain more than 600 plugs and 1500 receptacles, providing for thousands of possible combinations of inter-connections in the system. The entire electronic system is so delicately balanced that there are compensations for such slight loss in the computers as the tiny dials and meters, thus preventing even that element of error in the machine's computations.

The suite in which the analyzer is housed includes the instrument and control room, a consultation and blue-print room for engineer conferences and study, and an office for the supervisors and personnel. The special lighting fixtures in the instrument room were designed by Prof. Hogan to provide a maximum, shadowless light.

Boeing engineers design America's first jet transport

Pictured above is the full-scale cabin mock-up of the Boeing 707, America's *first* jet transport. In developing this interior, Boeing engineers helped design features and innovations as advanced as the 600-mile-an-hour performance of the aircraft itself.

Pioneering revolutionary new types of aircraft like the 707 is one of the sources of excitement — and satisfaction — that engineers and scientists enjoy at Boeing. This new jet-age transport has already been ordered by 10 major overseas and domestic airlines. These commercial orders, together with Boeing's tremendous backlog of military contracts, mean that this company will continue to expand during the years ahead.

Growth is a Boeing habit. During the past 10 years, for instance, the number of Boeing engineers has increased 400%. Expansion at this rate spells job stability — and plenty of opportunity to move ahead. Boeing promotes from within, and holds merit reviews every six months to give each engineer a *personal* opportunity for recognition, advancement and increased income.

Boeing engineers don't get lost in the crowd. They work in small integrated teams — on such projects, in addition to the 707, as the advanced B-52 and B-47 multi-jet bombers, the BOMARC IM-99 guided missile, the 502 gas turbine, and other developments still under security wraps.

Qualified engineers and scientists of *all* types are needed at Boeing — now. You'll find high starting salaries, and stimulating contact with men outstanding in the world of engineering. Other advantages include liberal insurance and retirement plans, and a choice of modern, young-spirited communities in which to live. Boeing helps arrange special work schedules for engineers taking graduate studies, and pays all tuition and fees. You're missing a bet if you don't at least *find out* how Boeing can help you get ahead in your engineering career.

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

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Company, Seattle 24, Wash.

F. B. WALLACE, Staff Engineer — Personnel
Boeing Airplane Company, Wichita, Kansas

A. J. BERRYMAN — Admin. Engineer
Boeing Airplane Company, Melbourne, Florida

BOEING

Aviation leadership since 1916

Seattle, Washington   Wichita, Kansas   Melbourne, Florida

SURVEY

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like to see "more psychology and human relations" in engineering courses, and "greater stress on really learning fundamentals" (of engineering science).

A PARTIAL SOLUTION

The situation still can be salvaged for those engineer-employees with deficient educational backgrounds, Dr. Paul Grogan feels, if management will encourage them to undertake graduate study, membership in professional societies and the preparation of talks and technical papers. Evening study and leadership activities also were proposed.

These are fields in which industry already has made a small start, as indicated by the answers to the survey questions. Approximately 40 per cent of the firms represented by both executives and employee-engineers encourage participation in professional society activities, and grant reasonable time off without loss of pay for such participation, but other "prestige" activities, such as writing for technical publications, teaching or lecturing on engineering subjects and participation in community affairs receive relatively minor encouragement from management.

About one-fourth of the firms encourage participation in community affairs, but only 16 per cent felt it advantageous to encourage their engineers to write for publication, and less than 11 per cent encourage teaching or lecturing on the part of their professional men.

EXECUTIVES AS TEACHERS

A number of executives, among them, Thomas F. Edson, assistant vice president of the American Potash Corporation, Los Angeles, suggested as another expedient that leaders in industry offer their services to the colleges as instructors in short courses on engineering subjects, and on such non-technical matters as human relations.

"Young engineering graduates," said C. A. Butler, Jr., engineering director of the big Diamond Alkali Company, Painesville, Ohio, "usually are lost when problems arise involving human relations, or ones which must be solved without detailed facts."

"They should be stimulated," he said, "to the development of more imagination and greater curiosity, and taught to place less reliance on text-book data."

R. L. Boyer, engineering vice president of the Cooper-Bessemer Corporation, Mt. Vernon, Ohio, also stressed the importance of "a short course in human relations and professional attitudes."

Several companies, like the Aluminum Company of Canada, Ltd., have sought to remedy the deficiency in the human relations side of engineering training by the establishment of their own training courses. At Alcan, all newly-hired engineering graduates are first given a variety of temporary assignments to familiarize themselves with all phases of the company's operations and then are brought in to the firm's head office in Montreal for a four weeks' course in human relations before they are placed in a regular job.

This type of training is almost a must, many of the executives said, in view of the current trend toward advancement of engineers to executive and advisory capacities where psychology and a thorough-going knowledge of human relations become vastly more important.

ECHO ANSWERS "YES"

Many of the engineers themselves echoed the feeling that many of our colleges operate under concepts much too narrow.

"The training which our young college graduates have received and the technical problems which they have learned to solve," said one, a veteran engineer employed by a large steel company, "are geared to the kind of work which they will not have to perform until they have spent from 15 to 20 years in industry.

"By that time, they have either long forgotten how to solve these highly technical problems or, more likely, the methods used in college have long since become obsolete.

"On the other hand they are not sufficiently trained in the manual dexterity required to make working drawings and they are not even sure enough in simple arithmetic to satisfy the demands of the jobs they actually fill as beginners. Besides being unable to perform what is demanded of them, which makes them very unhappy, they are even

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To the *creative* engineer...

AiResearch two stage lightweight gas turbine compressor provides pneumatic power for aircraft main engine starting and serves as auxiliary power source for a variety of ground and in-flight services.

The rapid scientific advance of our modern civilization is the result of new ideas from creative minds that are focused on the future. Our engineers not only have ideas but have the ability to engineer them into products.

That's why The Garrett Corporation has grown in both size and reputation to leadership in its areas of operation. That's why we are seeking more creative engineers to help us maintain and extend our leadership. If you fall in that category, you'll find working with us fulfilling in stimulation, achievement and financial rewards. In addition, financial assistance and encouragement will help you continue your education in the graduate schools of fine neighboring universities.

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

We are seeking engineers in all categories to help us advance our knowledge in these and other fields. Send resume of education and experience today to: Mr. G. D. Bradley

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SURVEY

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more grieved by not being able to get into the kind of work for which they have trained themselves at great cost of money, time and effort. Dissatisfaction all around!"

Another wrote:

"Industry needs closer liaison with the schools and students during the first years of the college course. Many a student has not learned until his senior year what an engineer actually does, and is repelled by the routine which he did not even know existed."

CONCLUSIONS

Industry could with profit devote more time to the engineering colleges *12 months a year* with a view to helping construct and maintain courses which come closer to a realistic approach to industry's needs.

It could, at small cost, raise the morale of its engineering employees, and stimulate their professional growth and their contentment by encouragement of "prestige" activities such as participation in professional organizations and community affairs, writing for publication, and lecturing or teaching. These activities also could be utilized as a part of the company's public relations program with benefit to all concerned.

Industry leaders could and should participate actively in college programs by promoting and, if need be, teaching short courses designed to give the engineering student a clearer picture of the profession which he plans to make his life's work.

RECRUITING TECHNIQUES

Overselling the college graduate

- Cut-throat competition on the campus
- A too-rosy picture often defeats its own ends
- Things to avoid in recruiting

Successful recruiting techniques

- Money and job security
- The advantage of old line companies
- Opportunities for additional training

"Big business is literally begging fledgling engineers to come to work for it. Hungry scouts from airplane, auto, chemical, oil, utilities and steel companies have been sweeping the nation's campuses, exercising all the salesmanship at their command, in an unprecedented drive to recruit new engineering talent to fill American industry's pitifully sparse ranks, and there is no sign that the insatiable demand will abate."

THAT IS the way a popular magazine* not long ago described the hectic competition which has been going on on the campus for the last two years as the dwindling crops of graduates and the increasing technological complexity of industry widened the gap between supply and demand. Unfortunately, it's true.

IT'S A SELLER'S MARKET

Probably never in history has there been such a scramble on the campus as occurred in the Spring of 1953, when "old grads" and staff recruiters from companies large and small vied with each other to see which could paint the rosiest picture of an engineer's life with his firm.

Manufacturing companies faced with the urgent necessity for early deliveries of complicated defense equipment were desperate for engineering help and as a result, ran the bidding up—well over $350 a month, in most cases, and higher figures in a few isolated cases.

Many companies offered transportation and "expenses" for trips to their plants, hundreds of miles away, for interviews; a Texas manufacturer flew engineer candidates to his plant from all over the United States, and entertained them royally while they were there; and one company was reported to have paid the airline passage of a graduate of a college in New York State to its plant in Colorado—and then sent him by air to Miami so he could participate in an athletic contest there before returning home!

These high-pressure junkets, and the glowing word pictures painted in the "help-wanted" ads, and the siren songs of the recruiters, got results in most cases—but today, only a few months afterward, the benefits to the recruiting companies have all too often proved to be short-lived.

* *Collier's*, October 2, 1953.

BUBBLES WILL BURST

The survey questionnaire circulated to the engineers tells the story. To the question: "Was your first job actually as it was described to you at the time you accepted employment?" 20 per cent answered "no." Most of the members of that group were younger members of the profession who entered it during the high demand of the last few years.

But even more significant:

Nearly all of those who answered "no" today are unhappy in their jobs. They are candidates for "greener pastures," and their companies face the potential added expense of recruiting and training new replacements for them.

Many of them, after months of routine work on a drafting board or in testing, analysis or computation assignments, are bored, and do not feel that their companies are making use of the talents for which there was such frantic bidding only a few months before.

So they themselves, with their answers to the survey questions, indicate all too clearly that such flamboyant recruiting tactics unusually pay off, in the long run, only in the coin of discontent.

Here is the evidence:

Q. Do you feel your company recognizes your professional status?
29 per cent answered "no."

Q. Do you feel your company is making effective use of your training and ability?
38 per cent answered "no."

*Q. Are you satisfied with your present job with respect to five different factors?**
38.6 per cent answered "no" with regard to two or more factors.

* Salary, prospects, nature of work, working conditions, location of work.

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SURVEY

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And each of those "no" groups included most of those who felt they had been "oversold" on their jobs.

$UCCE$$FUL RECRUITING?

There is a large body of personnel people who sum up their most successful recruiting practice in one word: MONEY!

Although there were varying degrees of literary ornamentation, that is the way a large number of the executives, like Walter W. Offner, president of the X-Ray Engineering Company, Mill Valley, Calif., answered the survey question: "What inducements or techniques has your company found most effective in recruiting new engineering employees?"

Most of the engineers themselves seem to disagree with this viewpoint, however, since only 12.3 per cent of those surveyed gave "financial rewards" as a reason for their choice of engineering as a profession. (A majority—73.5 per cent— said they entered the profession because of "engineering aptitudes.")

Answers to other survey questions, however, lead indisputably to the conclusion that the engineer's rate of pay becomes one of the most important factors in keeping him contented, if not *the* most important, after he gets over his apprenticeship and the attendant glamor of entering a new profession.

Although engineers in general today are enjoying the highest rates of pay in history (see *Professional Engineers' Income and Salary Survey**). Forty-five per cent of those surveyed declared themselves dissatisfied with their present salaries, and a majority of the executives questioned said that offers of more money by competing firms constituted the largest single factor in their engineering turnover.

This apparently is true, however, only of the engineer who has been in the profession long enough to have acquired a wife and family, since the younger respondents to the questionnaire — the Engineers-in-Training — in the main were satisfied with their salaries, and, for the most part, with all other factors concerning their jobs.

It would seem, therefore, that money is not quite so important a factor in recruiting as some of the younger and more aggressive companies believe.

The older, established firms seldom have found it necessary to engage in the competitive practice resorted to by a few of the newer, fast-expanding plants which have mushroomed on war contracts and have found themselves facing an ever-growing need for professional help.

STABILITY OF ADVANCEMENT

The stability and the advancement opportunities offered by these older firms bring them the top bracket graduates without any other special inducements, the survey showed. Such firms, therefore, rely generally on standard recruiting practices: newspaper and word-of-mouth advertising, some campus interviews, and referrals by their own employees.

Some do no recruiting whatever.

"They come to *us*," said the industrial relations director of one large eastern manufacturing firm, "and even today, we always have a waiting list long enough to take care of our needs.

"Our reputation for stability and the many professional-growth opportunities we offer the young engineer in the form of training programs and opportunities for expense-paid postgraduate university work bring us the cream of the crop without special salary inducements.

"The able, steady youngsters who look upon their first job as a continuation of their studies; who realize how little they really know, and want to continue learning, are the only kind we want, and that type is willing to pass up the fancy starting salaries in favor of proven opportunities for advancement.

"That is our most successful recruiting technique, if you can call it that."

ADDITIONAL TRAINING ATTRACTIVE

One of the firms which believes in training with a capital "T" spends approximately $5,000,000 a year to operate the equivalent of a graduate school for its young engineers, more than 1,000 of whom enter the course annually.

For 15 months or more before they are given permanent job assignments, these trainees are put through an intensive course of study by a "faculty" of 250 full-time people, with the company supplying textbooks, catalogs and other appurtenances. Trainees are graded just as they are in school.

During this schooling, they also are placed in a succession of job situations so that by the time they have finished the course, they have found the niches in which they will best fit.

DON'T OVERSELL THE JOB

It is probable, however, that as long as the present tight labor supply exists, some companies will continue to bid each other up for the available graduates and to engage in practices which can only make for unhappiness and discontent on the part of the engineer later on.

One thing that should be avoided at all costs, however, is overselling the job.

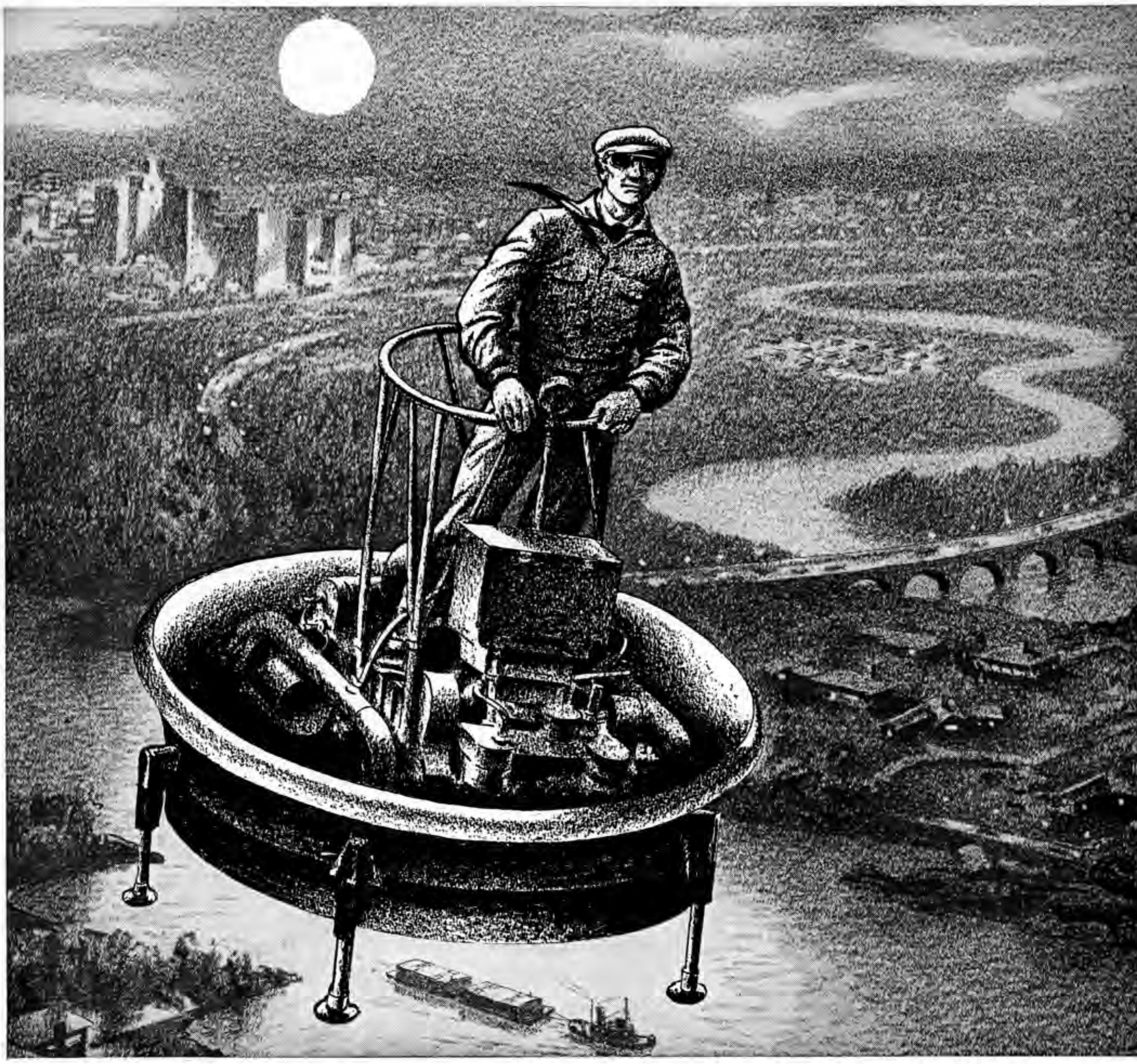
Many companies have found that one of their most successful techniques is the practice of recruiting top students during their junior year and giving them temporary employment during the summer before they reach their senior year.

This not only gives the student a clear conception of the work which will be expected of him after graduation and the company an opportunity to evaluate his capabilities, but it also helps the firm to take some of the load of semi-technical work off the shoulders of its engineering staff and free them for purely engineering work.

But most important, it insures that the graduate knows what he is getting into when he enters industry, and is prepared for the routine

(*Cont'd on page* 50)

* Available from the National Society of Professional Engineers. Single copies, $1.00.



URANIUM

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called "Yellow cake"—the uranium concentrate that is the end product of all the labor of the Plateau. After it dries, it is packed in steel drums for delivery to the Atomic Energy Commission.

The AEC, in keeping with its policy of encouraging private enterprise to develop the country's uranium resources, follows the practice of obtaining uranium ores or concentrates only after they have been mined or processed. And, although the Government wants all the uranium ore that can be found, and will give technical assistance wherever it is needed, it wants the actual work done by the people under a free-enterprise system.

ACKNOWLEDGMENT

The author wishes to express appreciation for the illustrations and use of material contained in the two booklets of the Union Carbide and Carbon Corporation:

"Mesa Miracle", copyright 1952

"The Petrified River", copyright 1956

SURVEY

(*Cont'd from page* 48)

tasks which inevitably must be performed before the young engineer goes on to more important and critical professional assignments.

OTHER RECRUITING ASSETS

In addition to those mentioned above, the companies which participated in the survey found the following to be effective in recruiting:

- A wide variety of work assignments for engineer trainees.
- A true and frank presentation of company policy.
- Work with products of a highly-engineered nature.
- Overtime pay.
- Profit sharing plans.
- Full time recruitment all year-round, with an answer to *every* inquiry.
- Payment of travel and moving expenses for new employees.
- Use of employee-alumni as recruiters in colleges.
- Extensive recreation facilities, including, in some cases, full scale country clubs complete with golf courses and swimming pools.
- Advertising in technical magazines.

CONCLUSIONS

While extravagant salary offers and unorthodox recruiting methods may be effective in producing trainee candidates, such devices in the long run are likely to defeat the desired end because of the let-down after the "honeymoon" is over and the young engineer becomes a relatively unimportant cog in the big industrial wheel.

Job security and opportunity for further training and advancement, with a wide variety of job assignments for beginning engineers, seem to attract the most desirable candidates and to make for contentment after the engineer is absorbed into the organization.

As long as the labor market remains tight, it is probable that the newer and smaller companies will continue to use special inducements over and beyond those customarily granted by the old-time firms.

ABOUT THE CONFERENCE BOARD

The Professional Engineers Conference Board for Industry composed of leading industrial executives was established to inaugurate and guide a program of research on engineer-management problems. This Board, working with officers and staff members of the National Society of Professional Engineers, screens and advises on the contents of research survey questionnaires and on the final reports which result from them.

ABOUT THE COOPERATING SOCIETY

The National Society of Professional Engineers, founded in 1934, is an engineering organization numbering more than 31,000 which devotes its entire effort to the professional, ethical, and social aspects of engineering. Its membership consists of registered, professional engineers engaged in all branches of the profession.

Graduates in engineering, physics, applied math., allied sciences:

You can do much better than a "standard" career today!

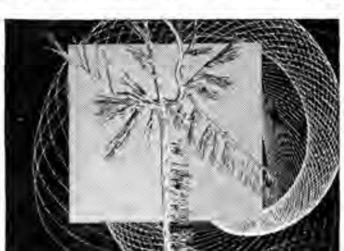
Careers, like cars, come in various models. And nowadays such things as security, adequate compensation, vacations-with-pay are not "extras" any more—they're just "standard equipment"!

MISSILE DEVELOPMENT

As an individual, **you** decide whether you want white wall tires or maybe a sportscar. You should do no less in choosing where you want to work. At North American, fringe benefits are second-to-none; but you can get much more than that. Such extras as creative work, advanced technology, latest facilities to implement your work—these all add up to rewards an ordinary job cannot give. You'll work with men of high professional standing. Your personal contribution will earn quick recognition.

It will be worth your while personally, as well as financially, to find out about the **extras** that go with a position in any of these four pioneering fields.

MISSILE DEVELOPMENT ENGINEERING
The SM-64 Navaho Intercontinental Missile is only one of the projects here. You can well imagine the exacting standards of the work, the quality of the facilities, the caliber of the men. Here you will deal with speeds well up into multiple Mach numbers, encountering phenomena that were only being guessed at a few years ago.



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BULLARNEY

By WHIT

"Beg your pardon, but aren't you an engineering student?"

"No, it's just that I couldn't find my suspenders this morning, my razor blades were gone, and a bus ran over my hat."

♣

The athletic young man was doing push-ups in the park very early one morning. A drunk, weaving his way home, paused to watch him. After a suitable lapse of time, he rambled over and tapped the athlete on the shoulder.

"Shay," he said. "Maybe you don't know it, bub—but your girl's gone home!"

♣

As they say in mechanics: "Every couple has its moments."

♣

Sign on back of truck: "Please don't hug me, I'm going steady."

♣

The Russian school teacher asked a pupil, "Who were the first human beings?"

"Adam and Eve," the kid replied.

"And what nationality were they?"

"Russian, of course."

"Fine, fine," the teacher commented. "And how do you know they were Russian?"

"Easy," said the kid. "They had no roof over their heads, no clothes to wear and only an apple for the two of them—and they called it Paradise!"

A bishop was sitting at a box in an opera house where collegiate commencement exercises were being held. The dresses of the ladies were very decollete. After looking around with an opera glass, one of the ladies exclaimed: "Honestly, bishop, did you ever see anything like it in your life?"

"Never," gravely replied the bishop. "Never, madame, since I was weaned."

♣

A fellow driving his car with the top down was wearing a bright red shirt, a polka-dot tie, a shepherd's plaid suit, and a lavender beret. A motorcycle cop stopped him and made him pull over to the side of the road.

"What's wrong, officer?" asked the lad, "I haven't violated any traffic laws."

"No," said the cop, "I just wanted to hear you talk."

♣

The house guests were assembled with their hosts in the living room after dinner, chatting pleasantly, when the five-year-old daughter of the host appeared suddenly in the room, her clothes dripping with water. She could scarcely articulate, so great was her emotion, and her parents rose in consternation as she entered:

"You—you," the little girl babbled, pointing to one of the male house guests, "You're the one who left the seat up."

♣

Hear about the top man in ag school transferring to K.U.? He raised the I.Q. of both universities.

♣

The demure young bride, her face a mask of winsome innocence slowly walked down the aisle, clinging to the arm of her father. As they reached the platform before the altar, her dainty foot brushed a potted flower, knocking it to the floor. She gazed at the dirt gravely, then raised her childlike eyes to the venerable minister and said, "That's a hell of a place to put a lily."

♣

Parsons: "Every time I kiss you it makes me a better man."

Date: "But do you have to try to get to heaven in one night?"

♣

And the old maid said: "Don't put 'Miss' on my tombstone when I'm gone, for I haven't missed as much as you think I have."

♣

"F-e-e-t," the teacher exclaimed. "What does that spell, Johnny?"

Johnny did not seem to know.

"What is it the cow has four of and I have only two?"

♣

"Damn," said the ram, as he hurtled over the cliff, "I didn't see that U-turn."

♣

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GENERAL ELECTRIC

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SHAMROCK

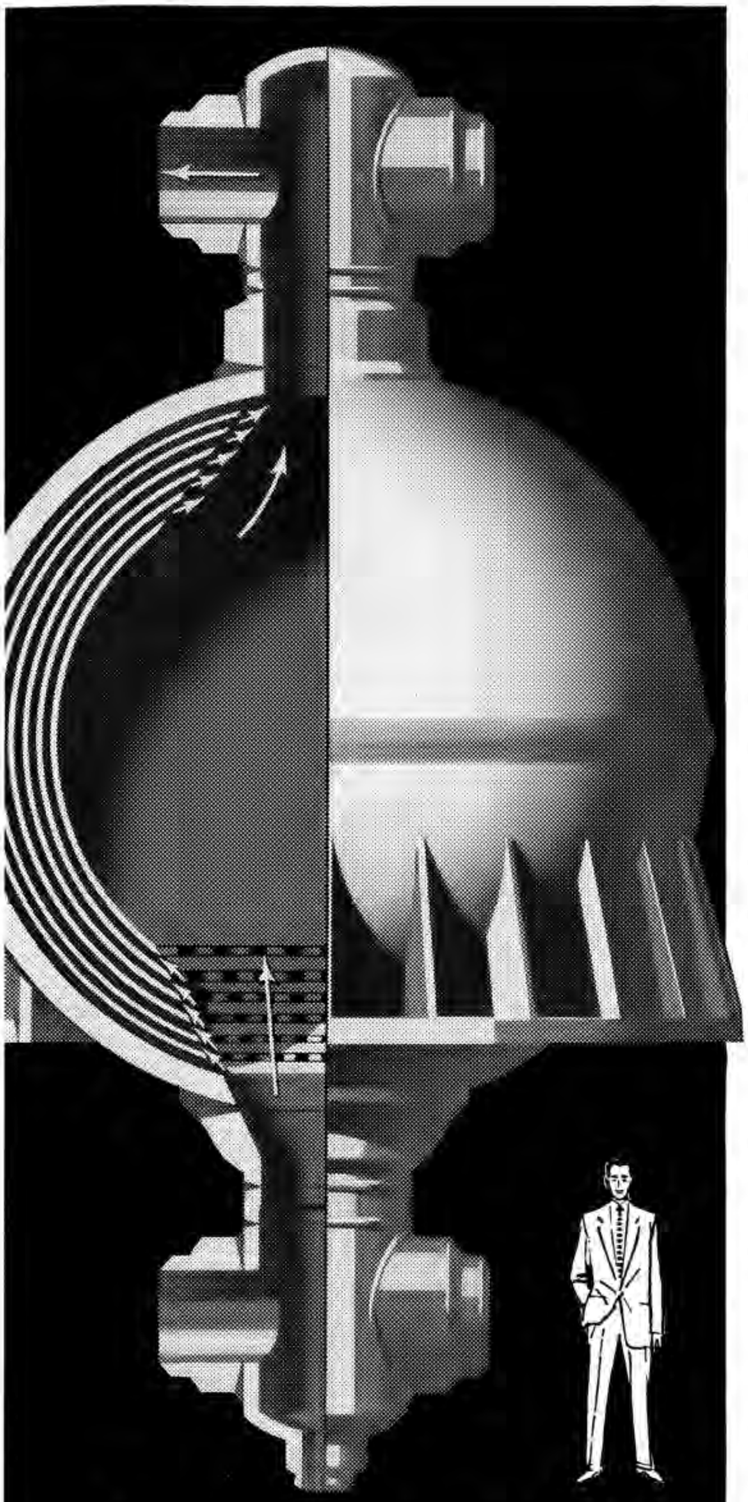
DECEMBER, 1956

FEATURES:

25c

Building the first large liquid-fuel reactor for a utility power plant.

...A PROBLEM IN ATOMIC POWER



Possible design for homogeneous reactor vessel.

The first large homogeneous reactor for a utility power plant is now being designed by Westinghouse engineers and scientists, in partnership with the Pennsylvania Power and Light Company, for whom the plant will be built. The plant will have a capacity of 150,000 kw.

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Westinghouse

ON THE COVER:

This month's cover needs little explanation — it conveys a most sincere sentiment . . .

MISSOURI SHAMROCK

VOL. XXIII DECEMBER, 1956 No. 3

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DEPARTMENTS:

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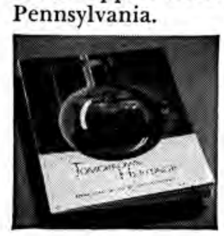

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CHEMICALS & ENGINEERING

Editorial

This month's editorial concerns a "pet" peeve—not merely a "private" peeve but one which a great many people would undoubtedly claim as one of their own.

Indeed a most unwelcome creature is that commonly referred to as the LITTERBUG. This outcast comes from no particular age, racial or financial group but is to be found in all walks of life. In reality he looks much like any other member of the specie of Homo sapiens. The only distinguishing characteristic by which he may be positively identified is his track or, more properly, his trail. By a wide trail of litter and rubbish he makes himself known, and does he ever!

Literally, armies must be employed to clean up after these thoughtless individuals. They can't seem to hold on to that scrap of paper until they reach the disposal can only a little ways down the sidewalk and never make it to the rubbish barrel with those picnic scraps. Surely most possess the intelligence to know the purpose for these numerous containers.

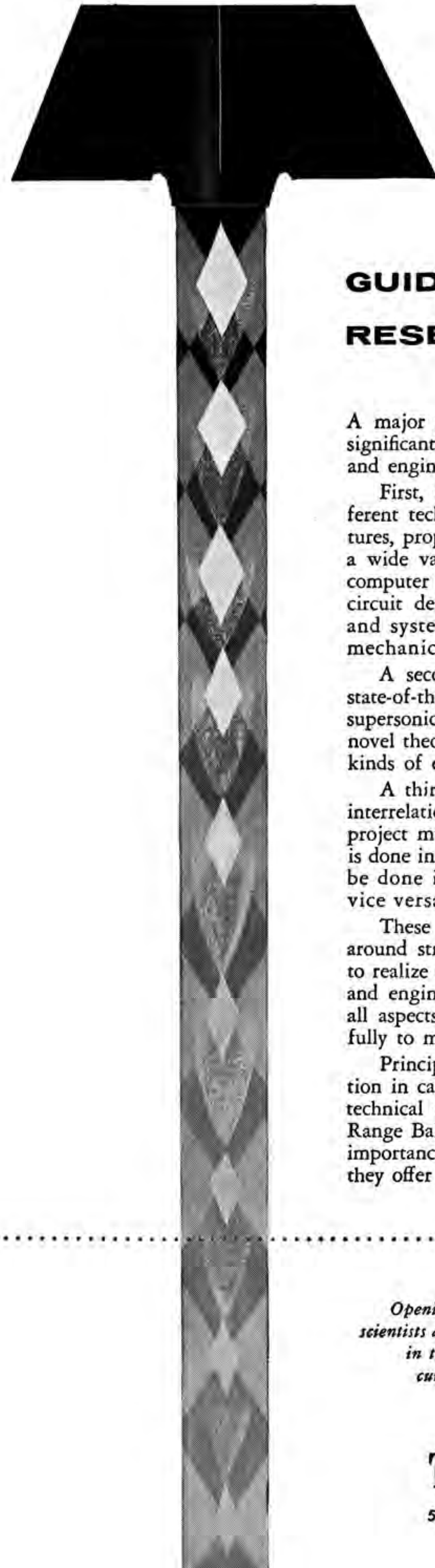
Think of our litterbugs as you see the glitter of beer cans along the highway, as you swerve to avoid the broken glass of a coke bottle lying in the road. Think of them, too, as you spot the large "No Trespassing" and "Keep Out" signs posted by farmers who have finally tired of picking up after our friends.

Some states, particularly those in the east, have been successful in exterminating this nuisance. Most of them have laws imposing fines for offenders who litter the roadsides. In passing through, one is impressed by the apparently higher degree of civilization they possess.

Certainly this problem deserves some thought in a locality where much of the "cream" of civilization is supposedly concentrated.

M.L.C.

FRONTISPIECE: an engineer peers at the glow in a radioactive lucite rod in the General Electric Company's new radiation laboratory, a component of the Company's General Engineering Laboratory. The new laboratory is part of the Company's expanding study program in peacetime uses of the atom. The glow comes from a 1000-curie cobalt source. One thousand curies gives off roughly as much radiation as would the entire world's supply of radium.



A CHEMICAL HEADLINE MAKER OFFERS CAREERS WITH A FUTURE

When the editors of the nation's business press devote cover stories to a company, it's a good sign that the company is setting a fast pace in today's competitive world. By branching off into new fields of creative chemistry, by building its sales from $7,000,000 in 1913 to more than $226,000,000 in 1955, Hercules Powder Company was one of the big stories of 1955. With an investment of more than $28,000,000 going into new plant facilities this year alone Hercules will continue to be a growth leader in the years ahead. This is the type of company in which ability finds its opportunity for advancement; where a young man can grow into the type of job he will find most rewarding. Why not find out more about careers with Hercules from your placement officer? Or write direct to Hercules for additional information.

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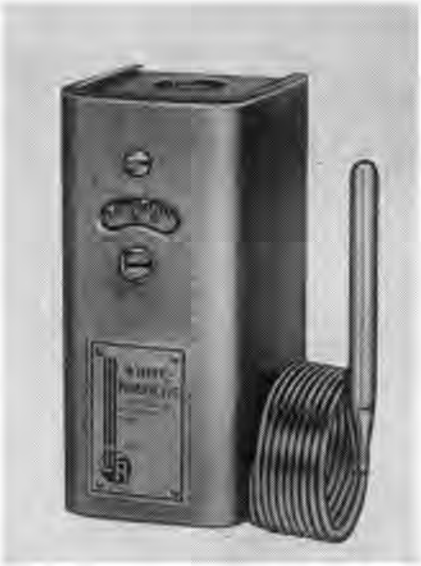


A typical hydraulic-action control. Note the sensing bulb and connecting capillary. The operating temperature and sensitivity are set by means of the screw adjustments visible on the face of the control box.

HYDRAULIC TEMPERATURE CONTROLS and Their Problems

PETE LANGER, EE '57

Although he is not a regular staff member, Peter Langer hopes to make frequent contributions to The Shamrock this year. The article entitled "Hydraulic Temperature Controls and Their Problems", which appears in this issue is his initial effort.

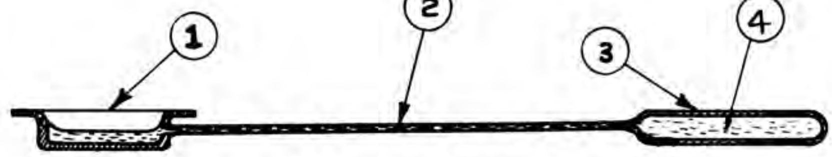
Peter is a Senior in Electrical Engineering and a member of Engineer's Club and the A.I.E.E. Aside from these professional activities he belongs to the Crest Co-op. and the Stephens College Burrall choir.

During the previous summer he worked for the White Rodgers Electric Co. in St. Louis as an application engineer, gaining the experience which enabled him to write this month's article.

Though not commonly referred to as such, the "thermostat" of your car is one of the numerous devices designed as temperature controls. Household appliances such as refrigerators, washers, dryers, water heaters and toasters are equipped with similar controls to provide service that will be safe and satisfactory.

A very important classification of temperature controls is the hydraulic-action type. A brief description of this control and its operation follows.

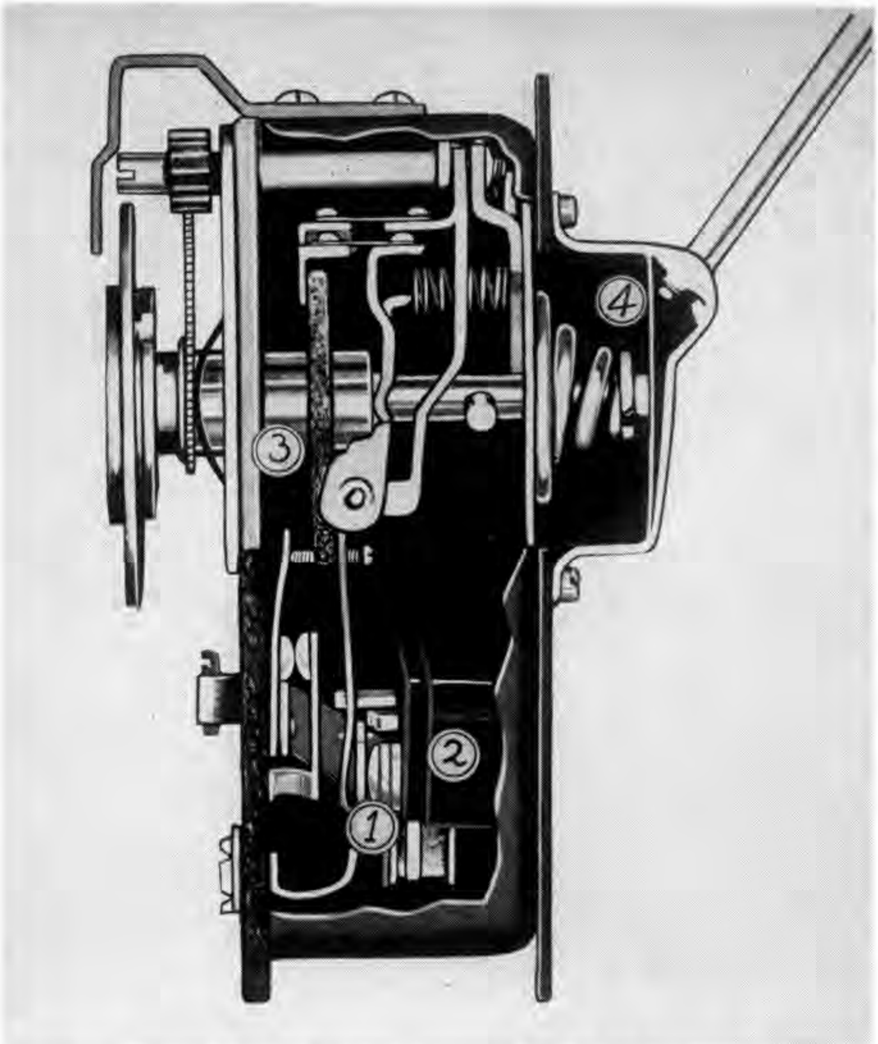
The portion of the control that detects the changes of temperature of the medium is called the *sensing element*. It consists of a bulb connected to a diaphragm or to bellows through a tube of very small inside diameter (called a capillary). The *diaphragm* consists of a rigid cup inside of which is a disc that can expand as the liquid expands with an increase in temperature. Movement of the diaphragm is transmitted to a switch or other actuating mechanism. The cross section of a magnet snap-action switch is shown on Fig. 2. The lever mechanism operates as indicated by the sketch of Fig. 3. Movement of the diaphragm is transmitted to the bolt against the ac-



1.—Diaphragm
2.—Capillary
3.—Bulb
4.—Liquid fill.

FIGURE 1.

Cutaway section of a diaphragm type sensing element. The capillary is of very small inside diameter so that ambient temperature will not affect the calibration of the switch.



1.—Electrical contacts
2.—Permanent magnet
3.—Bolt for adjustment
4.—Diaphragm element

FIGURE 2.

Cross-sectional view of a hydraulic-action type control utilizing a magnet ;nap-action.

:ion of the spiral spring. When the 'orce on the bolt becomes greater :han the force with which the mag- 1et attracts the contact arm, the :ontacts will snap open, operating ι desired electrical circuit.

In designing a control for a spe- :ific application, peculiar problems ırise. Some of these can be solved vithout too much difficulty while ›thers can be solved only after engthy testing. The liquid fill has o be chosen for the particular ange of temperature for which the :ontrol is designed. For example: ome liquids will decompose at emperature encountered in fur- ıaces. Mercury, a commonly used iquid, will amalgamate with certain kinds of stainless steel at furnace temperatures.

The bulb should be located so that it will give an accurate indication of the temperatures at the place to be controlled. In a freezer it would be desirable to put the bulb right into foods—this is obviously impractical. The bulb must be located where it will be free from mechanical injury and at the same time give a good indication of the actual temperature. The length of the bulb is one factor that determines how well it can sense temperature changes of the material. A control for a frozen food display case, for instance, should have a bulb that is long and thin because air circulates around the bulb by natural convection only.

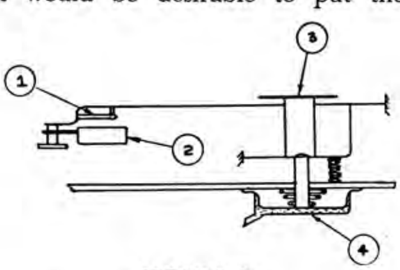


FIGURE 3.
1.—Floating contacts
2.—Permanent magnet
3.—Bolt with adjustment
4.—Diaphragm
Sketch indicating the lever arrangement of the switch.

The design of the diaphragm allows only a few thousandths of an inch for expansion before the proportional limit of the metal is exceeded. This places a definite restriction on the type of liquid used and the length of the bulb.

The lever mechanism receives the small movement of the diaphragm and amplifies it sufficiently to provide clearance for opening the electrical contacts. The lever ratio is 75 to 1 in the switch illustrated on Fig. 2. A requirement of the switch is to interrupt current without contact burning. A snap-action achieves this, opening the circuit rapidly and so avoiding detrimental arcs across the contact. The rapid closing of contacts creates another difficulty called "bounce" which is the effect caused by the momentum of the contacts and which results in a rapid succession of opening and closing of contacts with undesirable burning. It is therefore desirable that the contacts be cushioned or as it is often spoken of, "floating". Notice that contacts are "floating" in the switch illustrated.

A factor that affects all of the considerations mentioned so far is cost. Manufacturers will assure you that controls are never produced inexpensively enough. Reducing cost while maintaining high operating standards is the aim of every control manufacturer.

The author wishes to thank the White-Rodgers Electric Co. of St. Louis, Mo. for providing illustrations and information used in this article.

Charles C. Ingram, Jr. became Vice President of Oklahoma Natural Gas Company in less than 15 years

CHARLES C. INGRAM, JR.
B.S. in Petroleum Engineering, 1940
University of Oklahoma

Charles Ingram has been Vice President of the Land and Geological Department of Oklahoma Natural Gas Company since June of 1955. Mr. Ingram joined the company immediately after his graduation from Oklahoma, and was soon called into service. Following his discharge, 5 years later, he rejoined the Engineering Department in Tulsa. He was quickly promoted to Assistant Chief Engineer and then took over the position of Superintendent of Gas Purchase and Reserves, and by 1954 was District Superintendent of the Oklahoma City district.

After 6 years with Lone Star Gas, Bill Collins took over a new job in a new field for the company

WILLIAM A. COLLINS, JR
B.S. in Mechanical Engineering, 1947
A & M College of Texas

Bill Collins is employed by the Lone Star Gas Company in Dallas as Coordinator of Air Conditioning and Utilization. Bill operates over 400 square miles in North Texas and Southern Oklahoma. Since joining Lone Star, Bill has worked primarily in the design, sales and installation of air conditioning equipment, with some time devoted to industrial gas applications. When it was found that a large scale air conditioning program requires close attention to design and installation as well as sales and service policies, a special department was organized in 1955. Bill was put in charge.

A BRUSH WITH

DECEMBER HISTORY

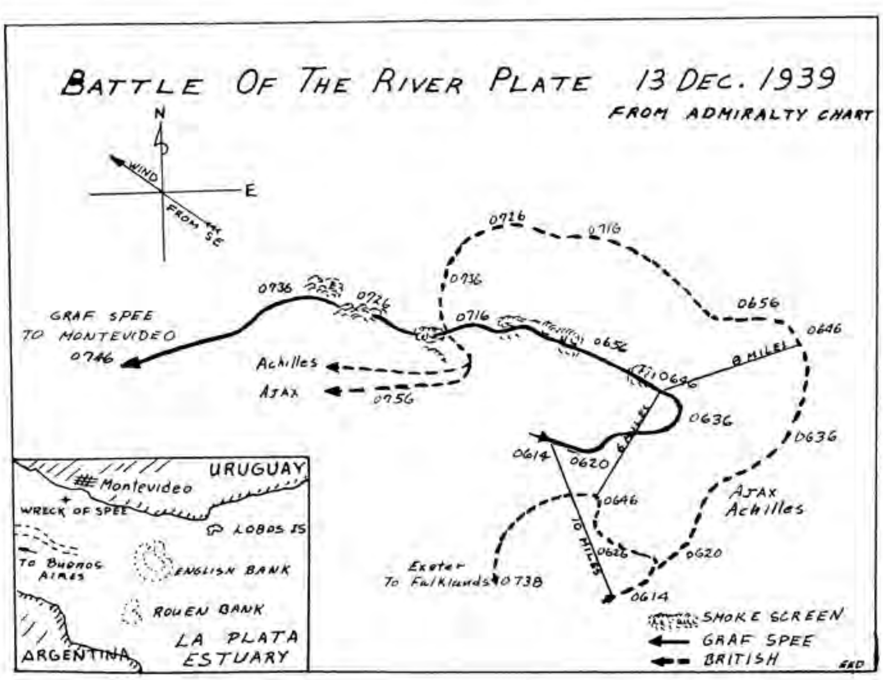
ED DUKE, ME '57

Entwined in the plot of the "Sea Chase" a recent movie and book and covered, ever so slightly, in the novel "The Cruiser" (a British publication) were facts and incidents involving what is commonly known as the Battle of the River Plate.

It is seventeen years this month that the unusual battle took place. Unusual in that it accomplished what no one at that time would have expected and had the normal fictitious suspense-plot-twist to it at its conclusion.

The United States had two years to wait before entering the war—so this battle involves a segment of the British navy and the feared German pocket battleship Admiral Graf Spee. We say feared, because this ship marked the zenith in German ship building. The Spee had the most intricate campartmentation, armor, and speed, of any battle cruiser or light battleship afloat. It was said, and perhaps rightly so, that what the Graf Spee could not blast out of the water, it could run away from.

The Graf Spee got under way sometime before December 1939. The debarkation date was clouded in secrecy at the time, since the British were extremely interested in destroying her as soon as possible. She did, however, leave a dotted trail to be followed—a number of allied freighters and tankers went to the bottom along the Graf Spee's route. It was on 2 December that the Doric Prince, a freighter, reported the Graf Spee's location between Capetown and Sierra Lone—as she sank from shelling administered by the Spee.



Luckily enough, the SOS reached the Ajax, flagship of Commodore Henry Harwood of the British South Atlantic patrol. Harwood guessed correctly that the Graf Spee would now head westward, and he briefly radioed his two consorts for a rendezvous on 12 December about 150 miles off the River Plate. As a guiding principle in case of battle, Harwood told his other ship commanders on that day, "to act without further instruction so as to maintain decisive range."

The British orders were to destroy the enemy; those of the Graf Spee were to destroy allied merchant shipping and to avoid damage.

Contact was made at 0600 13 December. The Exeter advanced directly, while the two smaller cruisers turned to the northward to bring the enemy under split fire. At 0618 the Germans opened fire with their main batteries. By 0622 the British were returning the fire at nearly

20,000 yards (10 miles in range).

Langsdorff, the German Captain, shifted his main battery fire to the approaching Exeter and in the next 18 minutes gave the ship his concentrated efforts. At 0624 a shell from the Spee's seventh salvo hit the Exeter's forward turrent, putting it out of action, and killing nearly all men on the bridge. A report later records the extent of damage to the Exeter:

"The Exeter closed, receiving 3 or 4 more hits from 11-inch shells . . . She returned shot for shot until only one 8-inch gun could be fired, and that by hand . . . The steering gear was damaged just after 0700, and for 45 minutes the Captain conned the ship from the after control . . . orders were conveyed from man to man to the after steering wheel and the engine-room, until the ship was no longer serviceable and fell out of the action."

From 0632 to 0640 the Exeter fired her starboard and port torpedoes at 9000 yards. All of these were wide, and upon receiving the fourth and fifth direct hits she took a 7° list. (Each 11-inch projectile weighed 670#). By 0730 her last guns were put out of action by flooding, and at 0740 she disengaged—heading for the Falklands barely under her own power.

While Langsdorff was concentrating his fire, the 6-inch cruisers closed the range — achieving the feat by increasing speed from 14 to 28 knots in 20 minutes. (Steam Power M.E.'s take note) The crucial turn of events was marked by Captain Langsdorff's decision to fall back to Montevideo. 6-inch shells had placed the Spee's fire-control tower out of service and made accurate firing difficult.

GRAFF SPEE (1934). 12,500 tons. Scuttled off Montevideo after being defeated in action four days earlier by H.M.S. Ajax, Achilles, and Exeter, December 17, 1939.

The Spee, low on fuel and with damaged fire control, laid a smoke screen and started away. By 0656 the Ajax and the Achilles again closed range and continued to hammer the Spee. The Ajax received heavy damage from the Spee's main battery and at this time had only three guns in action.

About 0738 after firing torpedoes without success — in view of the crippled Exeter and probable ammunition shortage—Harwood's decision was to follow at long range for the rest of the day with the possibility of making a torpedo sortie by night.

No other action followed. The Spee headed for Montevideo and by midnight anchored in the port. Waiting outside the nuetral harbor the Ajax and Achilles were reinforced by the 8-inch cruiser Cumberland which had just arrived from the Falklands. Rumors of other great reinforcements were spread about, but no such additional British combatant ships appeared.

The Uruguayan authorities had granted the German ship 72 hours for repairs. Even before this period was terminated, Langsdorff had received official orders from the Fuhrer, Adolf Hitler, to destroy the ship rather than engage the enemy. On the evening of 17 December the Admiral Graf Spee, pride of the German navy, slowly made its way outside the channel and disembarked its men. She was blown up at 2054. Captain Langsdorff wished to fight to the end. Unable to bear the thought of losing his ship in such a manner he shot himself in his room, wrapped in a flag of the Imperial Navy, to which he vowed his true allegiance.

The Battle of the River Plate was one of the most heroically fought naval battles of our time. Winston Churchill said of it "In this Dark somber winter . . . the brilliant action of the Plate . . . came like a flash of light and color on the scene." It is seventeen years this month that the battle took place. In that time we have seen the growth of giant aircraft carriers, guided missiles, and nuclear submarines. Battles to be fought on the sea now will be much different than those of 1939. "Old salts," like the surface commanders, who dream of trading broadside for broadside with the enemy at close range, are quickly seeing the possibilities fade with the technical progress of this modern age. The Battle of the River Plate had much in common with the battles fought by Nelson, Jones, Larrence, and Farragut. An epic of the past—that may never live again, and it happened in December 1939.

AJAX (1933). 6,985 tons. Flagship of Commodore Henry Harwood, victorious though sustaining heavy damage in an engagement with the Graff Spee, December 13, 1939.

Oran Ritter asks:

Does Du Pont hire men who have definite military commitments?

Oran A. Ritter, Jr., expects to receive his B.S. in chemical engineering from Louisiana State University in June 1957. He's now editor-in-chief of the "L.S.U. Engineer," local president of Tau Beta Pi, and senior member of the Honor Council of his university. Oran's question is on the minds of many men planning a technical career.

Don Sutherland answers:

Donald G. Sutherland graduated from Virginia Polytechnic Institute in 1953 with an M.S. degree in chemical engineering and an R.O.T.C. commission. He was hired by Du Pont's plant at Victoria, Texas. After two years in the service, Don returned to his career in engineering, and is now doing plant-assistance work in the technical section at Victoria.

YES, Oran, we certainly do! We've employed quite a number of college graduates with definite military commitments, even when we knew they could work no more than a few weeks before reporting for duty. Take my own case. I was hired in November of 1953 and worked for only four weeks before leaving for the Army. Two years later I returned to Du Pont.

You see, we're primarily interested in men on a long-range basis. The fact that they're temporarily unavailable, for a good reason like military service, isn't any bar to their being considered for employment. After working only one day, an employee is guaranteed full re-employment rights—that's the law. And if a man works for Du Pont a full year before entering the service for two or more years, he receives an extra two months' salary. If he goes into the service for six months, he's paid a half month's salary. When he's entitled to a vacation but doesn't have time to take it before leaving, Du Pont gives him equivalent pay instead.

Even if present employment is impossible, Oran, we definitely recommend your talking with Du Pont's representatives as well as those of other companies. The very least you'll gain will be valuable background and some contacts of real benefit to you when you leave military service.

WANT TO KNOW MORE about working with Du Pont? Send for a free copy of "The Du Pont Company and the College Graduate," a booklet that tells you about opportunities for work in all departments of the Company. Write to the Du Pont Company, 2521 Nemours Building, Wilmington, Delaware.

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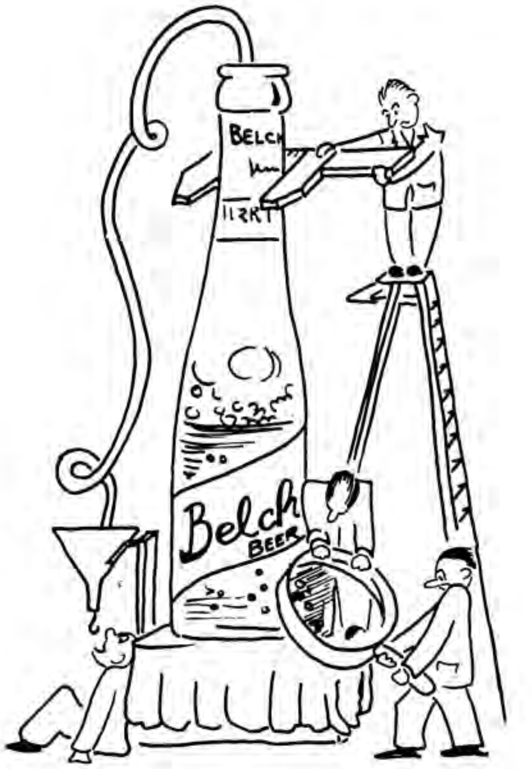
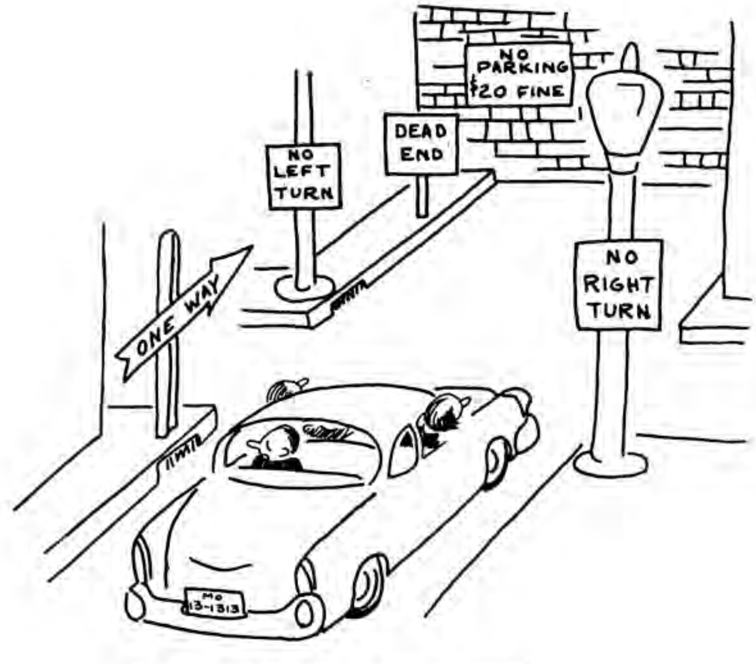


THE GO INS

by STANISLOUCE J. HAMMERSCHLUG, PS
(Professional Student)

Recently the EE's undertook an inspection trip to St. Louis, the purpose being to acquaint the seniors with the world of industry and to see how they would fit in.

The schedule of tours had been set up to show types of industry of the most interest to the most people . . . .



To some of the students from small towns (i. e., Moberly, Jefferson City, Kansas City, etc.) the St. Louis traffic signs were somewhat confusing.

E E's PECTING

Did you ever just stop and wonder "what the hell?"

After about six hours and fifty miles of walking the first day, the group checked into the hotel. It is rumored that several members of the group did not "party" extensively the first evening.

Our guides at Granite City Steel were the most "dynamic" speakers of the trip.

All in all, the tours were both interesting and informative. The companies visited furnished as guides men familiar with over-all plant operations and who could answer all the questions asked. With the help of the electric megaphones everyone could hear and understand the explanations of the plant activities.

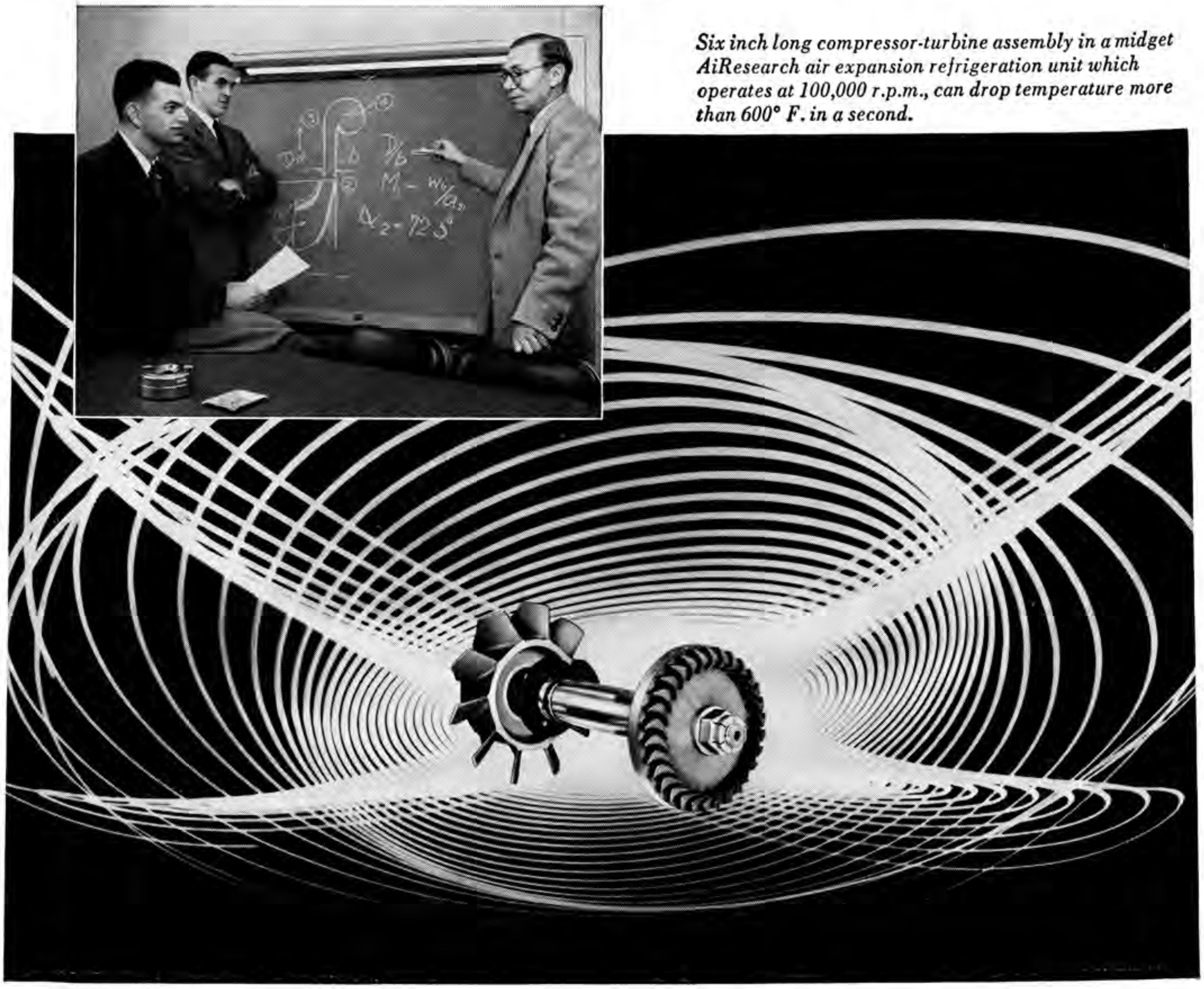
Well, you don't expect an instructor to go in smelling like beer do you?

After two hours the second with a third trip coming up that evening, some of the men felt the need of spiritual uplifting, and accordingly dropped into Shaw's Happy Haven Rest and Recreation Parlor. For some unknown reason the instructors could not be persuaded to join in and quaff a brew with the others.

The last tour was through the facilities of Bell Telephone and A. T. & T. Both companies had modern and well constructed pieces of mobile equipment of considerable interest to the inspecting party. Since we were on a rather tight time schedule, we did not have a chance to spend as much time at some installations as was desired.

And now that you've seen how the switchboard works we'll go out and look at the relays.

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



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

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

Reason for our important role is the forward looking approach of our engineers, who develop new solutions for industry as needed. If stimulating assignments and recognition for achievement is what you're looking for, you'll enjoy working with us.

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

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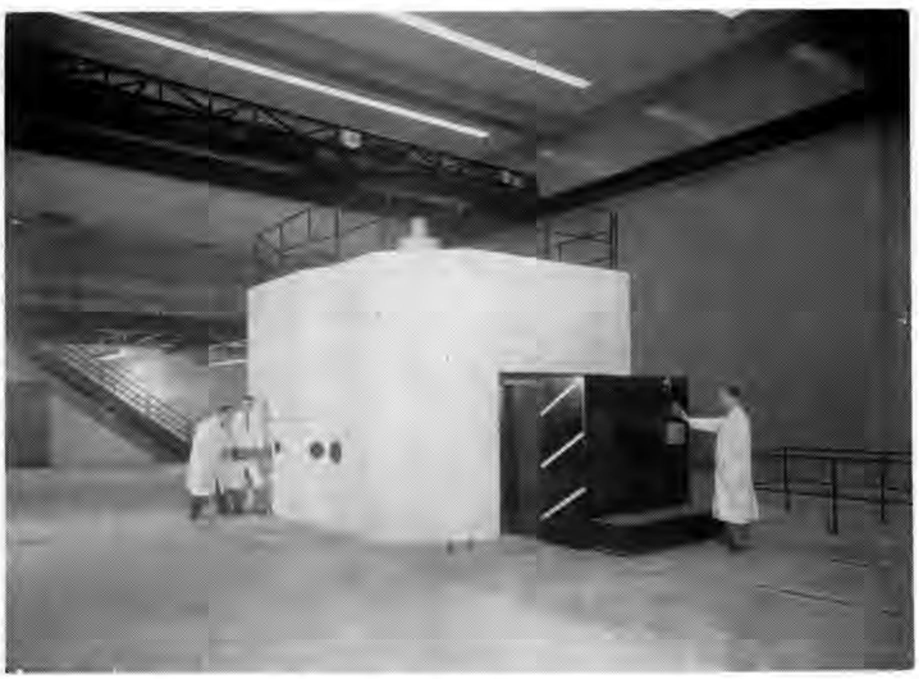
AIRESEARCH INDUSTRIAL • REX • AERO ENGINEERING • AIR CRUISERS • AIRESEARCH AVIATION SERVICE

RESEARCH

REACTOR

Edited by M. L. Crenshaw



Technicians (left) check a shielding plug in one of the experimental ports of the world's first private nuclear reactor for industrial research, constructed at Armour Research Foundation of Illinois Institute of Technology, Chicago. Scientist at right inspects the mechanism that closes and opens the 40,000 pound door of the reactor.

Note: This article is number three of the series on the subject of atomic energy. The information contained herein and the illustrations were furnished through the courtesy of ATOMICS INTERNATIONAL, a division of North American Aviation, Inc.

Operation of the first nuclear reactor built for private industrial research has begun at the Armour Research Foundation of the Illinois Institute of Technology. Twenty-four industrial companies are participating in the nuclear reactor research program at Armour Research Foundation. Under the participator plan, each firm is contributing $20,000 toward the construction and initial operating costs of the $700,000 reactor facility. ARF is providing the remaining funds. In return the companies will share in the benefits of an extensive three-year program whose aim is the application of atomic techniques to industrial problems.

The 50,000 watt research reactor, designed and built by Atomics International, a division of North American Aviation, Inc., will enable industry for the first time to conduct reactor studies without security restrictions and military competition. Located on the campus of the Illinois Institute of Technology, it is the first since the original nuclear reactor at Stagg Field, Chicago, to be constructed in a highly populated area. It is housed in a new $1,250,000 Physics and Electrical Engineering Research Building near 35th and State Sts. on Chicago's near south side. The reactor will open an entirely new field in industrial research and development by providing an on-the-spot source of high-energy gamma rays and neutrons. Short-lived radioisotopes, useful in medical, industrial and scientific research, will be available locally from the reactor. It is not intended for the generation of electrical power, nor for research on reactors themselves.

REACTOR DESCRIPTION AND OPERATION

The Armour Research Foundation reactor is a homogeneous solution-type reactor, designed to operate at 50 kilowatts and to produce a maximum thermal neutron flux of about 1.7 x 10^{12} neutrons/cm^2-sec at the center of the reactor core. The reactor consists of a core assembly, gas-handling, fuel-handling, and cooling systems, a control- and safety-rod system, and a reflector assembly, together with the necessary instrumentation and shielding for safe and efficient operation. In addition, exposure facilities are provided through which the neutron flux and gamma-ray radiation are available in various intensities for experimental purposes.

The core assembly contains the fuel, which serves as the primary power source, and the moderator, which controls the neutron speed. The fuel consists of enriched uranium, in the form of uranyl sulphate, dissolved in ordinary water, which serves as the moderator. The core assembly includes a spherical stainless-steel tank containing four control-rod thimbles which project vertically into the tank, central exposure tubes which extend horizontally through the center of the tank, cooling coils, a line for filling and draining fuel solution, and a gas outlet tube leading to the solution overflow tank and the gas-handling system.

The gas-handling system controls and processes the gaseous products generated within the fuel solution contained in the core tank. The system consists essentially of the recombiner assembly, which is located below the reactor in the subpile room, which is below the reactor, and piping connecting the recombiner to the core tank. The principal functions of this system are (1) to recombine the hydrogen and oxygen which are produced by radiolysis of the solution water and return the resulting water to the core tank, and (2) to confine the radioactive fission-product gases and provide for their disposal, when necessary.

The fuel-handling system provides a means of filling and draining the core tank. The system consists of a safe-geometry storage tank located in the subpile room, and the piping and valving connecting the tank to the reactor core and to the external servicing connections. The tank, which is shielded by lead bricks, is designed for complete subcriticality, even when it contains all of the core solution.

The cooling system maintains all significant reactor temperatures at their proper values. The system includes a primary coolant pump, the main and recombiner heat exchangers, core cooling coils, and the necessary piping and valving. Heat energy is removed from the core and recombiner by the primary coolant, which is distilled water. The heat energy is then transferred in the main heat exchanger to the secondary coolant, which is ordinary city water. The secondary coolant is completely isolated from the primary coolant water, and hence from any radioactivity; however, it is continuously monitored so that a malfunction in the cooling system will automatically close it off from the city water and sewage system.

The control and safety rod system consists of four boron carbide cylinders and the appropriate control mechanisms and circuitry to position the cylinders within the reactor core. These cylinders, or rods, absorb neutrons and thus control the intensity of the fission reaction. One of the four rods is driven by a servo-controlled motor and functions as the automatic regulating rod. Each control rod is held to its drive mechanism by an electro-

(Continued on page 44)

Physicist checks core for nuclear research reactor built for the Armour Research Foundation of Chicago. Atomic fission, the "splitting" of atoms which produces radioactivity and neutrons, takes place in this heavy stainless steel core.

Modern and advanced engines log up hundreds of test hours daily in Standard's automotive laboratory at Whiting. Radioactive carbon traces deposits in the guarded engine (foreground).

SURVEY—

Attracting and Holding Engineering Talent

Editor's Note—The first part of this article, reprinted in the November issue, received enough favorable comment that it was decided to run the remaining material so as to complete it. It is reprinted by special permission of the PROFESSIONAL ENGINEERS FOR INDUSTRY, INC.—JGH

THE GOAL

What does the young engineer want?

- Security is important
- Opportunities for advancement
- A sense of achievement

How to provide what he wants

- Advanced training
- Upgrading from within
- Keeping him informed

ADVENTUROUS ENGINEERS still are building radio stations high in the Andes, air fields in Africa, and submarine bases in the far north, on the fringes of the Arctic Circle. There still are modern counterparts of Goethals and Steinmetz and Hoover creating new miracles in jungles and deserts and mountains.

But the many young engineers of today are not looking for glamor in far places, but for security, both immediate and for the years to come. They want not only adequate compensation but also professional recognition and a sense of personal accomplishment.

DEPRESSION PSYCHOLOGY REMAINS

Although they were still small boys when the great depression of the thirties ended, many young graduates of today still remember its dislocations and its effects, perhaps on their own families, and they want a safe berth for themselves in industry.

Reasons for entering the engineering profession, as brought out in a previous chapter, were first, engineering aptitudes (73.5 per cent); secondly, professional status at work (16.6 per cent); and thirdly, financial rewards (12.3 per cent).

But after they have been in industry for a time, some attitudes change, as shown by the question: "Are you satisfied with your present job?"

Five different factors were listed, and all were answered in the negative as follows:

SALARY: 45%
PROSPECTS: 34%
WORKING CONDITIONS: 17%
NATURE OF WORK: 16%
LOCATION OF WORK: 13%

A number of the executives questioned felt that the engineer's preoccupation with money was a manifestation of a "something for nothing" attitude—that he was more interested in what he was going to get out of industry than in what he was going to put into it.

SOMETHING FOR NOTHING

"Young engineers must be made to realize that their engineering understanding must be converted to productive output," said the superintendent of engineering personnel of a large western aircraft manufacturing concern. "Too many of them feel that they can understand a bigger job, but overlook the fact that their output on their present job is far from satisfactory."

Said G. E. Shubrooks, manager of research of the Hamilton Watch Company, Lancaster, Pa.:

"The free flow of Government money has completely upset the engineering profession from the standpoint of the engineers being able to get high pay for little effort."

The same feeling was echoed by a number of others among the executives questioned. But the replies to the two questionnaires (from employees and employers), checked against each other, indicated that perhaps management itself is partly to blame for this attitude, if such an attitude actually exists on a widespread scale.

Both the executives and the engineers were asked if the latter were kept currently informed of their personal progress within the company.

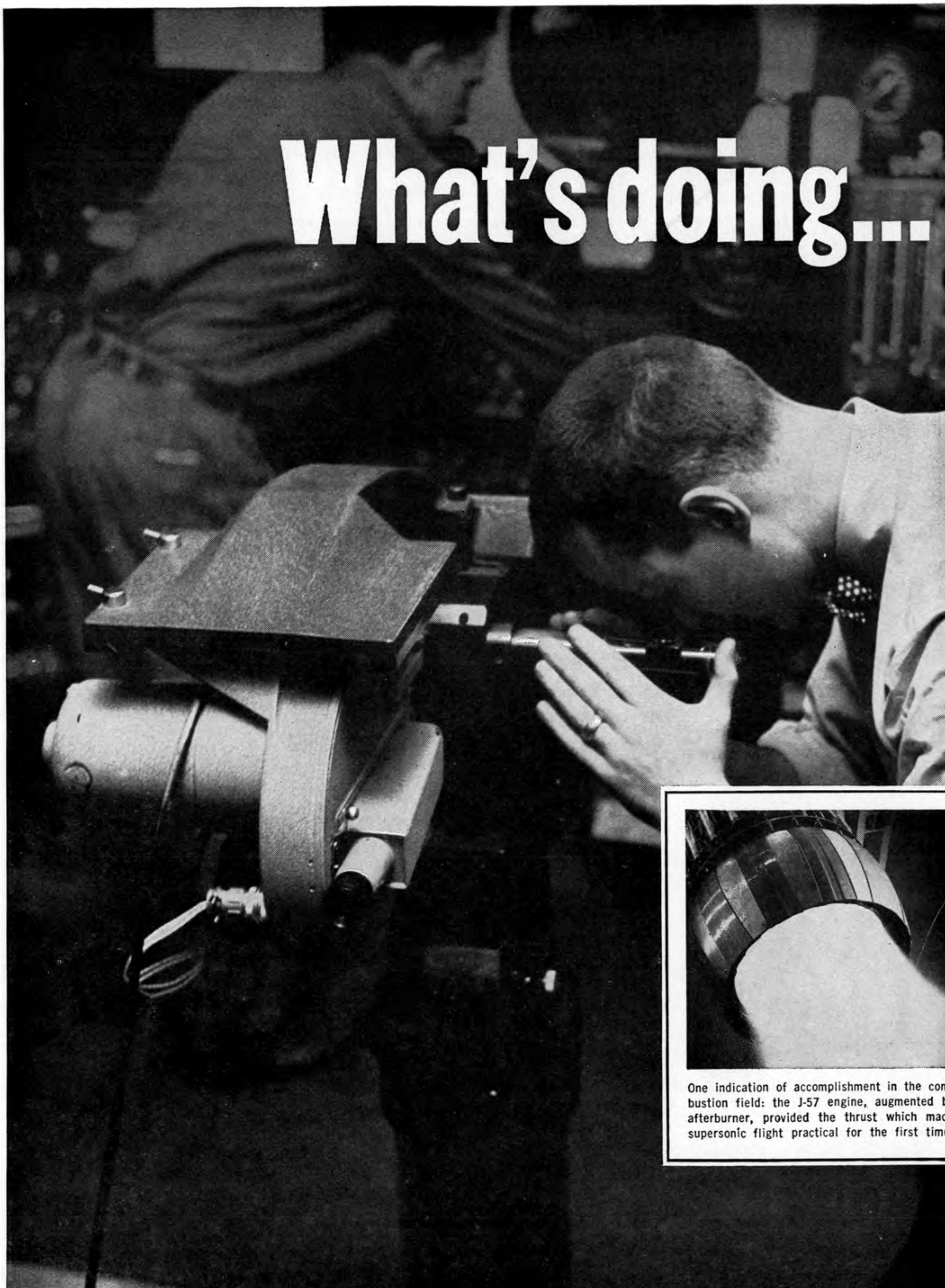
DIFFERENCE OF OPINION

Eighty-five per cent of the executives answered in the affirmative—but 50 per cent of the engineers said "no."

It is possible that both were right, since many times more engineers than executives were surveyed, and the latter were hand-picked from among companies known to have progressive and successful personnel policies, whereas the large sampling of engineers was not but was intended rather to represent a fair cross-section of American engineering activity.

It is plain, however, that more

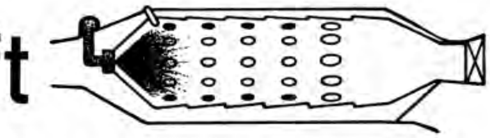
(Continued on page 38)



One indication of accomplishment in the combustion field: the J-57 engine, augmented by afterburner, provided the thrust which made supersonic flight practical for the first time.

This special periscope gives Pratt & Whitney Aircraft engineer a close-up view of combustion process actually taking place within the afterburner of an advanced jet engine on test. What the engineer observes is simultaneously recorded by a high-speed motion picture camera.

at Pratt & Whitney Aircraft in the field of Combustion*



Historically, the process of combustion has excited man's insatiable hunger for knowledge. Since his most primitive attempts to make use of this phenomenon, he has found tremendous fascination in its potentials.

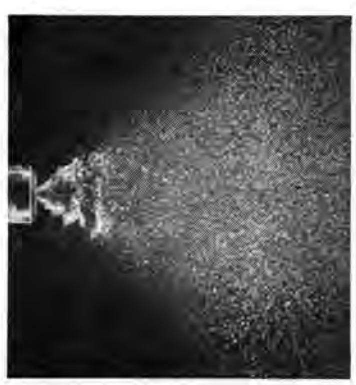
Perhaps at no time in history has that fascination been greater than it is today with respect to the use of combustion principles in the modern aircraft engine.

At Pratt & Whitney Aircraft, theorems of many sciences are being applied to the design and development of high heat release rate devices. In spite of the apparent simplicity of a combustion system, the bringing together of fuel and air in proper proportions, the ignition of the mixture, and the rapid mixing of burned and unburned gases involves a most complex series of interrelated events — events ocurring simultaneously in time and space.

Although the combustion engineer draws on many fields of science (including thermodynamics, aerodynamics, fluid mechanics, heat transfer, applied mechanics, metallurgy and chemistry), the design of combustion systems has not yet been reduced to really scientific principles. Therefore, the highly successful performance of engines like the J-57, J-75 and others stands as a tribute to the vision, imagination and pioneering efforts of those at Pratt & Whitney Aircraft engaged in combustion work.

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

Mounting an afterburner in a special high-altitude test chamber in P&WA's Willgoos Turbine Laboratory permits study of a variety of combustion problems which may be encountered during later development stages.



Microflash photo illustrates one continuing problem: design and development of fuel injection systems which properly atomize and distribute under all flight conditions.

Pratt & Whitney Aircraft engineer manipulates probe in exit of two-dimensional research diffuser. Diffuser design for advanced power plants is one of many air flow problems that exist in combustion work.

**Watch for campus availability of P & WA color strip film on combustion.*

World's foremost designer and builder of aircraft engines

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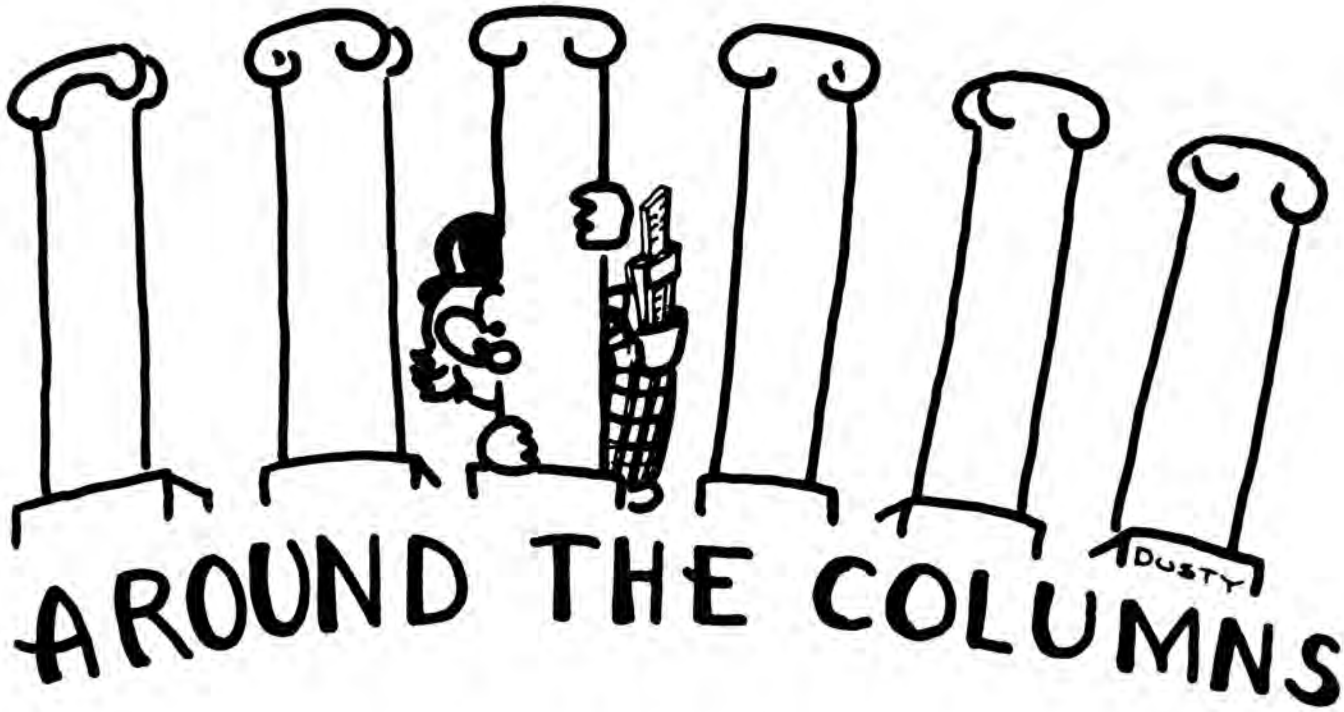


JOE WOLF, M.E. '58

AWARDS

On December 4, the Engineers Club of the University of Missouri held a meeting in the Student Union to honor students in the College of Engineering who have been awarded scholarships and prizes.

Award winners, their hometowns, and the awards they received are:

Joseph W. Palen, senior, 303 E. 3d, Lamar—General Electric Company Award; The Frederick O. Norton Memorial Prize.

Ralph E. Goodson, sophomore, Rfd 2, Ellington—General Motors Scholarship.

George A. Roupe, senior, RFD 2, Harrisonville—International Education Award by the American Society of Tool Engineers.

John H. Endebrock, senior, 408 W. Heidel, Carrollton, Missouri Engineers of Chicago Scholarship.

The following three students share the Monsanto Chemical Company Scholarship:

Ludwig A. Gritzo, junior, RFD 1, Defiance.

David H. Miller, freshman, Dalton.

Albert D. Epperly, sophomore, RFD 2, Clifton Hill.

The following four students received La Verne Noyes Scholarships:

Dean D. Froerer, freshman, 1602 Green Berry Rd., Jefferson City.

David D. McGuire, sophomore, RFD 3, Anderson.

Kenneth J. Kountz, 7 Craig Lane, Creve Coeur.

Richard L. Barnoski, senior, 6411 Washington St., St. Joseph.

Paul W. Klock, senior, 6928 West Park Ave., St. Louis—James S. Rollins Scholarship; Westinghouse Achievement Scholarship.

Roy D. Easley, freshman, 406 N. Ann, Columbia—Anthony W. Rollins Scholarship.

Leslie R. Axelrod, graduate, 1956, 864 N. McKnight Rd., University City—Mendell P. and Regina Paves Weinbach Memorial Prize in Electrical Engineering.

Donald Kay Kirby, junior, 409 W. Bdwy., Columbia — Western Electric Award.

John Cartwright, junior, Maysville—Chemical Engineering Department Award.

Dean Huber O. Croft and five members of the faculty presented the award certificates. The faculty members were Prof. Mack M. Jones, Prof. Gerhard H. Beyer, Prof. Horace W. Wood, Jr., Prof. Clifford M. Wallis, and Prof. Ralph Scorah.

V.I.P.'s

Thirty-two students at the University of Missouri have been named to appear in the 1956-57 edition of "Who's Who among Students in American Universities and Colleges," annual national publication listing campus leaders in the United States.

The 21 men and 11 women were chosen by a joint faculty-student committee appointed by the Student Government Association, to represent the Missouri student body

(Continued on page 52)

Extra-Curricular Engineering—

SOCIETY NEWS

GENE JOHNSON, Ag.E. '57

ENGINEER'S CLUB

A number of scholarships and awards were presented to engineering students at the November 6 meeting of the Engineer's Club. A complete list appears in Around the Columns.

Three other items of business were included in the meeting agenda: the annual budget was presented, proposed amendments to the club by-laws were read for the first time, and petition blanks for St. Pat's Board were distributed to the members.

The program for the meeting was a talk by Mr. Arthur Kuriloff of Convair. Mr. Kuriloff's talk was followed by a film, "The Supersonic Wedge."

A.I.E.E.-I.R.E.

The second regular meeting for the year of the joint Student Branch of the A.I.E.E.-I.R.E. was held on November 13, 1956. Chairman Bill Nichols made a report on the sectional meeting at Rolla on November 9.

Professors Hogan and Tudor of the Electrical Engineering Department gave an interesting talk on the history and operation of the Network Analyzer Board which was recently installed at the University. They conducted a tour through the Analyzer and gave a demonstration of the board in operation.

The program scheduled for the December 4th meeting is a speech by Mr. John Raffone of General Electric. His subject will be "Technical Writing". A speaker from I.B.M. is tentatively scheduled for the January meeting.

A.S.A.E.

Several M.U. Student Members of the A.S.A.E. will attend the Winter Meeting of the Society at the Edgewater Beach Hotel in Chicago on December 9, 10, and 11. They will hear papers read by engineers from many industries and other organizations connected with agriculture and will attend personal interview sessions for employment possibilities.

Local chapter business conducted at the two November meetings included voting to by space in the Savitar for a chapter picture and the creation of a publicity committee to assist the Scribe in publicizing chapter functions.

The speakers at the November 13 meeting were Mr. Jack Smith, Chief of the Water Pollution Control Section of the Missouri Division of Health, and Mr. Albert W. Happy, Director of the Bureau of Public Health Engineering of the Division of Health. Mr. Smith spoke about the duties of a Public Health Engineer, and Mr. Happy outlined the organization and talked about the functions of the Division of Health.

Mr. L. D. Harrison, Employment Manager for the Southwestern Bell Telephone Company, spoke to the Student Branch on November 27. He explained some of the organizational features of the Bell System and told how engineers are trained and used in the various Bell companies.

A.S.C.E.

The Student Chapter of the A.S.C.E. held its November meeting on Thursday the 29th in the Student Union.

Mr. Waugh, of the Personnel Department, Tidewater Oil Company, delivered a talk entitled, "Technical Engineering Aspects of Tidewater Oil Company". A short, entertaining film followed his talk.

Arrangements are being made to hold a joint meeting with the Mid-Missouri Section of the A.S.C.E. on December 13, which will include a banquet before the actual meeting begins. This should prove to be an interesting and enjoyable evening.

It is hoped that many students will attend the meetings of A.S.C.E. whether they are members or not. All Civils are invited and anyone else interested in attending is always welcome.

A.S.M.E.

The regular monthly meeting of the Missouri Student Branch of the A.S.M.E. was held on November 13. The business meeting included

(*Continued on page* 56)

Mizzou Memos

—*by ELLIOTT PUCKER E.E. '58*

This month's career sketch is of Eugene F. Hill, manager of the Chemical Department Scientific Laboratory of the Ford Motor Company.

Eugene graduated with First Honors with a degree of B. S. in Chemical Engineering from the School of Mines and Metallurgy, University of Missouri in 1938. Student activities included being Sports Editor of the school annual, the Rollamo, President of the Ira Remsen Society (Chemistry), and Treasurer of the Dramatic Society, Alpha Psi Omega. Honor Societies included Tau Beta Pi, Phi Kappa Phi and Alpha Chi Sigma.

He continued at the School of Mines and received the degree of M. S. in Chemical Engineering in 1940. In 1940 he was elected to membership in Sigma Xi, the honorary Research Society.

Eugene was a Graduate Assistant in Physics at the Missouri School of Mines during the school years of 1939 and 1940. This involved teaching Laboratory Physics to sophomore physics students.

After graduation in 1940 he accepted a position as Research Chemist in the Research Department of the Wyandotte Chemicals Corporation at Wyandotte, Michigan. While there he developed some new laboratory techniques for evaluating the performance of synthetic detergents.

Eugene was later appointed Research Supervisor of the Inorganic and Textile Chemicals Section. While with Wyandotte Chemicals, he authored several papers and patents on detergents.

He was also on loan during World War II to the office of the Quartermaster General for the purpose of developing detergents for use in sea water. While on this assignment he was sent to Italy as a "Civilian Major" on a hospital ship to aid in applying laboratory findings to regular army practice on these ships.

From Wyandotte Chemical, Eugene next accepted a position with the Ethyl Corporation as a Research Supervisor and was promoted to Assistant Director of Chemical Research in 1952.

While at Ethyl he was in charge of research on detergents, agricultural chemicals, gasoline antioxidants, and research on sodium, calcium and other active metals.

Over twenty patents were issued to him on new antioxidants, some of which are of an entirely new type and appear to be of commercial interest. He has several other patents and publications in the field of sodium metal utilization. These are of interest in many diverse industrial fields, such as petroleum refining and detergent manufactures. He also directed work on titanium metal manufacture. A staff of about sixty professional men were under his direction.

In 1954 Eugene accepted a position with the Ford Motor Company as manager of the Chemistry Department Scientific Laboratory.

Eugene is a member of the American Chemical Society, American Oil Chemists Society, Society of Automotive Engineers, American Rocket Society, an alternate Councilor of the Detroit Section of the American Chemical Society, and Treasurer of the Detroit Alumni Section of Tau Beta Pi.

Eugene was married to Phyllis Margaret Brand, May 8, 1943 and now has two children, Marilyn, age 10 and Michael, age 8.

New careers for engineers, now that

Color TV is here!

RCA's pioneering in this exciting medium means unlimited opportunities for you in every phase from laboratory to TV studio

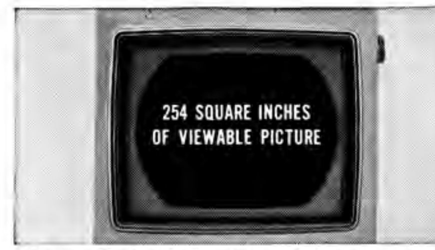
Now, more than ever, new engineering skills and techniques are needed in the television industry — to keep abreast of the tremendous strides being made in Color TV. RCA — world leader in electronics — invites young engineers to investigate these challenging opportunities. Only with RCA will you find a scientific climate particularly suited to the needs of young engineers. Your knowledge and imagination will be given full rein. Rewards are many.

Your talents are needed in research — in TV receiver design — in network operations — even "backstage" at TV studios. The experience and knowledge you gain can take you anywhere!

WHERE TO, MR. ENGINEER?

RCA offers careers in TV and allied fields — in research, development, design and manufacturing—for engineers with Bachelor or advanced degrees in E.E., M.E. or Physics. Join the RCA family. For full information write to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, New Jersey.

Like 2 sets in 1—get Color and black-and-white shows, too! It's RCA Victor Compatible Color TV. See the great Color shows in "Living Color"—regular shows in crisp, clear black-and-white. With Big Color, you see *everything.*



Big-as-life 21-inch picture tube — overall diameter. Actually 254 square inches of viewable picture area. And every inch a masterpiece of "Living Color." Here are the most natural tones you've ever seen—on a big-as-life screen!

Color every night — right now! Something for everyone! You'll have "two on the aisle" for the best shows ever—drama, comedies, Spectaculars, children's shows, local telecasts. For now 216 TV stations are equipped to telecast Color.

Big Color TV is so easy to tune, even a child can do it! Turn two color knobs and there's your Big Color picture! It's easy, quick, accurate. It's a new thrill when the picture pops onto the screen in glowing "Living Color."

Practical and trouble-free! Service at new low cost! Big Color is *dependable* Color. And RCA Victor Factory Service is available in most areas (but only to RCA Victor owners). $39.95 covers installation and service for ninety days.

Color TV is a common-sense investment—costs only a few cents a day. It's sure to become the standard in home entertainment for years to come—yet you can enjoy Color every night *right now!* And you can buy on easy budget terms.

Now starts at $495 — no more than once paid for black-and-white. This is the lowest price for Big Color TV in RCA Victor history! There are 10 stunning Big Color sets to choose from—table, consolette, lowboys, and consoles, too.

Make sure the Color TV you buy carries this symbol of quality. Because RCA pioneered and developed Compatible Color television, RCA Victor Big Color TV—like RCA Victor black-and-white—is First Choice in TV.

RADIO CORPORATION OF AMERICA
ELECTRONICS FOR LIVING

SURVEY

(*Continued from page* 29)

than half of that large group of engineers do not know whether their employers are satisfied with their work. And they would like to know.

It would appear that in the great industrial expansion of the last few years, in the rush to turn out the tremendous volume of materials and manufactured goods demanded by the military, perhaps industry *has not* given enough thought to supervision and guidance, and perhaps, because of the shortage of professional talent, the tendency has been to move young engineers up to positions of responsibility before they were ready for it.

REVERSAL OF FORM

Some support is lent to the latter speculation of the engineers' answer to the question: "Do you think you are subjected to too much supervision?"

It is the nature of youth to be rebellious and resentful of authority, and the answer might be expected to have been weighted toward the affirmative side, at least among the junior engineers. Such, however, was not the case. Eighty-six per cent of those questioned answered "no."

One way of keeping the engineer informed of his personal progress is the merit rating system, a device which at present is employed by only about half of the companies surveyed.

Seventy-eight per cent of the engineers—including a large proportion of the discontented group and the group which feels that industry is not making effective use of their training and talents — said they would like to have their work evaluated by a merit rating system.

It would seem, therefore, that those employers who do not have some system of keeping the members of their engineering staffs informed of personal progress might give thought to the possibility of installing a merit rating system or some similar device.

Reference to Executive Research Survey Number One, *How to Improve Engineering-Management Communications,* also is suggested.

TRAINING OPPORTUNITIES

One of the best devices not only for recruiting new engineers (see Chapter II) but also for retaining their services is the maintenance of an adequate training program, coupled with a policy of upgrading professional personnel from within.

Training programs are not new in American industry. Nearly all companies except the very smallest have some organized system of orienting their new employees and of training them in specific applications of the scientific background they have gained in college.

Never, however, has there been such a tremendous expansion of such programs as has taken place since the beginning of World War II, and in many of the larger plants, the training courses actually are continuations of the formal college curriculums. Credits toward advanced academic degrees are granted for completion of a few of these courses.

There also has been a growing tendency in industry to assist the abler young engineering personnel financially in their pursuit of graduate university work, a device which, those who have tried it say, works both to the benefit of the company and the engineer, and is a major factor in the retention of the services of brilliant young men who might otherwise be lured away to greener financial pastures.

A STAKE IN THE FIRM

Another effective method of promoting continuity of service—one which long has been used by the larger corporations and which is now being inaugurated on an increasingly widespread scale by smaller firms—is the profit-sharing or stock bonus plan.

One of the most interesting is the stock-purchase plan used by the Sun Oil Company of Philadelphia and Marcus Hook, Pennsylvania. There, all employees are permitted each year to buy stock in the company to an amount equivalent to ten per cent of their annual pay at the average price per share prevailing over the previous quarter.

The company then adds, in stock, fifty per cent of the employee's purchase so that he actually obtains the securities for two-thirds of their real value.

The significant provision in the plan is that although dividends start at once and are payable to the employee as soon as they are declared, the actual transfer of title to the stock certificates does not take place until one year after the purchase has been accomplished. If the employee leaves the company during the year, he is refunded the amount he paid in, but his shares, along with the company's fifty per cent stock contribution, go into a stock pool which is divided at the end of the year among the other employee stockholders on a pro rata basis as a bonus.

WORTH STAYING FOR

"It's worth real money to stay on the Sun payroll," said one engineer in their Marcus Hook refinery. "Last year, for instance, I bought 10 shares of company stock to which the firm added another five. But at the end of the year, I got another 10 shares free as a distribution from the pool.

"Actually, therefore, I received 25 shares for the price of 10, and that is worth sticking around for!"

Paul Woodrow, personnel manager at the refinery, thinks the stock purchase plan is one of the most important of the firm's incentives from the standpoint of retaining professional talent for long periods of service, along with the pension plan which is paid for entirely by the company.

"Taken together," he said, "these two plans give them a very real sense of security, and that seems to be the primary goal of most of them nowadays."

Sun also has an extensive training program in which newly-employed engineers are rotated in various jobs until they "find themselves," and additional programs are designed to assist professional personnel in fitting themselves for better jobs.

CONCLUSIONS

Security and an opportunity for advancement are the primary objects of the engineer today with professional recognition and a sense of personal achievement running close behind.

Although present salary scales are at the highest level in history, he still is not quite satisfied with his current rates of pay, nor does he feel that his ability is being utilized fully.

That there is a stoppage in the channels of downward communication between management and engineers is indicated by the fact that more than half of those surveyed do not know whether their employers are satisfied with their work, or how they stand in relation to their fellow engineers. Further work on the improvement of communications seems indicated, and the possibilities of a merit rating system should be explored.

It is also apparent from the survey that prestige of the company is an intangible asset in keeping employees. It was generally observed that those employees of organizations with high prestige in the business world took pride in their company's position.

Among other effective devices for increasing the engineer-employee's sense of security are pension and stock bonus plans and opportunities for continuation of professional training.

THE PROFESSIONAL AS AN EMPLOYEE

The young engineer

- Most executives think his attitudes "unprofessional"
- But they recognize his professional standing
- Better communications are needed

How to build "professional attitudes"

- Personnel policies
- Prestige activities
- Varying work assignments

THE YOUNG ENGINEER as an employee sometimes finds it difficult to adapt the traditionally objective viewpoint of the professional to the hard facts of competitive business.

A very large number of the executives, like J. Robert Tomlinson, executive vice president of the Borden Corporation, Danbury, Conn., complained about the young engineer's "research approach" and his lack of knowledge of practical economics as applied to, and in, the industries in which he will find employment.

UNPROFESSIONAL ATTITUDES?

Sixty-two per cent of those surveyed felt that the young engineers' attitudes are unprofessional, although one, Ingolf F. Kvamme, division engineer of the Duquesne Light Company, Beaver, Pa., added that "men do not feel like professionals when they are paid less than skilled labor," and others asserted a professional attitude is gained only by experience.

A majority of the companies participating in the survey admitted that they made little or no distinction between engineers and nonprofessional employees insofar as their personnel policies are concerned; and the 40 per cent who said they do so, observe the distinction for the most part only to the extent that they pay their engineers salaries on a monthly basis and do not require them to punch time clocks.

Even so, it is evident that some intangible distinction generally is observed, for only 29 per cent of the engineers queried said they do not feel their companies recognize their professional status.

Certain it is that personnel practices designed to fit the rank and file rarely meet the requirements of the professional employee.

The minority group of employees—the 29 per cent who feel that their professional status is not recognized—while a minority, still is large enough to be of concern.

CAUSES OF RESENTMENT

A number of them, interviewed personally, complained of being treated "like any other employee," and one, who worked in a manufacturing plant with a government security status, was bitterly critical because he, like other employees, had to open his brief case for the guard's inspection on entering and leaving the grounds!

This, of course, was carrying the point to absurdity, but it is evident that there is a large number of engineers who *are* "treated like any other employee," and who resent it strongly.

Management representatives in the same plant, on the other hand,

(*Continued on page* 46)

Scholarship Announcement

The Missouri Shamrock wishes to announce that, as in the past, scholarships will be awarded to deserving students enrolled in the College of Engineering. These stipends will be awarded on the following qualifications:

He or she must be enrolled in the College of Engineering.

The need for such an award must be apparent.

There are no class or grade-point restrictions.

A letter must be submitted to the Business Manager of the Shamrock stating the need as to amount.

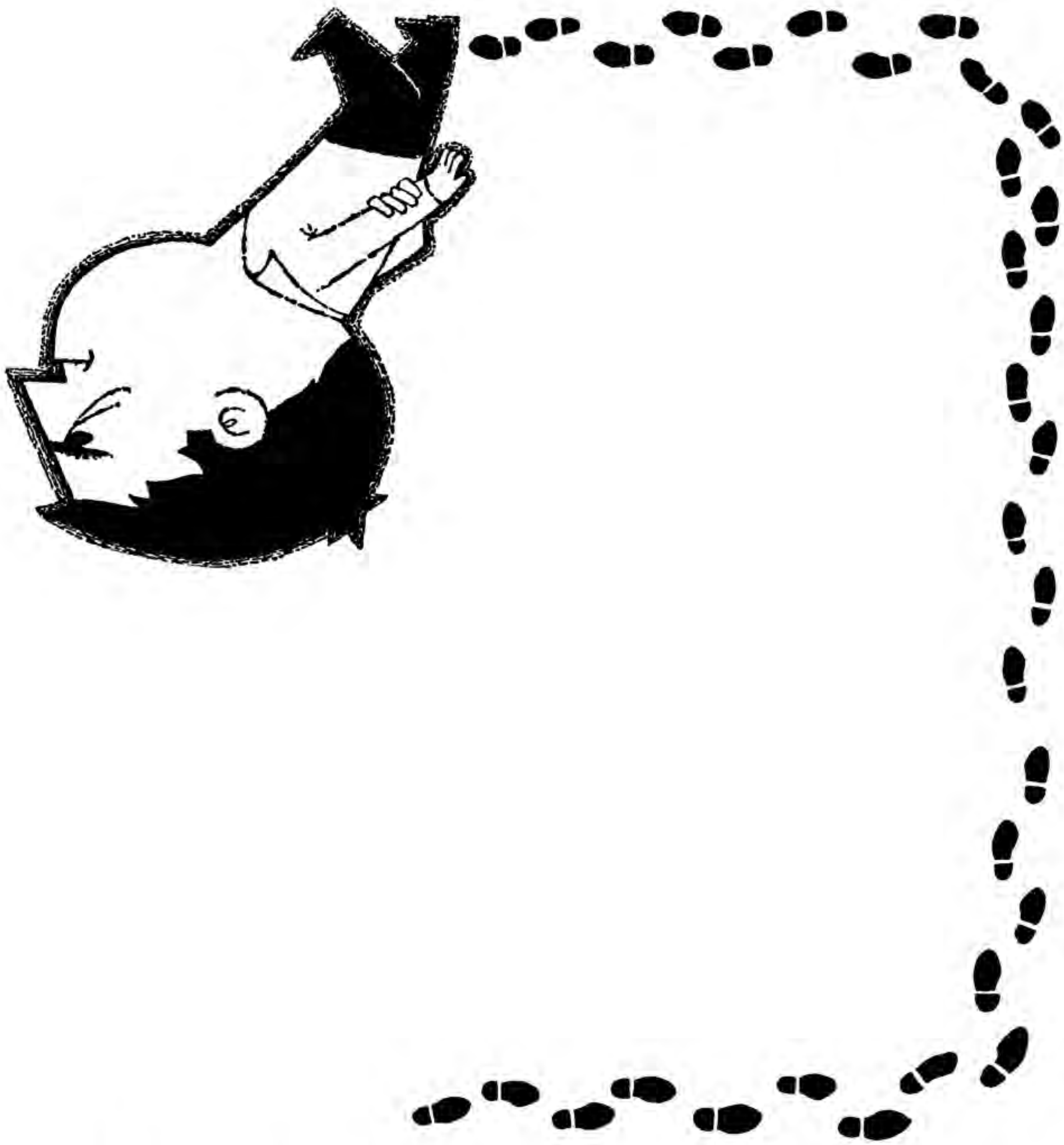
It is also recommended that the student show why he thinks he is deserving of the scholarship.

The letters must be in the Business Manager's hands before January 11, 1957 so that interviews may be held in time for the presentation of the award before the start of the winter semester.

Remember—The scholarship is based on the need of the student!
Get those letters in today!

Address them to:

Missouri Shamrock
c/o Ed Duke
Room 223
Engineering Bldg.



NEWSTUFF

JIM WILHELM, M.E. '57

LONGEST AND STRONGEST

—This aerial view of the first of Lockheed Aircraft Corporation's two new commercial airplanes, the huge-winged Model 1649A Super Constellation (left) and the 1049H —H for Husky—convertible passenger/cargo Super Constellation, shows the contrast in design for planes developed for different missions. The 1649A in the foreground is the longest-range airplane in the world, capable of non-stop flights up to 6300 miles without consuming its fuel reserves. Its all-new 150-foot wing, longest in span of any transport, carries 9600 gallons of fuel and allows relocation of engines farther outboard, for maximum cabin quiet. The sturdy 1049H, identical in dimensions with the Super G, can carry up to 20 tons of cargo, equivalent to two freightcar loads, or it can be converted in a few hours into a comfortable airliner for 92 passengers. The 123-foot wing of the 1049H has an aspect ratio of 8.5, compared with an aspect ratio of 12 for its sister ship. The 1649A wing is also one-sixth thinner, making possible cruise speeds of 350 m.p.h. and a top speed approaching 400 m.p.h.

FIRST ENGINE X-RAY

A General Electric-Detroit Arsenal engineering team has achieved the feat of making motion pictures of the innards of an engine while it is running.

The job involves taking X-ray pictures of the spinning, throbbing internal movements of the engine through its steel housing, and visually "stopping" with a camera their high-speed motion.

The new technique, called stroboradiography, could have a significant effect on engineering design. Slow-motion X-ray movies and still pictures of pistons, cams and other moving parts have enabled engineers to scrutinize, for the first time, complete cycles of engine operation for faculty performance or wear.

The revolutionary process gives designers their first glimpse inside a completed engine operating at normal speed under load conditions. Improved, lightweight designs, and perhaps important basic design changes could result from the X-ray motion studies.

The special stroboradiographic equipment was developed by the General Electric Company for use with its high-energy industrial X-ray betatron, operating at 5 million to 15 million volts.

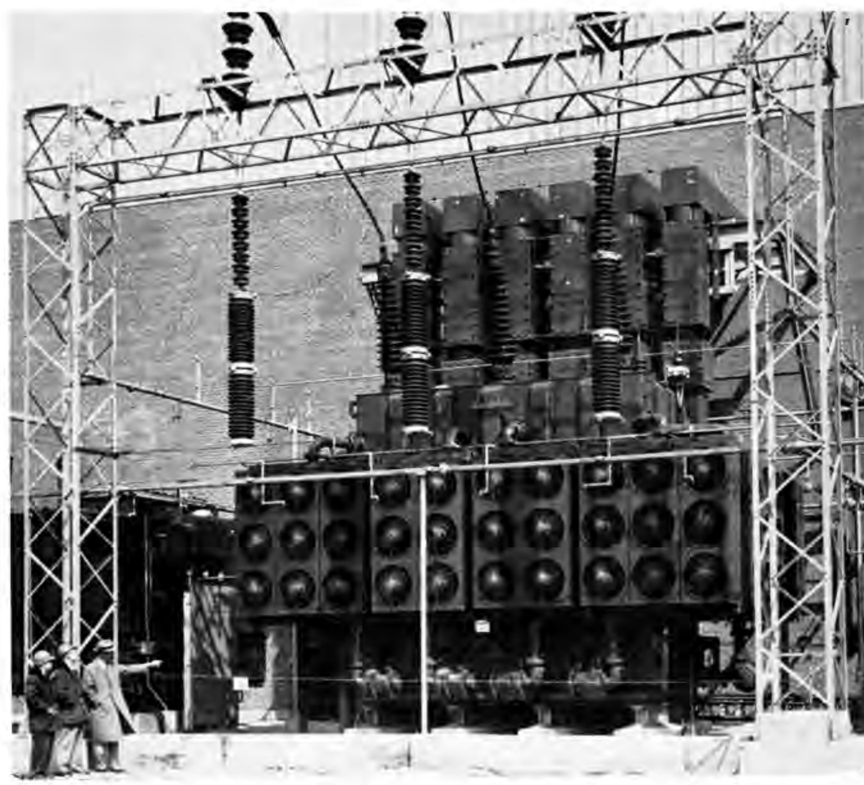
Unlike conventional X-ray equipment, the betatron furnishes the surging radiation pulses—416 per second—that have given engineers this unprecedented "inside" view of any deflections, vibrations or bouncings inside a running machine.

Previously, single-shot exposures of moving objects had been made with low-energy equipment, but the quality of the radiographs suffered when the object was composed of heavy parts of varying thickness.

The new process involves taking thousands of short exposures accurately synchronized with the moving part. With an exposure time of 10 to 15 millionths of a second, it is possible to radiograph an engine turning at several thousand revolutions a minute.

A synchronizing disc attached to the specimen engine signals the betatron and releases the surge of electrons that make the split-second X-ray exposure. Several thousand repetitions result in a strong image clear enough to be analyzed for operational data.

The superimpositions form the picture on special film that receives the filtered X-rays after they have passed through the specimen.



WORLD'S LARGEST GENERATOR TRANSFORMER INSTALLED

This 315,000-kva, 17.3/129-kv generator transformer built by Westinghouse Electric Corporation is the largest ever installed. The three-phase forced oil-to-air cooled unit is the first of two identical units the Company is building for the #1 and #2 units of the Detroit Edison Company's new River Rouge Power Plant. The second will be installed by late 1956.

The transformer, weighing 325,000 pounds, was shipped upright in a one-piece tank, less bushings and cooling equipment. The installed unit weighs 448,000 pounds and is about 24-1/2 feet high (from foundation to bushing tips), 16-2/3 feet wide, and 26 feet long.

Westinghouse also has under construction a 360,000-kva generator transformer for the #3 unit of the River Rouge Plant.

RESEARCH REACTOR

(Continued from page 27)

magnet located at the bottom of the drive mechanism. When it is desired to "scram" the reactor—that is, to shut it down quickly—the electromagnets are de-energized, thus permitting the rods to fall freely by gravity into the control-rod thimbles extending within the core tank.

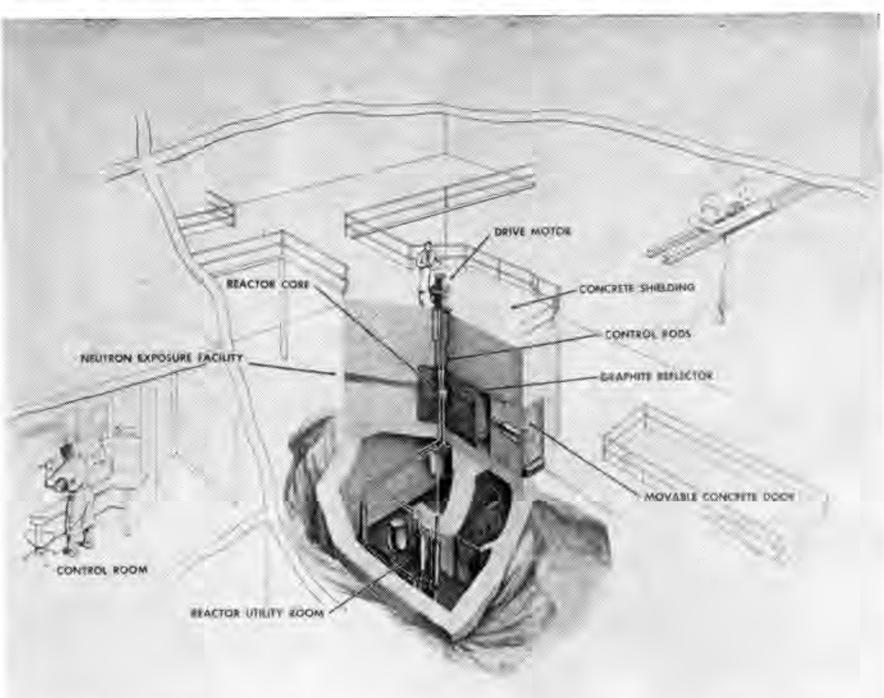
The reflector assembly increases the efficiency of reactor operation by confining neutron activity to the reactor core. The reflector consists of rectangular graphite blocks which are stacked in layers around the core assembly. These blocks form a rectangular prism about 6½ feet by 5 feet by 5 feet which is enclosed in a steel shielding tank.

Shielding for the reactor is provided by a five-foot thick biological shield of dense hematite-colmanite concrete which surrounds the reflector and the subpile room. In addition, lead shields and bismuth windows are provided for special shielding purposes, as required. The concrete shielding is sufficient to reduce radiation levels at the outer surface to less than one tenth of the generally accepted safe dosage rate specified for laboratories handling radioactivity.

The instrumentation system consists principally of circuits which monitor reactor power and the performance of the gas-handling and cooling system. In addition, there are instruments associated with other important variables, and there is provision for area radiation monitoring and similar instrumentation.

Power level is measured by fission chambers and gamma-compensated ion chambers. Temperature-, pressure-, and flow-measuring instruments for gas-handling and cooling system monitoring include instruments measuring sweep-gas flow, core temperature, catalyst-bed temperature, recombiner gas pressure, hydrogen concentration, sweep-gas temperature, and surge-tank level.

The reactor is shut down automatically in the event the flux level or change in flux level exceeds present values, if a malfunction occurs in the auxiliary equipment, or in the event of a power failure. The shutdown is accomplished by circuits which de-energize the magnets which hold the control and safety rods, causing them to fall by gravity into the core. When shutdown occurs, instruments on the control console indicate to the operator the nature and location of the malfunction.



Artist sketch of the first nuclear reactor for private industrial research. The 50,000 watt reactor will be used to develop the peacetime applications of atomic energy. Atomic fission, which takes place in the reactor core, center, produces radiations useful in medical, industrial and scientific research. The reactor will be located underground and shielded by five feet of dense concrete.

EXPERIMENTAL FACILITIES

The reactor is located in the new Physics and Electrical Engineering Research Building, which is located at the south end of the Technology Center in Chicago. The reactor is installed in the west end of the building, in a room which is 72 feet long, 48 feet wide, and 30 feet high. The remainder of the building comprises nuclear laboratories and other areas associated with reactor operation.

The tube facilities consist of steel sleeves extending through the concrete shield and aluminum thimbles or liners which reach to the immediate vicinity of the core. Each tube facility is equipped with a graphite reflector plug and a dense concrete and steel shielding plug to be installed when the facility is not in use.

The horizontal thermal column is formed by a five-foot square column of graphite, in the center of which are nine removable graphite stringers. A large volume which may be used for exposures is provided between the end of the thermal column and the inner face of a movable concrete door. The thermal column access ports open into this volume.

To take advantage of the gamma activity produced by the fission-product gases circulating through the gas recombiner tank, exposure facilities are provided which extend from the subpile room into the exposure room and into the valve room. The facilities listed below consist of steel sleeves and aluminum thimbles which extend through the dense concrete walls of the subpile room into the exposure room. As with the beam tubes, each port is equipped with a plug to be in-

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SURVEY

(*Continued from page* 39)

complained that many of the engineers do not think of themselves as "working for the company" but have the attitude that the company, as one put it, "is a laboratory operated for their own special benefit."

Obviously, understanding is needed on both sides.

The company's complaint of the engineer's "research approach" taken together with the engineer's feeling that he is recognized as a professional but doesn't know how he stands as to personal progress might well indicate that industry expects too much of him—that it is permitting him to operate in an atmosphere of isolation from the normal business currents; that perhaps his tendency to ignore practical economic factors in his engineering work, his failure to think in terms of time and dollars and cents, is the result not only of the deficiencies in his academic background but also of the company's failure to keep him informed of its business objectives.

SEMINARS MIGHT HELP

Where such a condition exists, it is evident the lines of communication need a thorough overhauling to the end that an interchange of ideas between management and engineers is facilitated. Here too, the narrowness of academic background might be remedied in part by the institution by the company of seminars for engineering personnel built around specific situations and problems which cause friction.

A greater participation by engineer-personnel in planning and other management functions might also help to ease the situation.

Whatever program is instituted, however, it should be built with a view according to the engineer that professional recognition which he feels is his due and to exposing him to situations which will help to stimulate in him those professional attitudes which so many executives feel he lacks.

Many companies have found it helpful to encourage all of their engineering personnel to become registered, and to praticipate in the activities of professional organizations. More than 85 per cent of the firms grant time off for registration examinations, a number of those also pay expenses incurred in connection with those examinations, and 43 per cent pay initiation fees or dues in professional societies for at least some of their engineering employees.

OTHER STIMULI

Among the better stimuli to development of the professional viewpoint are those activities which tend to throw the engineer into contact with other professionals, not only in his own specialized field but in others as well.

Obviously management cannot force its engineering personnel to participate in such activities, but it can give tacit encouragement by granting time off when it is needed and by singling out for some form of recognition those who do achieve professional prestige or success outside the company, no matter how small that success might be.

A number of executives who do encourage their engineers to participate not only in professional but also in cultural and civic activities outside the company said the procedure paid off richly not only in building a new sense of confidence and self-esteem (and consequently contentment) in the engineers but also in public relations value for the company itself.

The employment of as much variation as possible in the engineer's job assignments, and the exercise of care to see that he understands how each of the jobs fits into the company's overall picture, also was cited as an important aid to creating in the young engineer an attitude of professionalism.

CONCLUSIONS

It would appear that the young engineer thinks of himself as a professional, and believes his employer recognizes his status as such, even though a great majority of companies make no distinction between engineers and non-professionals as to personnel policies, benefits and other incentives.

Because of faulty downward communications between management and its engineers, however, the latter are not sure of their standing as to personal progress or chances of advancement, and they are kept informed of their employer's business objectives, which frequently creates collisions between the professional and practical viewpoints.

Personnel policies as regard engineers (and, probably, all other professional employees) should be separate and distinct from those relating to non-professional help.

Registration, membership in professional societies, and participation in technical, cultural and civic activities should be encouraged actively, both for the professional growth and social contentment of the engineer and for the public relations benefits which accrue to the company from such activity.

Job assignments for the engineer should be as varied as possible so as to develop in him a greater breadth of understanding concerning the company's activities, and fit him for greater responsibility.

BENEFITS AND INCENTIVES
What makes a good job?

- Benefits won't draw new employees, but . . .
- If you don't have them, you are at a disadvantage

Incentives are important

- Best are linked to security
- Training programs excellent

WHAT PART do benefits play in the attraction and retention of engineer-employees? That question was asked of scores of executives and engineers in a number of plants along the eastern seaboard, and the answer in every case was the same:

"None, except from a negative standpoint."

Because virtually every large plant, and most smaller ones as well, now offer such benefits as group hospitalization, low cost insurance (or in some cases, policies

(*Continued on page* 48)

SURVEY

(Continued from page 46)

paid for entirely by the company), pension plans and elaborate recreational facilities, they have ceased to be inducements from the standpoint of recruiting.

REPRESENT SECURITY

But—the company that does not offer them is at a considerable disadvantage, both from the standpoint of recruiting and of keeping its employees happy once they get on the payroll, for those benefits represent extra dollars and cents in the pockets of the employees, and security against emergencies.

Incentives such as unusual opportunities for training and advancement professionally are much more important, according to the survey respondents, first, because they are vital rather than static factors in which the employee himself plays the important part, and secondly, because they are not offered on nearly so widespread a basis.

The benefits, in the main, are offered to all employees, professional and non-professional alike, as are many of the incentives, but from the latter category come any special inducements which may be offered engineers and other professionals.

Typical of the programs offered by the larger industrial plants is that of North American Aviation, Inc., which operates aircraft factories in Los Angeles, California, and Columbus, Ohio.

Like nearly all companies today, North American offers its employees a group health insurance plan, part of the cost of which it defrays, but to that plan, it has added an idea of its own—an employees' blood bank to which employees donate blood for future use either by themselves or by close relatives. The company also pays the donors for the time they spend giving their blood.

$110,000 PROGRAM

North American also runs a $110,000-a-year recreation program, about half of which is paid for out of vending machine profits of two company-sponsored corporations, North American Aid and North American Foundation. The other half comes out of the company's funds. The recreation program, one of the most extensive in American industry, includes baseball, basket ball, football, soccer, boxing, wrestling, tennis, bowling and many other activities.

The company also maintains tool stores, where employees may buy high quality tools at greatly reduced prices, and other "fringe" benefits which add up to extra dollars and cents on the pay check—hundreds of thousands of dollars in the aggregate.

On the incentive side, the company operates a training program which offers courses from the trade school through the college level. About 175,000 employees have taken courses at North American since the Los Angeles program was inaugurated in 1948 and that at Columbus in 1951, for a total of nearly 2,000,000 hours of training.

In addition, the company operates an education refund plan under which an employee may pursue studies in outside educational institutions and receive reimbursement of two-thirds of the cost of his tuition if his grades are passing.

Under that plan, which has cost the company in the neighborhood of $100,000, nearly 200,000 hours of study have been completed by North American employees, many of whom have earned college degrees and a few of whom have completed graduate work.

The firm's suggestion box program, while not unique, also is a strong incentive which, incidentally, has paid out approximately $350,000 to employees with ideas for the improvement of plant operation.

EVEN PLANT PSYCHIATRISTS

Nearly all large plants operate variations of the North American program—most of them on a somewhat smaller scale—and a few of them go so far as to provide complete country club facilities, like the Curtis Publishing Company in Philadelphia, or free psychiatric service, like E. I. duPont de Nemours & Company in Wilmington.

Du Pont's psychiatry, it might be mentioned in passing, is a vital cog in the production machinery which turns out hundreds of products which are known throughout the world. The big corporation has learned that industrial psychiatry, instituted there on an experimental basis in 1944, pays very worthwhile dividends in increased production and a constantly improving safety record.

Du Pont's Dr. F. W. Dershimer, and his assistant, Dr. Gerald Gordon, are not interested so much in the treatment of the maladjusted and disturbed individual as they are in keeping the corporation's employees happy and contented.

They are concerned, of course, with any duPont employee who has a problem in emotional adjustment, but a large part of their work concerns group behavior patterns under various job situations, a field which is still new and about which little is known.

CONCLUSIONS

All of the benefits and incentives enumerated above are of considerable value in holding employees, but those which are most effective, the survey showed, were those which are closely linked with that primary goal of the engineer of 1954—security.

How important a part security plays in the plans of the average engineer is indicated by the fact that of 1,300 respondents to the questionnaire, 42 per cent said they would not accept a higher-paying job with more responsibility if they were not assured of the same security of employment as existed in their current jobs.

This might be taken as evidence that they were happy in their present jobs were it not for the fact that 68 per cent of the respondents said they are now seeking other positions in the firms where they now are employed, and 78 per cent said they plan eventually to shift to fields other than those in which they now are engaged.

(Continued on page 52)

Better opportunities await the young engineer who starts his career with a fast-growing firm like Spencer Chemical Company.

Why You Should Start Your Engineering Career With A Fast-Growing Company:

Not a company's size, but its rate of growth is what to look for. Read how Spencer Chemical Company's rapid growth makes it an ideal place for you to begin your engineering career . . .

Don't confuse bigness with opportunity when you're deciding on the place to begin your career as an engineer or scientist. The important thing to look for is rate of growth.

Rapid growth means opportunity! With constant expansion and new projects, a company has continual demand for men with proven ability to fill new and more responsible posts. Even the same position grows in importance, responsibility, and rewards as a firm enlarges its scope. In only 9 years, Spencer has grown into an organization with six manufacturing centers distributing products to nation-wide markets.

Compare this growth with those of other companies before you decide where to begin your career in engineering or chemistry. For further details, see the Spencer representative when he calls at your campus this year.

Spencer's rapid growth is shown in this graph of property, plant, and equipment evaluation, 1947-1955.

SPENCER CHEMICAL COMPANY

General Offices: Dwight Bldg., Kansas City 5, Mo. • Manufacturers of "Poly-Eth" Polyethylene Ammonia (Commercial and Refrigeration Grade) • Aqua Ammonia • 83% Ammonium Nitrate Solution Synthetic Methanol • Formaldehyde • Hexamine • "Mr. N" Ammonium Nitrate Fertilizer • SPENSOL (Spencer Nitrogen Solutions) • FREZALL (Spencer Dry Ice) • Liquid CO_2 • Cylinder Ammonia • Nitric Acid

Watch for this name SPENCER® at interview time

America's Growing Name in Chemicals

RESEARCH REACTOR

(Continued from page 44)

stalled for shielding purposes when the port is not in use.

USE OF THE REACTOR FACILITY

The Armour Research Foundation reactor offers a wide and extremely promising field of nuclear research. Capable of operating at a power level of 50,000 watts, the reactor will produce neutrons and gamma radiation for research and development in the fields of biology, metallurgy, food processing, electronics, chemistry, textiles, oils and gases, rubber and leather, machinery, building materials, and allied industrial and scientific pursuits. Of particular interest are studies in the atomic radiation of foods to extend the length of time they can be kept edible. Among the processes offering promise are the pasteurization of fresh meat to extend its shelf life, "cold" sterilization of meats and vegetables for indefinite storage, deinfestation of grains and flour and prevention of sprouting in potatoes and onions.

Radioisotopes provide some of the most useful and promising applications of the reactor. Such "short-lived" isotopes have not been widely used because of the time delay and resultant radioactivity loss if moved over long distances.

Because radioisotopes send out "signals" that can be detected and measured, a small quantity of material can be radioactively "tagged" and its invisible course traced in metals, plants and animals. Flaws in the casting and welding of metals can be easily detected in this manner. Used as tracers that can be picked up by detecting instruments, radioisotopes are revealing the secrets of how plants grow and the most efficient ways they can be fertilized and irrigated.

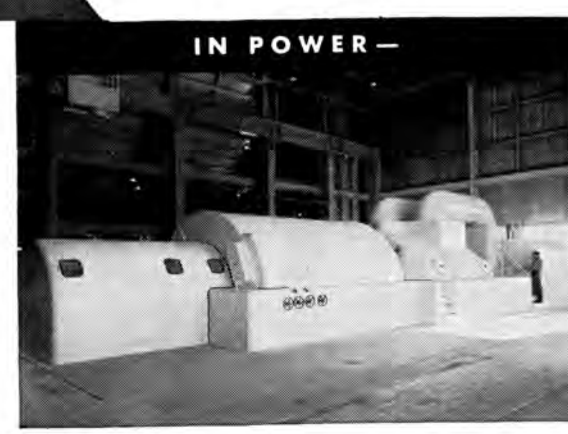
As an example of the new and powerful techniques made possible by the reactor, "neutron activation" now permits what is probably the most sensitive method of chemical analysis known to date. For many elements, a sensitivity of detection of one-trillionth of a gram can be achieved.

Another newly-developed technique is that of "neutron diffraction." Since the diffraction of neutrons is almost independent of atomic number, there is now available a powerful method of structure analysis which complements, and frequently exceeds, the standard x-ray diffraction techniques. This technique has already proved valuable in the study of organic compounds, hydrogen and oxygen in solids, and anti-ferromagnetic materials.

Bombardment of materials by radiation produces effects in almost infinite variety—usually deleterious, but occasionally beneficial. The study of such effects in glasses, plastics, organic systems, and metallic alloys can be undertaken readily with the reactor. The flux also will permit study of the influence of radiation on chemical reactions, some of which are known to accelerate under these conditions.


IN CONSTRUCTION—


IN MANUFACTURING—


IN POWER—

AROUND THE COLUMNS

(*Continued from page* 32)

of more than 9,500 in the annual publication.

Names of the 32 students were announced by the committee which selected the group.

Those chosen from the College of Engineering were:

John Lawrence Wray,
549 W. 1st, Maryville, Mo.
Jimmy Ray Buell,
Longview Farm,
Lee's Summit, Mo.
James David Cover,
New Hampton, Mo.
John Henry Endebrock,
Qts. Q. PSNS,
Bremerton, Wash.
Jimmy Mays Hunter,
3832 Tipton Dr.,
St. Louis, Mo.
Carl Lynwood Wesemann,
RFD, Rhineland, Mo.

POLLUTION CONFERENCE

Columbia, Mo., Nov. 29—Kinescopes were made of two panel programs presented in connection with the conference on Air and Water Pollution held recently in the Memorial Student Union.

KOMU-TV kinescoped these programs, and will distribute the films to television stations throughout the state.

The significance of radioactive fallout as a form of air pollution was discussed by Dr. Newell S. Gingrich, professor of physics in the University, at the kinescoped panel moderated by Dr. Ralph H. Luebbers, professor of chemical engineering in the University. Dr. F. V. Morriss, graduate of the University, discussed the "Contribution of the Automobile Engine to Air Pollution." This is the same topic Dr. Morriss talked on at the afternoon session of the conference, and was the subject of research he conducted for the Los Angeles Air Pollution Foundation.

Other members of this panel were Louis Garber, chief of the industrial hygiene section of the State Division of Health, and Joseph F. Nemeth, pollution control engineer of the Queeny Plant of the Monsanto Chemical Company, St. Louis.

Mr. Garber spoke on the health aspects of air pollution, and Mr. Nemeth's topic was "Reducing Air Pollution in a Large Chemical plant."

The other kinescope panel, on "Safeguarding our Water Resources" was moderated by Prof. Lindon J. Murphy of the civil engineering department of the University. The panelists were: Jack Smith, Chief of the Sewerage and Water Pollution Section of the State Division of Health, Jefferson City, Mo.; Harry Bolon, Division Engineer, U. S. Geological Survey, Rolla; Allan Wymore, Engineer with Burns and McDonnell, Consulting Engineers, Kansas City, Mo.; Paul Hodges, pollution control engineer for the Krummrick Plant of Monsanto Chemical Company, St. Louis; Ed Stegner, Executive Secretary, Missouri Conservation Federation, Jefferson City, Mo.; and former speaker pro tem of the State House of Representatives, Robert C. Smith of Columbia. Mr. Bolon, Mr. Hodges, Mr. Wymore and Mr. Smith spoke on various aspects of "Progress Toward Control of Water Pollution" in the morning session.

With the exception of Prof. Gingrich and Mr. Garber, all of the panelists appeared on the regular conference program.

Others on the conference program, which began at 9 a.m. and ended with the session at 3:15 p.m., were: D. W. Rychman, civil engineering department, Washington University, St. Louis; H. M. Steininger, who is in charge of the Sugar Creek Laboratory, Standard Oil Co., Kansas City, where the only oil refinery in Missouri is located; Leonard Dworsky, Asst. Regional Engineer, U. S. Public Health Service, Kansas City, Mo.; and Lt. Robert Bunstein, USAF Hospital, Whiteman Air Base, Sedalia, Mo. Dr. Ryckman spoke on "Reducing Industrial Waste of the Source"; Dr. Steininger on "Handling oil Refinery Wastes", and Mr. Dworsky on "Federal Aid for the Abatement of Water Pollution."

The conference was sponsored by the Public Health Engineering Bureau of the State Division of Health, the Civil and Chemical Engineering Departments of the University, and the University Adult Education and Extension Service.

SURVEY

(*Continued from page* 48)

Foremost among the incentives, therefore, would seem to be the one which only the older, established companies can offer with any acceptable degree of assurance—secuity of employment. Closely linked with job security are such incentives as training programs (with their attendant opportunities for advancement within the company), tuition plans, and stock bonus or profit-sharing arrangements.

It is in the area of incentive, along with the improvement of communications, that management will find its most fertile field for creating that climate in which engineers can work happily and efficiently as employees.

The employees' questionnaire responses showed 55 per cent of their employers offered job security and 54 per cent, opportunities for advancement. Only 32 per cent had training programs, and 30 per cent of the companies had profit-sharing or stock bonus plans. Six per cent offered other inducements.

It would appear that there is still plenty of work to be done with profit in the field of incentives.

The concluding portion of this article will appear in the Jan. issue.

The young wife was not anxious to have a family right away. She visited her old family doctor to seek his advice.

"Well, there's one way that never fails," he said "Simple, too. You just lean over and touch your toes ten times without bending your knees."

"Is that so?" said the girl. "Before, or after?"

"Instead of," said the old doctor.

SOCIETY NEWS

(*Continued from page* 34)

announcements of the technical society, discussion of how much space to take in the Savitar for A.S.M.E. and various officers' reports. New members in the Society totals approximately eighty.

The speaker for the evening was Mr. Stratmeyer of Monsanto. He spoke on "The Role of Mechanical Engineers in the Chemical Industry" and showed some slides showing the engineers at work at Monsanto. After the talk, the group saw a movie from Du Pont entitled Mechanical Engineering at Du Pont."

CHI EPSILON

On Thursday, November 8, Chi Epsilon held a smoker at the Student Union for all prospective members. Faculty Advisor, Professor Karl Evans and President Jack Moberly gave brief explanations of the history and purpose of Chi Epsilon.

On Thursday, November 15 a meeting was held in the Engineering Building and new members were voted on. The initiation ceremony will take place at 5:30 in the Engineering Building on Thursday, January 3, 1957. An initiation banquet and program will follow at Moon Valley Villa.

ETA KAPPA NU

Pledges and members of Eta Kappa Nu met at 4:30 p.m. on November 29 in the Engineering Building. Dr. Wallis and Dr. Waidelich spoke about fellowships, assistantships, and scholarships available at the University of Missouri and other schools in the United States and other countries. They gave full particulars on many of these programs including deadlines for application and stipends involved.

The initiation of new members was held on Monday, December 3 preceding the initiation banquet at Harwell Manor. Professor Lamb spoke to the group.

Eta Kappa Nu officers for the Fall semester are President, Burton Engle; Vice-President, Byron Sherman; Secretary, James Fitzgerald; Treasurer, Paul Klock; Corresponding Secretary, Dudley Childress; Bridge Correspondent, Jack Shultz; and Faculty Advisor, Professor James R. Tudor.

Salesman: "Young man, this handbook is just the thing you need. It will do half your college work for you."

Engineer: "Fine, give me two."

♣


60

BULLARNEY

By WHIT

Once upon a time there lived in the South a man who worked all day in a stove factory, making stoves. He was, in fact, a stover, i.e., one who makes stoves. Now, this stover's boss not only ran the stove factory, but also (this was in pre-Civil War days) picked up loose change by trading in the slave market. He kept his spare slaves in the basement of the stove factory, right under where the stover worked.

One day the boss brought in a slave who was sick—had a high temperature (106° F) and was delirious. The slave kept shouting and ranting all day, which made it very hard for the stover to work. So when he, the stover, went home that night, his wife said, "My dear, you look tired."

"So would you look tired," he replied, "if you had been stoving over a hot slave all day."

♣

A college senior dated a young lady from a nearby school a few times. Then some weeks passed and when she hadn't heard from him she sent a telegram: Dead, delayed or disinterested?

To which the young man promptly wired back: Hunting, fishing or trapping?

♣

Pop Robin returned to the nest and proudly announced that he had made a deposit on a new Buick.

Maacop had wired a government bureau asking whether hydrochloric acid could be used to clean a certain type of boiler tube. The answer was:

"Uncertainties of reactive processes make the use of hydrochloric acid undesirable where alkalinity is involved."

The inquirer wrote back, thanking the bureau for the advice, saying that he would use the acid. The bureau wired him: Regrettable decision involves uncertainties. Hydrochloric acid will produce submuriate invalidating reactions."

Again the man wrote back thanking them for their advice, saying that he was glad to know that hydrochloric acid would be all right. This time the bureau wired in plain English: "Hydrochloric acid will eat hell out of your tube."

♣

Two Indians had watched the building of a lighthouse on the rocky west coast with much interest. When it was finally completed they sat and watched it every night. A thick fog came rolling in one night and the siren blew continuously.

"Ugh," grunted one Indian to the other. "Light shine—bell ring—horn blow—but fog came in just the same."

♣

A circle is a round line with no kinks in it, joined up so as not to show where it began.

OPTIMIST: A man who figures when his shoes wear out he'll be back on his feet.

TOMORROW: Today's greatest labor saving device.

DIAMOND: One of the hardest substances known to man — particularly to get it back.

CHINESE WOLF: A guy who takes his girl for a rickshaw ride, then stops and tells her he ran out of coolies.

♣

Engineer: "Going around with women a lot keeps you young."

2nd Engineer: "How come?"

Engineer: "I started going around with women when I was a freshman two years ago, and I'm still a freshman."

♣

When Eloise returned from a ride, her mother noticed that one of her shoes was muddy.

"Why is your right shoe muddy and not your left?" she asked.

"I changed my mind," Eloise answered.

♣

Then there was the geology major who had the hobby of collecting stones and putting them in his bathroom. He had rocks in his head.

♣

The birds do it
The bees do it
The bats do it
Join the Air Force

SHAMROCK SEZ

Merry Christmas, and if you didn't get your Shamrock by the 25th, Happy New Year. If you didn't get it by the first, Happy Lincoln's Birthday. If you didn't get it at all, write Bob Holley, c/o Dead Letter Office, Columbia, Mo.

Anyway, Herdan and I went to the Engineering College Magazines Associated Convention at the University of Arkansas the other day. Ol' Shamrock came home with the Association's First Place Award for the Best cover last year. (See cut below.) Congratulations to Paul Gernhardt, Ye Ed 55-56. The photo was by Jerry Herdan and the young gentleman on the cover was William C. Boteler, Jr., whose old man was Associate Ed last year. Incidentally, Gernhardt has an article next month, be sure and read it.

First Place Award—Best Cover of the year '55-'56.

Oops. While pasting up the dummy for the November issue in the lounge of a girl's dorm and watching a football game on T.V., Ye Eds garbled the Society News. It seems the AIEE-IRE officers got in the back of the Engine Club news. Ye Eds both being members of AIEE, we hasten to correct the error. The Chairman is Bill Nichols; vice-chairman, Bill Barber; treasurer, Jack Schultz; recording secretary, Roger Pape; AIEE secretary, Charles Butler; IRE secretary, Jim Fitzgerald.

In case anyone asks, the engineering society secretaries are a real sharp group of people. A couple of years ago, Ol' Shamrock tried to print society news and got negligible support from the societies. This year, Gene Johnson, Society Ed, and the society secretaries have been coming through with the copy, loud and clear.

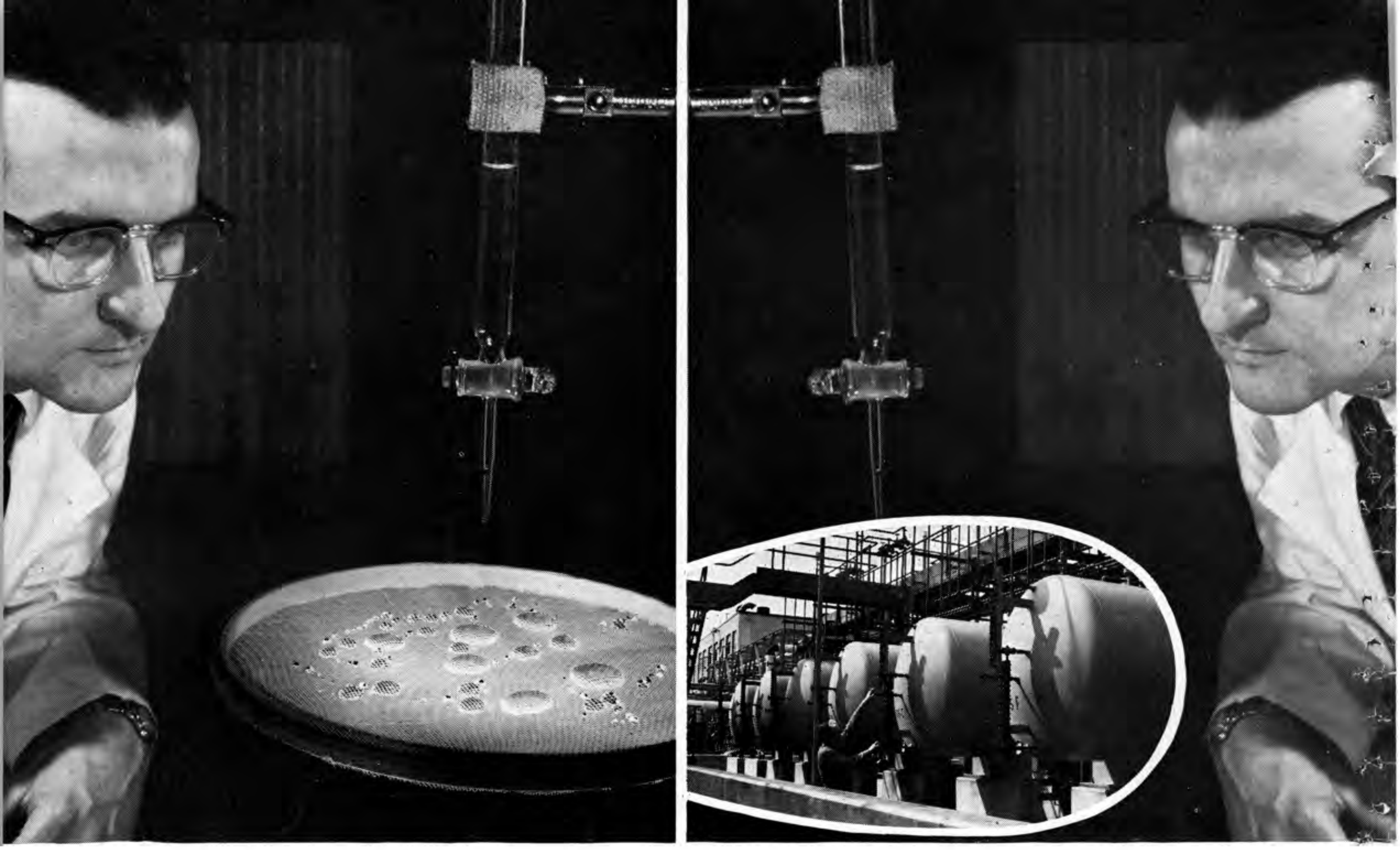
If you've been wondering about the little Irishman behind the column, he's the creation of Dusty Cravens. In the opinion of Ye Ed, Dusty is the first real artist Ol' Shamrock has had since Mark Parsons, back in '53. Mark's engineering ability didn't compare with his artistic ability and he wasn't on the staff too long. Dusty is Tau Beta Pi, however, and we'll be seeing quite a bit of his work. He has a picture story on the EE inspection trip you won't want to miss.

Ed Vredenburg, E. E. Prof. and secretary of the Missouri Engineering Alumni Association, and Ed Duke, Business Manager of Ol' Shamrock, have been getting new members for MEAA like mad. There's a list of these new members somewhere in the magazine. Shamrock is the official publication of MEAA, which holds its annual meetings during St. Pat's Week, each year. We'll have a list of officers, more information and more new members in the January issue.

Ye Ed has received several comments lately on Bullarney. A director of guidance and counciling at a large Missouri high school complimented us quite highly on the jokes and a M.E. Professor shared the opposite view. Some of the faculty here seem to want us to print a magazine of Sunday School Lessons. We do have a new joke editor, though. He's Weldon Whiteaker, ME 58, doesn't drink, doesn't smoke, bathes regularly and hasn't missed church in months. Even if the jokes don't reflect it, we *are* trying to raise our moral standards.

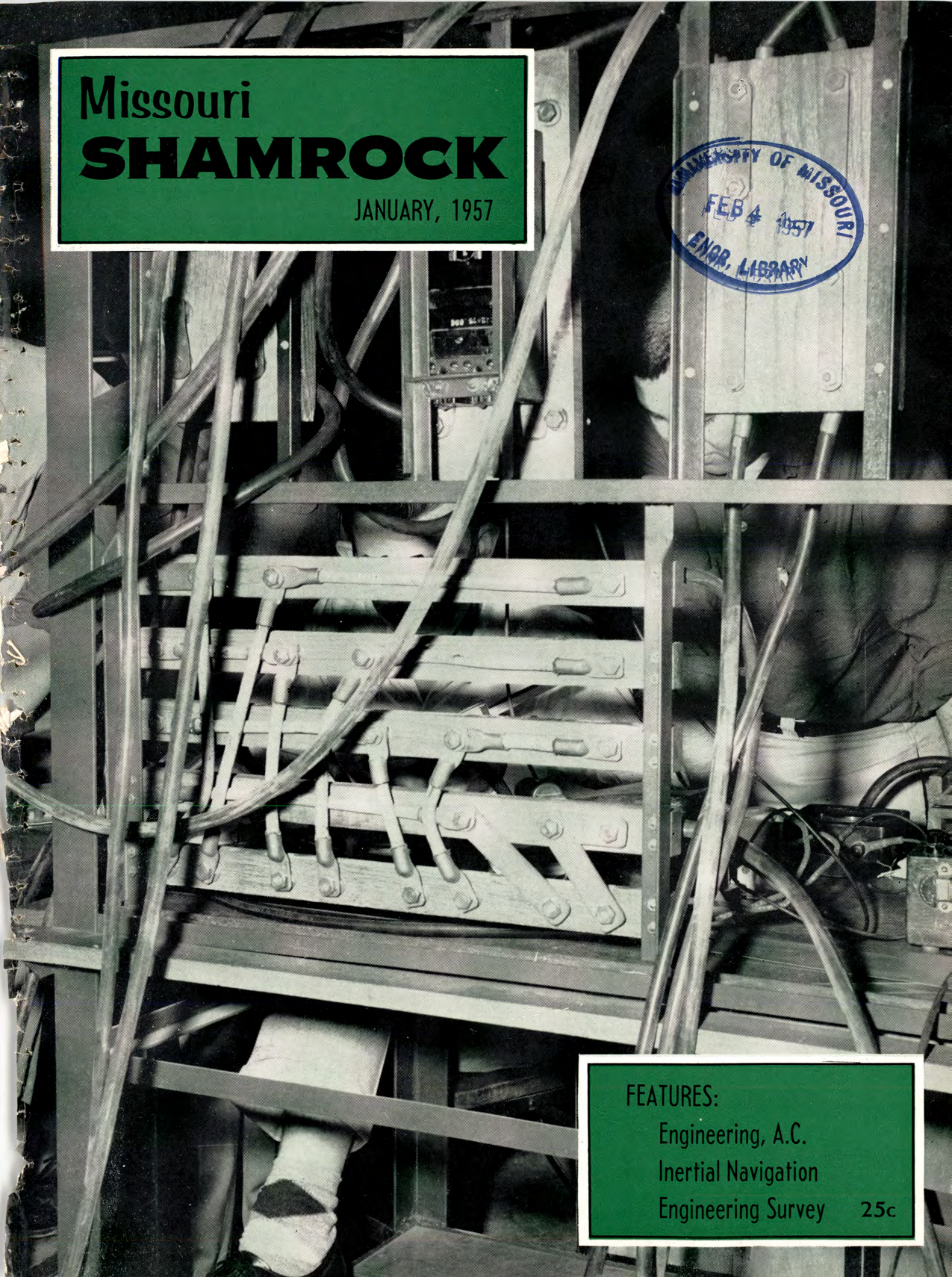
Au Revoir


PHOTOGRAPHY AT WORK—No. 25 in a Kodak series



Missouri SHAMROCK

JANUARY, 1957



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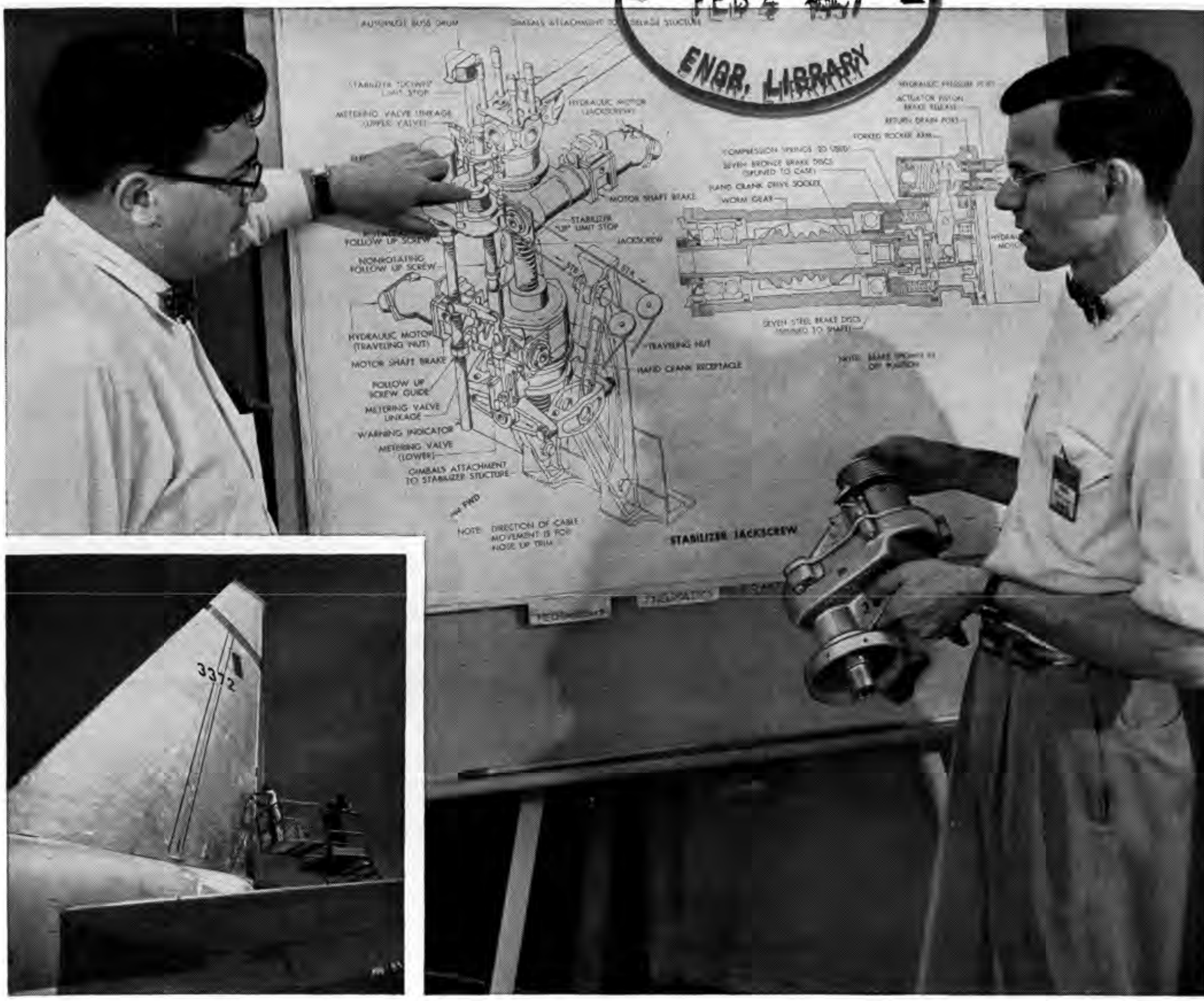
Engineering, A.C.

Inertial Navigation

Engineering Survey

25c



B-52 jack screw—a typical Boeing design challenge

On Boeing B-52 bombers, the horizontal tail surface has more area than the wing of a standard twin-engine airliner. Yet it can be moved in flight, up or down, to trim the aircraft.

The device that performs this function is a jack screw, which, though it weighs only 255 pounds, can exert a force of approximately 225 *tons!*

Many kinds of engineering skills went into designing and developing a jack screw so precise that it automatically compensates for stretch and compression under load. Civil, electrical, mechanical and aeronautical engineers, and mathematicians and physicists — all find challenging work on Boeing design projects for the B-52 global jet bomber, and for the 707 jet tanker-transport, the BOMARC IM-99 pilotless interceptor, and aircraft of the future.

Because of Boeing's steady expansion, there is continuing need for additional engineers. There are more than twice as many engineers with the company now as at the peak of World War II. Because Boeing is an "engineers' company," and promotes from within, these men find unusual opportunities for advancement.

Design engineers at Boeing work with other topnotch engineers in close-knit project teams. They obtain broad experience with outstanding men in many fields, and have full scope for creative expression, professional growth and individual recognition. And they find satisfaction in the high engineering integrity that is a Boeing byword.

In addition to design engineering, there are openings on other Boeing teams in research and production. Engineers like the life in the "just-right" size communities of Seattle and Wichita. They may pursue advanced studies with company assistance in tuition and participate in a most liberal retirement plan. There may be a place for *you* at Boeing-Seattle or Boeing-Wichita.

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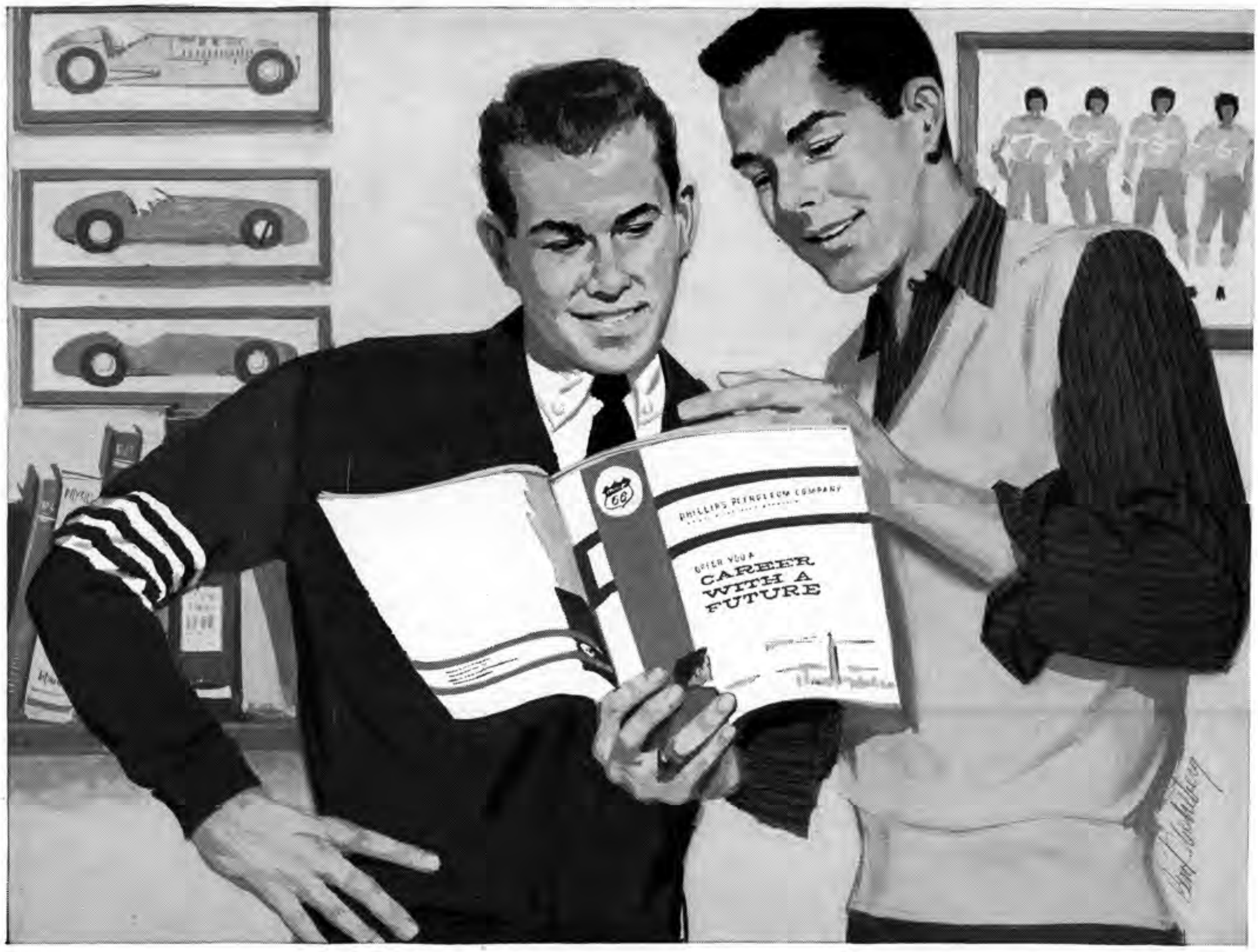

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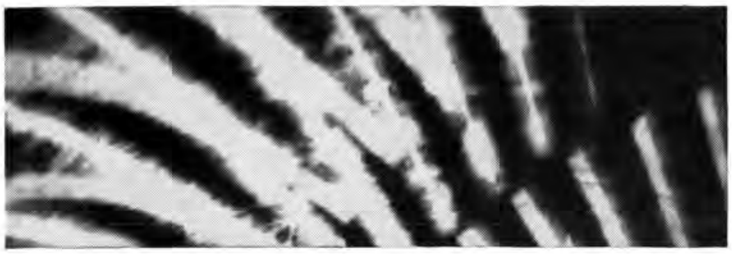
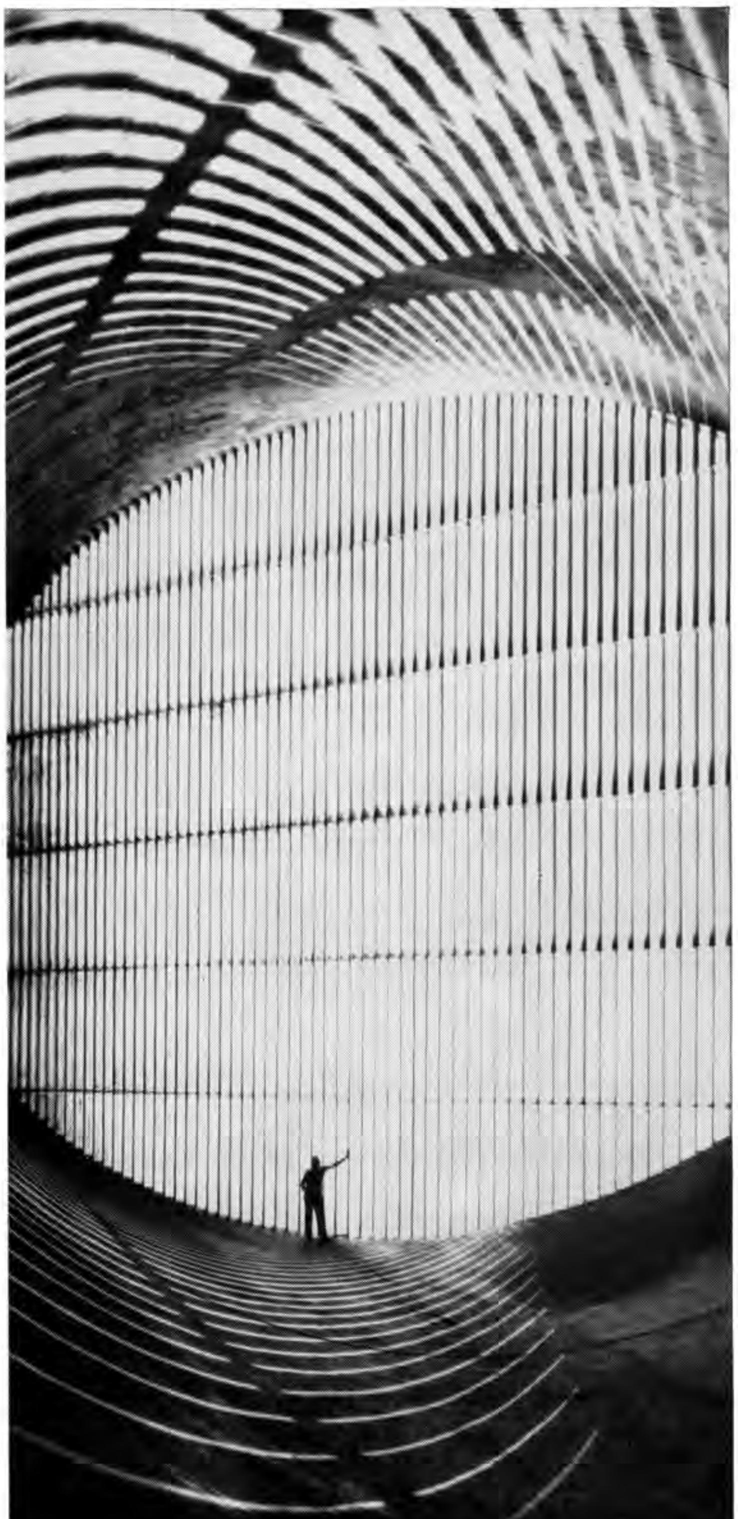
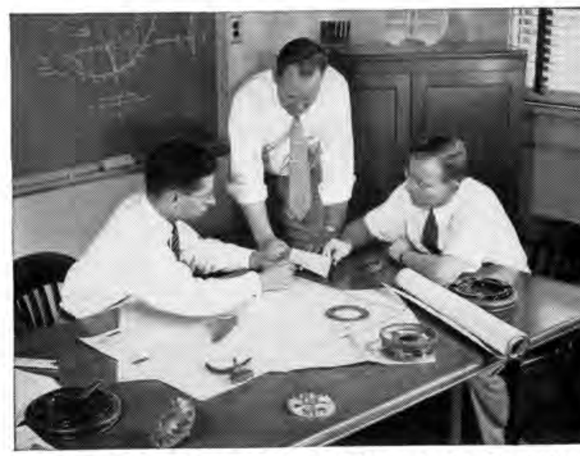


Building the world's largest wind tunnel

. . . A PROBLEM IN PROPULSION





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ON THE COVER:

One of life's exaspirating moments—more watts than volt-amperes . . .

Photo—J. Herdan

MISSOURI SHAMROCK

VOL. XXIII JANUARY, 1957 No. 4

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ENGINEERING COLLEGE MAGAZINES
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WHITING
350 TON

Editorial

WHY?

As it again becomes time to enroll for the new semester a thought comes to mind—one which has become more frequent as the eighth semester rolls around. It involves a sacred thing known as the curricula of the college of engineering.

To start with let's see how the other customers of this skull factory live. These lucky souls are required to have only 124 semester hours for graduation as compared with the 138 required of engineers. Other little fringe benefits which non-engineers enjoy include such things as full credit for advanced ROTC (totaling some 16 hours) as compared with 1/4 this amount accredited to engineers. And of course there's always the well bemoaned story of so few free electives.

In order to graduate in four years (somewhat a rarity) the engineer must consistently take eighteen and over hours per semester. In contrast our chemist and physics friends over in the arts and science college must labor under a maximum load of sixteen hours per semester. Sometimes it appears that engineers must manage to survive only by convincing their ego that they are something special, quite differentiated from the average Joe College. Maybe we are a little different.

Granting that only the most meager sampling of our rapidly advancing technology can be obtained at best in four years, it appears foolhardy to suggest any decrease in amount of knowledge supposedly assimilated by the student. Might it not be good to make the engineering degree a five year course, with perhaps slightly more technical education, but, more important, **lighter** loads and **more** liberal arts courses? Many other universities have been forced to take this step—will we also?

Certainly a five year college education would be worth more than a four year course. Industry would be among the first to recognize it. Aside from any economic worth—wouldn't some **SMALL** benefits be derived by allowing the engineer-to-be to enjoy his college life a little more and also receive a better-balanced education.

M. L. C.

← **Frontispiece—This 350-ton Whiting Gantry Crane rears 94 feet high at the hydroelectric power station of the Inland Power and Light company of Portland, Oregon at Areil, Washington. The crane has a span of 97 feet, 9 inches. It was used during the construction phase at the site and is now part of the permanent equipment at the station.**

—Courtesy of General Electric Educational Service

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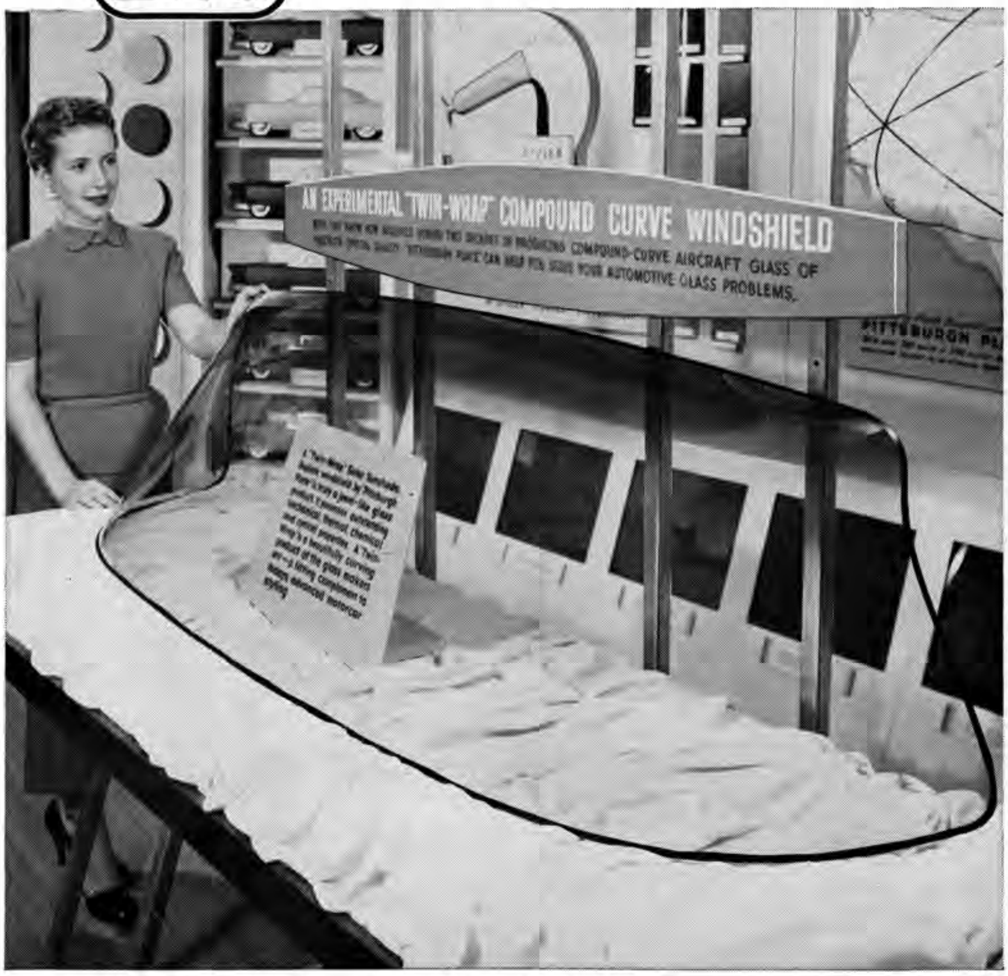

PPG produces volume items such as wrap-around windshields, other automotive glass, Herculite® doors, and processes radar screens, atomic glass, aerial camera lenses, and the like.

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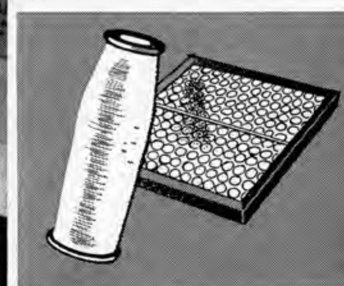
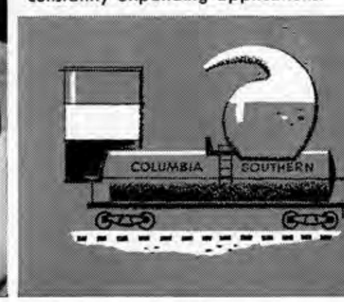


PPG's fiber glass is being used for constantly expanding applications.



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INERTIAL NAVIGATION

M. L. CRENSHAW

Inertial navigation is just now passing from the realm of a theoretical possibility to a practical reality although the basic principle underlying its operation has been known since for many years. It offers many operational advantages over other methods, which give useful answers with moderately precise instruments but have inherent limitations beyond which further refinements in components no longer help. While inertial navigation has no such limitation, extremely precise instruments are required before even moderately acceptable performance can be achieved. Only in recent years have technical arts advanced to the degree where the development of instruments of suitable quality has been possible.

At the present time, inertial guidance is being applied almost exclusively to military problems. Because of the necessarily rigid security restrictions, the details of the systems under development are known to relatively few. The principles upon which systems are based have been known to the scientific world for many years and cannot be considered classified. The intention of this article is to outline the basic theory of inertial navigation and some of the problems associated with its operation.

Any inertial navigation system is essentially a form of dead-reckoning device. The geographic positions (latitude and longitude or similar equivalent) of both the origin and destination must be known and these instructions set into the instrument. Thus, inertial guidance is applicable only to targets stationary with respect to the earth during the missiles flight, unless of course, some form of homing device is used during the final phase of the course.

Once the information as to starting and destination points have been placed in inertial navigator, it is capable of determining and providing the following information:

1. Geographic position of the vehicle
2. Ground velocity and track
3. Distance traveled and distance to destination
4. Direction to destination
5. Attitude of the aircraft or missile

DR COMPUTERS

Inertial guidance is often confused with automatic dead-reckoning (DR) computers, which have been in the operational stage for some years. The results yielded by the two devices is somewhat similar although the solutions are obtained from quite different information.

The DR computer works from essentially the same information which a pilot or navigator would use if he were working out the problem manually. Vehicle speed is obtained from a conventional airspeed indicator, modified by external wind velocity which is set in manually or automatically by means of a Doppler or other type radar.

Some DR Computers employ Doppler/FM radar to measure ground speed which is then integrated as a function of time to provide the displacement from the starting point and then resolved into its north-south and east-west components.

Without such a radar (ground-speed) input, an accurate source of static-pitot pressure for airspeed measurement would be needed. Not only is this difficult to obtain on high-speed aircraft and missiles, but accurate and continuous information as to the velocity and direction of winds aloft is practically impossible to obtain.

The inertial system, on the other hand, utilizes an entirely different technique of measuring vehicle displacements which eliminates the necessity for accurate airspeed and wind velocity or drift.

INERTIAL FUNDAMENTALS

The fundamental law of inertia, Newton's Second Law, states that force is equal to time rate of change of momentum without approximation or correction for any effect. This, then, is a fundamental effect upon which there will not be any inherent accuracy limitations.

In some ways inertial navigation is similar to dead-reckoning. Acceleration is measured by some type of instrument, steps being taken so that only acceleration due to change in vehicle velocity is recorded. Velocity is obtained from the time integral of acceleration. Position is obtained as in the conventional DR system by a second integration. The inertial system, however, senses accelerations with respect to inertial space, thus, no corrections for wind velocity, vehicle "crab angle" or any of the other sources of error inherent in dead reckoning appear.

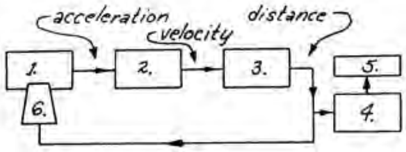


FIG. 1. Simplified Inertial System

1. **Accelerometer**
2. **First Integrator**
3. **Second Integrator**
4. **Computer**
5. **Position Indicator**
6. **Stabilized Platform**

A simplified block diagram of a pure inertial system is shown in Fig. 1.

BASIC SYSTEM COMPONENTS

Accelerometers and integrators, often combined into a single unit, are the basic sensing elements of the inertial navigating system. Two or three are needed so that motion in the north-south, east-west and

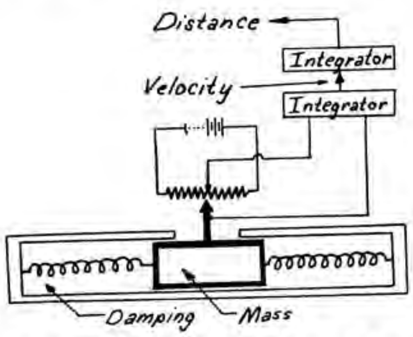


FIG. 2. Basic Accelerator and Integrator

often even the vertical direction may be measured. Extremely wide range devices are needed since values vary over a range of several thousand to one. Fig. 2 shows diagrammatically elements of an accelerometer and integrator.

In order that the accelerometers are not subject to undeterminable components of gravity, they are mounted on a stable element. This device is able to maintain some predetermined spatial orientation irrespective of any change in vehicle attitude or heading. The well-known property of gyroscopes of preserving angular fixity in space is utilized to this end. Fig. 3 indicates the elements of such a platform. Each gyroscope may be of the single-degree-of-freedom as sketched. Torque about the input (platform gimbal) axis causes no deflection about that axis but precision occurs about the output (rotor support) axis. A sensitive pickoff detects such motion and causes an opposing input axis torque by means of a servo system. In general, resolution of the gyro signals is necessary, since the platform may assume any orientation relative to the outer gimbal axes.

However, since the gyros stabalize the platform in relation to an absolute system, any movement of the vehicle around the earth will cause the accelerometers to be displaced in relation to vehicle's "local vertical" (a line connecting the vehicle and the center of the earth). Therefore, it is necessary to mount the accelerometers on a equatorial mount so that by proper drives they can be kept substantially level with respect to the earth and thus not be effected by the acceleration due to gravity. The latitude cannel functions by supplying the doubly integrated output of the N-S accelerometer to a servomechanism so that the E-W trunnion is rotated by an amount sufficient to correct for this effect. The operation of this channel is indicated by Fig. 4. The longitude cannel is identical except that linear distances traveled on the surface of the earth corresponding to a given change in longitude angle depends upon the latitude position. It is necessary, therefore, to multiply the output of the E-W accelerometer integrator by the secant of the latitude angle. This information is added algebraically to "clock" information (necessary to compensate for the earth's rotation relative to a point in space) and used to rotate

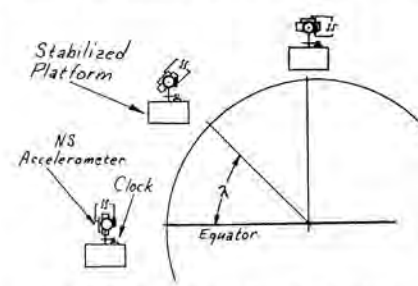


FIG. 4. The Latitude Channel

the mount the proper magnitude.

These basic elements of an inertial navigator are shown in Fig. 5.

ERROR LIMITING

It would appear that any constant acceleration error would cause the computed position to be in error by an amount proportional to the second power of the time, ie. as given by the relation:

$$s = \frac{1}{2} a t^2$$

Were such the case, even instruments of very high precision would yield errors of such size as would render their answers worthless.

To solve this crucial problem and the associated problem of maintaining the accelerometer mount horizontal, the concept of the "84-minute pendulum" is applied. This principle states that if a simple pendulum were of sufficient length to

(*Continued on page* 16)

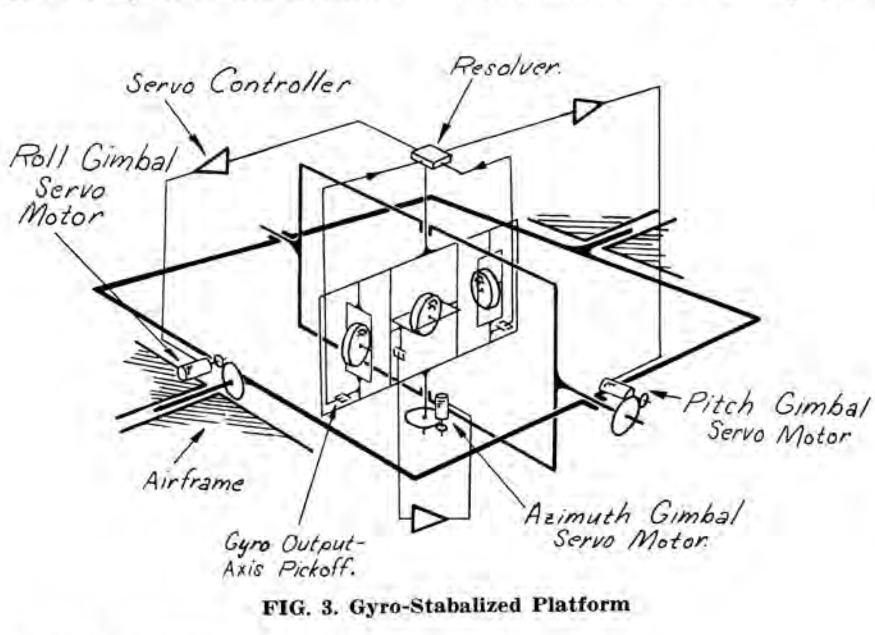
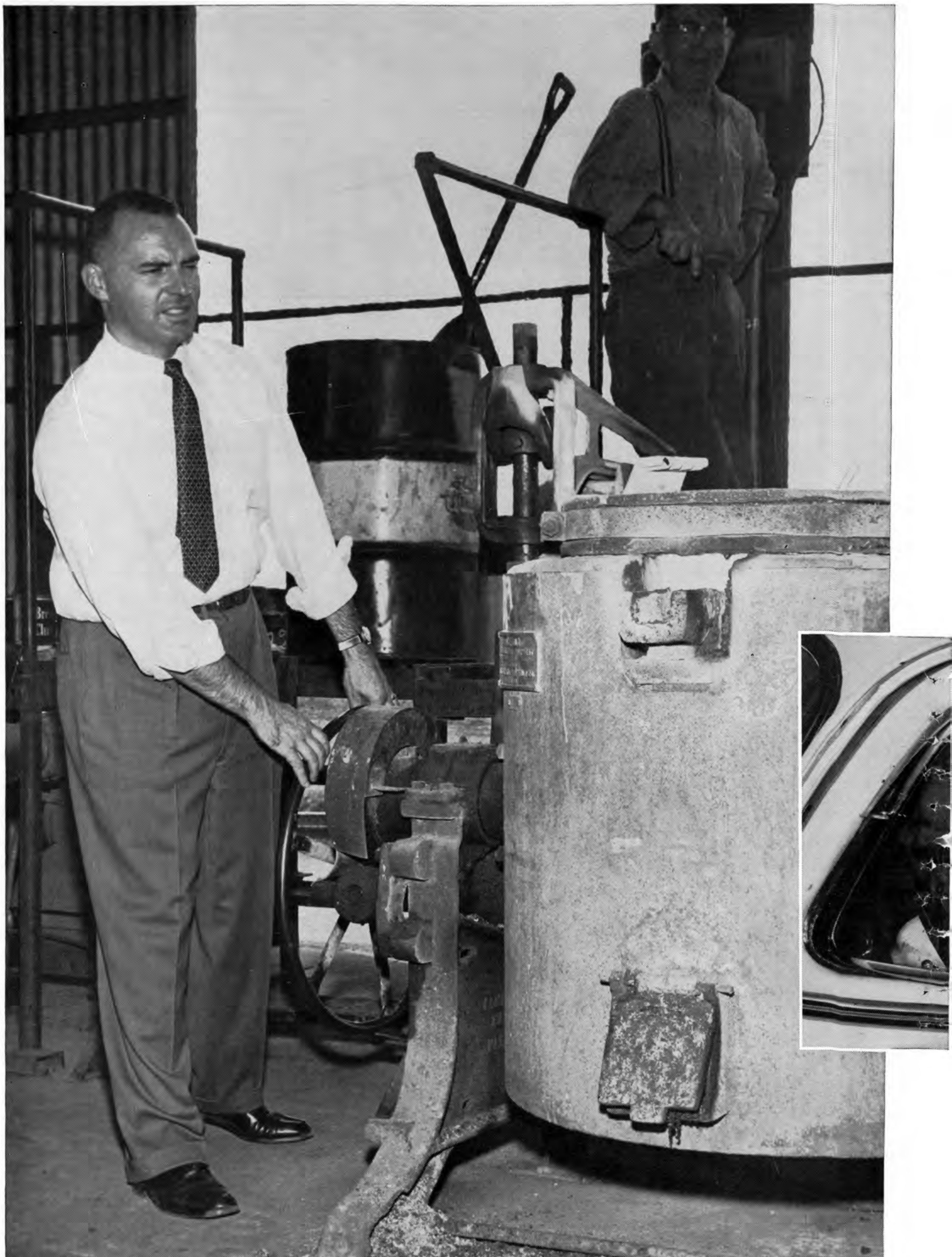


FIG. 3. Gyro-Stabalized Platform



More graduate engineers moving up in the GAS industry ... the nation's sixth largest

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

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

Joseph J. Drechsler
B.S. in Mechanical Engineering, 1948, Johns Hopkins University

Joe Drechsler, after 8 years with Baltimore Gas and Electric Company, is now Assistant Superintendent in a department with over 450 employees

After completing the company's Student Engineering Training Program, Joe spent one year in the Gas and Steam Testing Laboratory. He was then promoted through various levels of engineering and supervisory assignments, to his present job of Assistant Superintendent on April 1, 1956. This department has over 450 employees and is responsible for the installation and servicing of industrial, commercial and domestic gas appliances on customers' property, and the installation and servicing of gas and steam metering and pressure recording equipment.

Robert K. Von Der Lohe
B.E. in Industrial Engineering, 1948, University of Southern California

In just 6½ years with Southern Counties Gas Company of California, Robert K. Von Der Lohe has become Manager of Commercial and Industrial Sales

After two years with a construction engineering firm, Bob Von Der Lohe joined the gas company and began his steady climb to his current position. Starting as an assistant technician in 1950, Bob has moved up through the jobs of industrial sales engineer and staff representative-industrial sales, to his present post as Manager, Commercial and Industrial Sales. Bob does more than "sell" industries and commercial operations on the use of gas. He also supervises a staff which advises restaurant and hotel owners on ways to improve their gas operations and over-all productive efficiency.

(*Continued from page* 13)

allow the center of gravity of the pendulum (bob) to coincide with the center of the earth, it would be possible to move the point of suspension around at will without disturbing the bob. Thus, a vertical reference would always be available. Naturally the simple pendulum is unusable in this form, however, the same effect is obtained with a physical pendulum having the same period of oscillation. This period is given by:

$$T = 2\pi\sqrt{L/g} = 2\pi\sqrt{\frac{(3{,}963)(5{,}280)}{(32)(3{,}600)}} = 84 \text{ minutes}$$

Looking at the latitude channel, consider what happens if a slight unbalance error occurs in the accelerometer, i.e., the device indicated and acceleration although there is none. This signal, intergrated twice, appears as an indicated change in the vehicle's latitude and causes the servo to tilt the accelerator mount in the same direction. This tilt causes the accelerometer to sense a component of gravity, which at some angle of deflection will balance out the spurious signal. Although no acceleration signal reaches the first integrator, the second integrator interprets this to mean that the vehicle is continuing to move at constant velocity and so continues to tilt the mount in the same direction. As the table deflection becomes greater, the accelerometer output indicates a change in direction of acceleration and at some position the output of the second integrator changes sign, and cycles reverses and repeats itself. Thus, it can be seen that the combination of accelerometer, integrators and servo-feedback behave exactly like a long period pendulum. By tuning this system to an 84-minute period, i.e. proper selection of scale factors, loop gains, etc.; the angular acceleration of the mount system is made equal to the angular acceleration of the vehicle about the center of the earth. The acceleration disturbance then, results in an oscillation, not a cumulative integrated error, so that the position error is bounded, i.e. does not increase (in average value) with time. This fortunate circumstance occurs because the earth has a finite radius, inertial navigation over an infinite flat earth would be much more difficult.

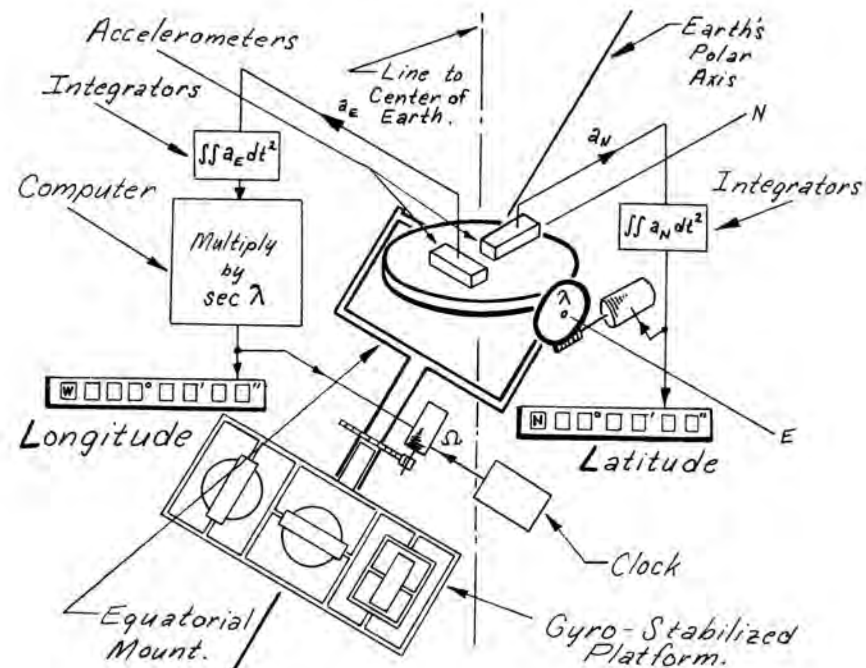


FIG. 5. The Basic Elements of an Inertial Navigator

COMPENSATION FOR OTHER ERRORS

The elementary system just described must have provisions for compensating for errors due to what are called "phantom accelerations". These accelerations are caused by the earth's rotational velocity.

One is due to the fact that the earth is not a perfect sphere but is rather an elliptical ovoid having a somewhat shorter radius at the poles than at the equator. This causes a maximum difference of up to 11 minutes arc between the vertical position as established by a plumb line (or 84-minute pendulum) and a line through the center of the earth at a latitude of about 45°. This causes the N-S accelerator to experience a false indication of magnitude proportional to:

$$\Omega^2 \sin 2\lambda,$$

Where Ω is the earth's rotational velocity and λ is the vehicle's latitude.

This effect can be compensated for by computation of a bias voltage to be applied to the N-S accelerometer.

Another troublesome acceleration is the Coriolis effect. This is caused by the fact that navigation is being done on a rotating base, i.e. the earth, so that a "straight" course relative to the earth is a curved one in space. Thus, in space the vehicle is continuously changing the magnitude and direction of its tangential velocity in space. The error factors are equal to:

$$2\,\Omega\,(V_{N-S} \text{ or } V_{E-W}) \sin\lambda$$

where, Ω is the earth's rotational velocity,
λ is the vehicle's latitude,
V_{N-S} or V_{E-W} = the vehicle's ground velocity, measured in the respective direction.

For compensating, the components of V may be obtained by a single integration of the acceleration outputs, multiplied by the proper factor and applied as bias voltages to the respective accelerometers.

In navigators for vehicles having a wide range of vertical velocity and height above the earth, other corrections must be made. They, however, are of second order importance.

HYBRID SYSTEMS

Because of the extreme accuracy

required in a pure inertial system, the components often prove quite difficult and costly to manufacture. Also the weight of such high precision equipment often becomes prohibitive for airborne use.

Much study is being devoted to "hybrid" systems. These employ supplemental radar, celestial or ground reference techniques to correct for the cumulative errors which occur in the pure inertial system. It is necessary to sacrifice some of the advantages of the pure inertial system, such as complete freedom, external radiation and reference. However, the resulting reduction in size, complexity, and cost often makes this a valuable trade.

One of the most obvious types of hybrid systems utilizes a Doppler radar for determining the vehicle's velocity relative to the ground. This

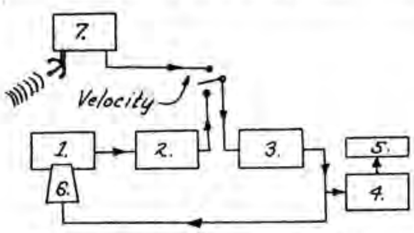


FIG. 6. Inertial-Doppler System

1. **Accelerometer**
2. **Accelerometer**
3. **Accelerometer**
4. **Accelerometer**
5. **Accelerometer**
6. **Accelerometer**
7. **Doppler Radar**

relatively accurate velocity measurement is compared with the integrator-computed velocity. If any steady state difference exists, a compensating bias can be introduced into the integrator until the two velocities are identical. Fig. 6 shows the block diagram of a simplified inertial-Doppler system.

Another way of obtaining position fixes for recalibrating an inertial system is to make use of an automatic celestial navigation system. By obtaining a celestial fix on two stars (their altitude angle relative to the horizontal plus their azimuth positions), it is possible to establish a vehicle's position anywhere on the earth. One of the major problems in celestial systems—that of obtaining an accurate horizontal reference—is solved when used in conjunction

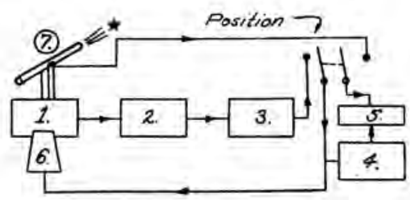


FIG. 7. Inertial-Celestial System

1. **Accelerometer**
2. **Accelerometer**
3. **Accelerometer**
4. **Accelerometer**
5. **Accelerometer**
6. **Accelerometer**
7. **Automatic Star Tracker**

with an inertial system which has a gyro stabilized platform that maintains accurate horizontal alignment. Fig. 7 shows the block diagram of a simplified inertial-celestial system. Periodic position fixes from the celestial unit are introduced to correct the position coordinates determined by the inertial system. Single or dual star trackers are used according to the desired accuracy. The dual tracking system would probably be capable of serving as a complete alternative navigation system.

When used in conjunction with ground based radio navigation aids, relatively simple inertial navigation systems could prove invaluable for civil aviation operations in the event of a major war. Since the radio beacons would prove an ideal aid to enemy bombers, they could only broadcast for short periods at irregular intervals. The inexpensive inertial systems would supply the pilot with the necessary information between two radio fixes.

CONCLUSION

An inertial guidance system is defined as "one which is independent of information other than gravitational effects, obtained from outside the missile. The sensitive elements make use of the principle of Newton's second law of motion.

Inertial systems have the main advantage of operational freedom. Such a system does not depend upon information transmitted by its origin or the destination. It is not impaired by weather conditions and is not vulnerable to "jamming" or other man-made interference.

Inertial guidance is limited to use against targets which are stationary during the time of flight of the vehicle unless some form of target seeker is employed in the final homing stage.

Components for inertial systems must possess a degree of accuracy comparable with that used in establishing basic standards in the great physical laboratories. This coupled with the ruggedness necessary for operation in high speed aircraft and missiles have made the problem difficult indeed. Only in recent years has an inertial navigation system become even remotely practical. Vast improvements have been made in the design of gyros, accelerometers, and integrators and also in accurate high-speed servosystems. Analog computers capable of performing spherical trigonometric computations have been long used in aviation. They will probably be replaced by digital computers as greater and greater accuracy becomes necessary.

"Hybrid" or combination systems ease to a large extent the accuracy problems of pure inertial navigation. They utilize some form of earth or celestial reference technique to correct cumulative errors in the inertial system.

The problems of designing smaller, more accurate, and more reliable components will continue to challenge the ingenuity of inertial system designers for many years to come.

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Engineering, A. C.

P. D. GERNHARDT, M.E. '56

Editor's Note—We were recently very pleased to hear from "Ye Ol' Ed" ('55-56). Paul is now employed at Marley Co., Kansas City.

Note — No, this isn't an article on alternating currents. Instead it deals with engineering "after college".

In college, the subject of engineering is treated as an exact science, or nearly so. The examination (frequently referred to in less flattering terms) usually has a number (or numbers) as its final result. If you get the correct number, you're in; if not, you're out. It's as simple as that.

The situation in industry is quite different, however. It is practically impossible to approach your boss, spout a number, and get anything but a look of benign sympathy. Instead you must argue, plead, deny, accuse and use all the other means of intimidation if you wish to gain acceptance for your "number". Why is this? Perhaps the main reason is the lack of a product in College (other than canned brilliance—in its greater and lesser forms. In college, if the book says so, and the instructor says so, then it must be so! In industry, the boss can say so, the foreman can say so, the machinist can say so, but if the product says no, it's no! It wouldn't be so bad if only the product could say "no." But in addition, there are the machine tools, the process equipment, the workers and the almighty "available funds", each of which can utter a most audible "no!"

Another thing which tends to separate the college and "A. C." phases of engineering is the fact that graduate engineers are frequently dealing with untried ideas —ideas which offer a better process or a better product—something with which to get "a jump on the competitor." There is no textbook for this sort of thing and the engineer must make the best guesses he can. Perhaps the classic example of this is the development of Nylon, into which millions of dollars and years of effort were poured before any profit was realized.

Thus, it is that a pompous engineer, Mo. U., '56, (lording it over his drafting table) cannot merely say "This gimwhompey should be made of plastic!" and consider that anything momentous has occurred. Before the gimwhompey *can* be made of plastic, a chorus of "no's" must be silenced.

Let's suppose that our engineer visits the accounting department and asks if making gimwhompeys out of plastic will save money. The accountant doesn't really know for sure but as a matter of policy he says no. In this way all he has done is squelch another hairbrained idea. On the other hand, if he says "yes" the company may lose a half million dollars (and an accountant at about the minus three hundred thousand mark). Here the battle line is drawn and the engineer must bring out his weapons. After considerable skirmishing (Are you aware that part would be 2.48 times as strong if made of plastic?) the engineer finally makes his major attack. In a deep, sonorous voice he says, "How do you *know* this part won't be cheaper in plastic?" The accountant, taken by surprise, says, "Well, *maybe* it could be cheaper." And the engineer rushes off to report to other skeptics that "our accountant *believes* the part can be made cheaper with plastic!" Gradually, he builds a backlog of "believers" until he feels ready to tackle the Big Boss. Then he discovers that the part is being eliminated in a redesign of the product by engineering group "Z" (up on the sixth floor).

A situation which the author has seen is typical of the manner in which a good answer in theory can become a bad answer in practice. A company has developed a very excellent method of producing finned tubing for air-cooled refrigeration units. The only trouble is that approximately 90% of the cost of producing these tubes is in the purchase of raw materials. Thus, companies which are able to purchase raw materials in larger quantities and at a greater discount can more than make up for their more expensive manufacturing costs. The "best" product from the pure engineering standpoint is then the "worst" from the competitive standpoint!

Even in college the engineer discovers that his superiors (instructors and no cracks) are damnable skeptics, but the skepticism of an instructor is nil compared to that of B. B. (Big Boss—not Big Brother). After all, if you get the correct answer (2.684732—slide rule) on the quiz, how can your instructor argue? (For the purpose of this discussion, let's assume he can't). On the other hand, if you recommend that a new machine tool be purchased you are basing your opinion on a host of intangibles. Next year's sales may be unexpectedly low so that no extra machine capacity is needed or a better machine may appear on the market immediately after your recommended machine is purchased. These and innumerable other possibilities must be considered and some sort of a reasonable conclusion must be obtained. B. B. must be satisified that the best possible course of action is being followed. The net result is that the Engineer, A. C., finds himself continually involved in situations where engineering is *nine* parts salesmanship and *one* part—Engineering!

SURVEY—

Attracting and Holding Engineering Talent

Editor's Note—This is the remainder of an article started in the October Issue and continued in the November Issue. It is reprinted by special permission of the PROFESSIONAL ENGINEERS FOR INDUSTRY, INC.—JGH

WHAT ABOUT UNIONS?

Do engineers want a union?

- Sixty-six per cent answered "no"
- Only three per cent belong
- Unionization handicaps recruiting

Do they want non-bargaining organization?

- Sixty-six per cent answered "yes"
- Ten per cent of plants have one
- Six per cent of those surveyed belong

IT IS AXIOMATIC that Americans are apt to render snap judgments when asked to take sides on a controversial question, but when they are quizzed on their beliefs regarding pertinent questions bearing on the main issue, they are likely to exhibit a leaning quite opposite to the stand initially taken.

In keeping with that tradition, the engineers who responded to the survey questionnaire indicated clearly that they regard themselves as professionals and wish to be so regarded by their employers; that they are impatient of regimentation, and want to stand on their own feet and so grow professionally.

But thirty-four per cent of them answered in the affirmative the questions: "Do you believe engineers' interests are strengthened economically or otherwise by membership in a collective bargaining organization?"

NO MALCONTENTS THEY

Nor were these voters in the affirmative malcontents who were dissatisfied with their jobs and groping for something better. They were a fair cross-section of the entire group surveyed.

Represented in this group of thirty-four per cent were approximately the same proportions of contented and discontented engineer-employees. It is evident, therefore, that the leaning toward labor organizations of so high a percentage of men who are professionals both by training and inclination has little or no connection with their attitudes toward their own jobs.

It is perhaps significant that the opinion voiced by this group was formed by most of its members without any actual experience with a labor organization, for of the more than 1,300 engineers queried, only about six per cent are employed in plants which have collective bargaining organizations for professional employees. Of that relatively insignificant number, only half belong to the union.

Of the sixty-six per cent who answered the question on unionization in the negative, a large percentage of them indicated their emphatic disapproval with exclamation points and penciled comments on their questionnaries.

PROFESSIONAL VIEW

Those in the sixty-six per cent reflected the view that unionization is wholly inconsistent with professionalism. One of them enclosed with his questionnaire a reprint of a paper by D. B. Steinman, founder and first president of NSPE, which gave eleven reasons why engineers should not join unions.

Although many who understand the professional attitude are thoroughly familiar with these reasons, it might be well to quote a few of them.

"The usual methods of unions (coercion, strikes, picketing, closed shop, etc) should be unthinkable in a profession. Such methods are inconsistent with all of the ethical ideals of a profession.

"Engineers occupy a position of confidence and trust between capital and labor, and between employers and employees. Unionization is inconsistent with the highest discharge of that trust.

"Unionization places the sole emphasis on wages and hours, and on union membership, instead of emphasizing qualifications and quality of service.

"Unionization tends to pull all members of a profession down to the same level, discouraging individual effort, loyalty and ambition.

"Unionization is identified with the trades. Unionization of engineers undoes the work of years in winning public recognition of engineering as a profession.

"Unionization is inconsistent with the professional spirit and attitude, which places service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations."

THE THREAT OF UNIONIZATION

That union organizational activity has not reached widespread proportions among the employers of engineers—at least insofar as the engineers are concerned—is indicated by the participating companies, since only eight per cent of them reported they had been the targets of any organizational activity.

(Continued on page 22)

SURVEY

(Continued from page 20)

The fact that so high a proportion of engineers favored unionization, however, marks an alarming trend which, if it continues, could become a movement which eventually could reduce the profession of engineering to the level of a trade.

Of the executives who said their plants had been the scene of union activity, twenty-nine per cent said such activity had affected them adversely with respect to their ability to recruit and hold competent engineering personnel.

This was particularly true, they said, of recent college graduates, few of whom would take employment with a unionized plant.

One, the executive vice president of a large manufacturing company which employs several hundred engineers, said all the members of the engineering staff of one of its twelve plants were inducted into the American Federation of Labor Office Workers' Union several years ago, but that after two years, they voted themselves out of the union on a National Labor Relations Board petition.

"During the period they were unionized," he said, "we encountered great difficulty recruiting college graduates because of their reluctance to accept jobs covered by a union contract."

DO NOT LIKE UNIONS

This evidence that recent college graduates do not favor unionization for engineers was pointed up by the fact that of the thirty-four per cent of engineers who believe in collective bargaining agencies, few came from the group which had been graduated within the last two or three years. Most of them, however, fell within the twenty-five to thirty-five age group.

When it came to the question of non-bargaining organizations, however, age did not seem to be a factor. Sixty-six per cent of the respondents, representing a fairly accurate cross-section of the group from the standpoint of age, said they favor such an organization within the company "for the purpose of establishing a medium for interchange of ideas and improving communications with management."

Several among the thirty-four per cent who voted "no" explained their negative opinions with the assertion that "all too often" such non-bargaining organizations can be swung into the union fold by a small but active minority of pro-union sympathizers, and that "I'm not having any."

Approximately ten per cent of those surveyed work in plants where the engineers have a non-bargaining organization. About eighty per cent of that group belonged to their company organizations.

CONCLUSIONS

Widespread, vigorous union organizational activity among engineers is, at the moment, not developed, but there has been an alarming increase in the number of engineers who have so far deserted accepted professional standards as to consider unionization (for themselves) in a favorable light. In a survey conducted in May, 1946, of the members of a leading association of engineer employees, only five per cent expressed themselves as favoring unionization.

This trend could easily snowball into an unpleasant actuality, particularly in the event of a business recession, and it serves as a clear warning that the professional societies and industry must take immediate steps to forestall the all-too-easy descent from professionalism to trade unionism.

As W. R. Woolrich, Dean of Engineering at the University of Texas and president of the American Society for Engineering Education, declared:

"The Engineers Joint Council, the Engineers' Council for Professional Development and the National Society of Professional Engineers now face the alternative of speeding up their coordinated effort to improve the professional status of the recognized engineer or giving way to a less discriminating group of union engineers who would like to speak for all of us on the workman's side of the collective bargaining conference table."

Engineers of less than average ability generally can get an immediate salary increase by collective bargaining at the expense of those who are above average, Woolrich said, but, he declared:

"The future is not too bright in collective bargaining for advancement of men of creative genius and individual professional abilities. Collective bargaining is never inspirational to the men of creative talents and recognition cannot be readily afforded him other than as part of a collective group."

He suggested that industry, for its part, should increase rates of pay for that "woefully neglected" group, the engineers with three, five, ten or twenty years of service "commensurate with the beginning salaries."

his is an area deserving of careful study by management in view of the fact that throughout industry, although starting rates for engineers now are at a high level, the spread between the rates of pay for beginners and those for experienced engineers is small.

The idea of encouraging non-bargaining, intra-plant organizations for engineers also might be explored as a potentially beneficial move, not only from the standpoint of giving the engineers a vehicle of expression and a center for the interchange of ideas but also as a valuable channel of communication.

It is very apparent from the survey results that a large number of engineers employed in industry now feel isolated and remote from management, and that the need for a thorough overhauling of company communications policies is indicated for most plants.

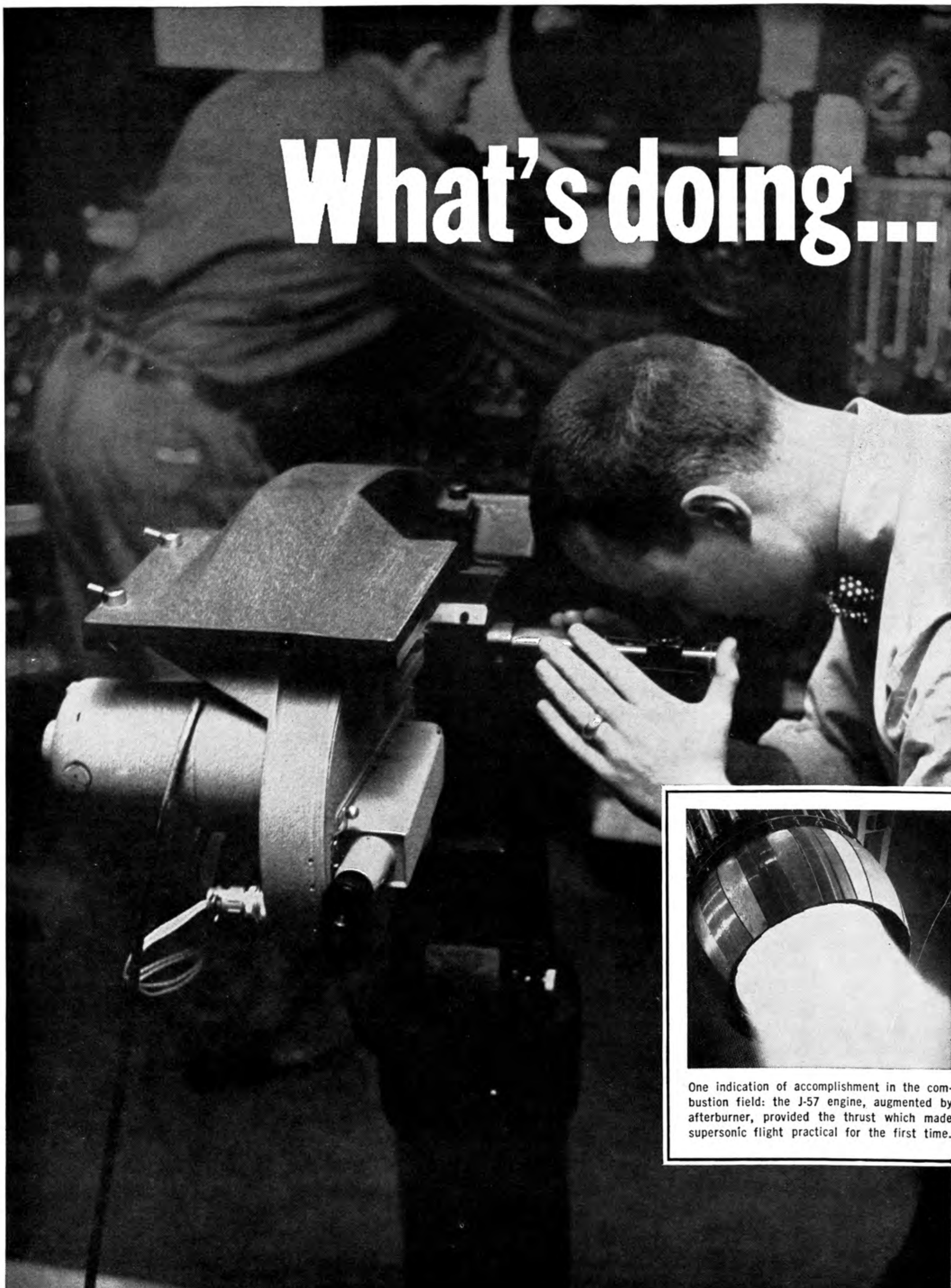
How to Attract and Hold Engineering Talent

The engineering schools

- Close liaison with colleges needed

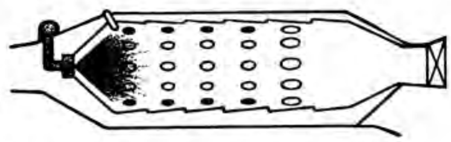
(Continued on page 38)

What's doing...



One indication of accomplishment in the combustion field: the J-57 engine, augmented by afterburner, provided the thrust which made supersonic flight practical for the first time.

This special periscope gives Pratt & Whitney Aircraft engineer a close-up view of combustion process actually taking place within the afterburner of an advanced jet engine on test. What the engineer observes is simultaneously recorded by a high-speed motion picture camera.

at Pratt & Whitney Aircraft 
in the field of Combustion*

Historically, the process of combustion has excited man's insatiable hunger for knowledge. Since his most primitive attempts to make use of this phenomenon, he has found tremendous fascination in its potentials.

Perhaps at no time in history has that fascination been greater than it is today with respect to the use of combustion principles in the modern aircraft engine.

At Pratt & Whitney Aircraft, theorems of many sciences are being applied to the design and development of high heat release rate devices. In spite of the apparent simplicity of a combustion system, the bringing together of fuel and air in proper proportions, the ignition of the mixture, and the rapid mixing of burned and unburned gases involves a most complex series of interrelated events — events ocurring simultaneously in time and space.

Although the combustion engineer draws on many fields of science (including thermodynamics, aerodynamics, fluid mechanics, heat transfer, applied mechanics, metallurgy and chemistry), the design of combustion systems has not yet been reduced to really scientific principles. Therefore, the highly successful performance of engines like the J-57, J-75 and others stands as a tribute to the vision, imagination and pioneering efforts of those at Pratt & Whitney Aircraft engaged in combustion work.

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


Mounting an afterburner in a special high-altitude test chamber in P&WA's Willgoos Turbine Laboratory permits study of a variety of combustion problems which may be encountered during later development stages.


Microflash photo illustrates one continuing problem: design and development of fuel injection systems which properly atomize and distribute under all flight conditions.


Pratt & Whitney Aircraft engineer manipulates probe in exit of two-dimensional research diffuser. Diffuser design for advanced power plants is one of many air flow problems that exist in combustion work.

**Watch for campus availability of P & WA color strip film on combustion.*

World's foremost designer and builder of aircraft engines

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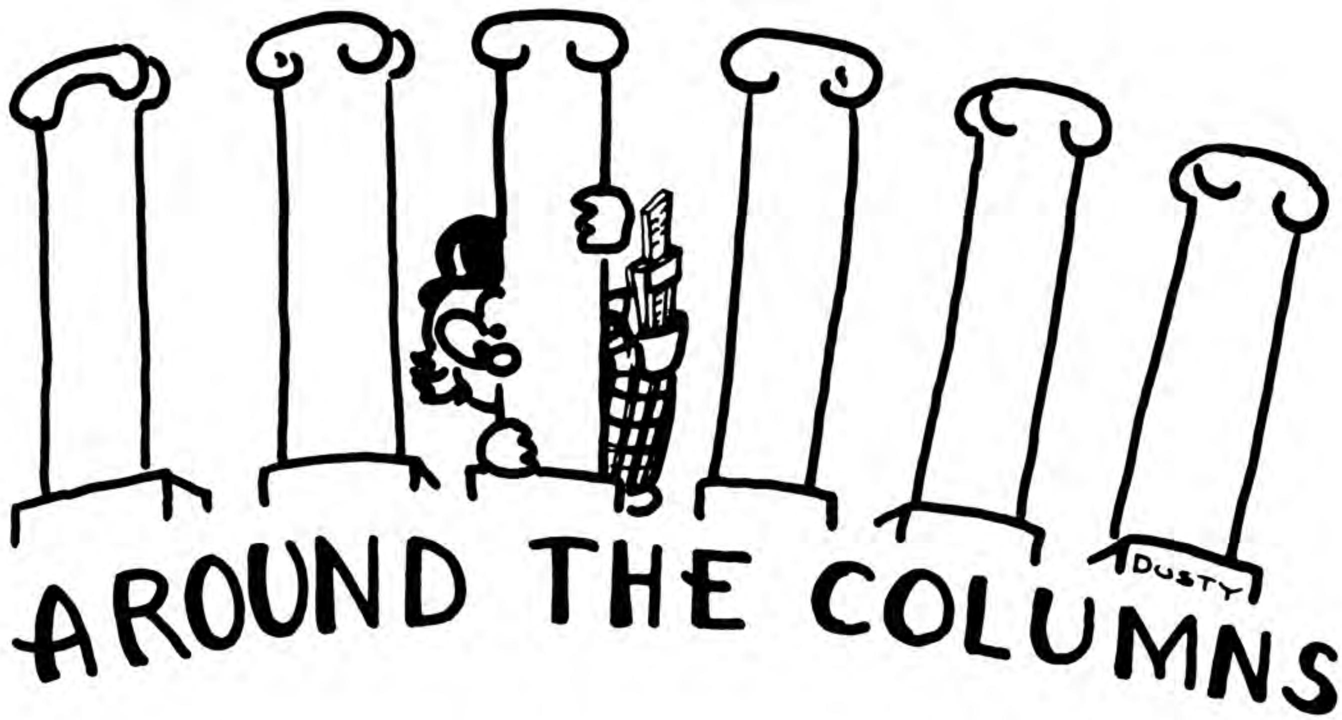


by JOE WOLF, M.E. '58

"Elegant Ensemble For Engineers"

Are you interested in French heels? Or do you prefer loafers? Maybe you are the kind who only like pumps. Whatever the case may be, you would have seen them all demonstrated and explained by the Christian College Modeling Club. Everything worn from head to toe was modeled, swim suits, casual clothes, sports wear, and cocktail dresses, with special emphasis on accessories.

These "Elegant Ensembles" were presented as a Christmas program for the American Society for Mechanical Engineers. A better program could not have been planned.

The show also featured two displays, one of various synthetic fabrics and how they are used in making the latest fashions and the other showed assortments of Christmas gifts suitable for girl friends, fiancees, wives, and etc.

The clothes were explained and commentated on by Miss Betty Nan Carpenter. The sponsor was Mrs. Dorothy Holsinger, physical education instructor. The coordinator and man through whose efforts the show was brought about was Bob McCann, vice president of ASME.

The clothes were modeled beautifully by: Misses Janice Livingston, Mary Lynn Jordan, Sally Old, Carolyn Hall, Ann Setzer, Mary Jane Rogers, Louella Baker, Annabelle Wilson, Gail Godfrey, Jerre Ann Teter, Lou Ann Browning, Marilyn Coe, Gwain Branson, Bettye Ruth Halder, Gwen Grey, Jo Ann Dobbs, Marsha Essex, Joan Tottenham and Terry Mann.

Great Britain's H. M. T. S. *Monarch*, world's largest cable-laying ship. A. T. & T. joined with the British Post Office and Canadian Overseas Telecommunications Corporation in the historic venture.

Victory at 2400 fathoms

Background of the first transatlantic telephone cables

Teamwork characterized the Bell System's role in the success of a tremendous undertaking: laying the first transatlantic telephone cables.

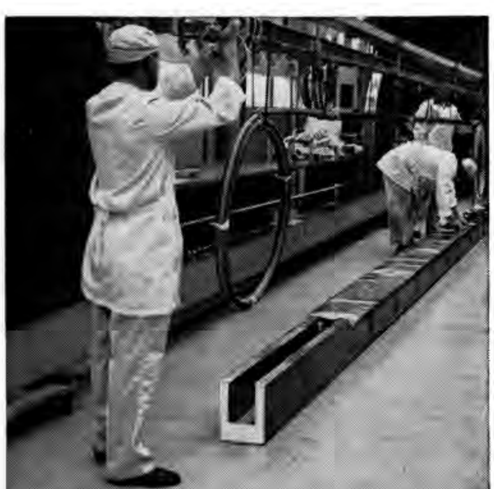
One challenge given engineers and scientists at Bell Telephone Laboratories was that of designing equalizing networks and amplifiers to be placed in the cables every 40 miles to compensate for the huge attenuation losses. Electron tubes of unrivaled endurance were developed, capable of operating for up to twenty years.

Western Electric, manufacturing and supply unit of the Bell System, assembled the repeaters in a special plant under clinical conditions. A mere speck of dust could fatally upset the sensitive amplifiers.

The delicate and demanding job of laying the cables was supervised by engineers from Long Lines Department of A. T. & T. New cable-laying equipment was designed, and exacting procedures were devised so that the cable could be laid smoothly and safely on an ocean floor in places more than two miles deep.

Teamwork helps Bell System engineers and scientists to anticipate and provide for America's growing communications needs, no matter what the magnitude of the job to be done.

Able, imaginative young engineers and scientists will find absorbing careers with the Bell Telephone Companies, Bell Telephone Laboratories, Western Electric and Sandia Corporation. Your placement officer can give you more information about career opportunities in the Bell System.



Each room in Western Electric's clinically clean repeater plant was kept under positive air pressure at all times so that dust-laden air could not leak in.

Bell Telephone System

Extra-Curricular Engineering—

SOCIETY NEWS

GENE JOHNSON, Ag.E. '57

ENGINEERS' CLUB

The December 4, 1956 meeting of the Engine Club proved especially profitable to a new member. Earl Kennett, who had just joined the club, won the P. & E. pocket slide rule which was the door prize for the evening.

Several amendments to the club's by-laws were adopted at the meeting. The amendments concern requirements for the Knight of St. Patrick degrees.

The executive council chose the following persons to serve as members of St. Pat's Board for this year: Seniors — Tom Harper, Jim Musgrave, Jerry Herdan; Juniors—Marvin Frerking, John Trost, Dick Barnowski, Jim Teegarden; Sophomores—Earl Bennett, Dave Snider; Freshmen—Charles Jones, Bill Morris, John Pugh, and Tom Williams.

Mr. M. B. Tracey of General Electric spoke to the club after the business meeting. Mr. Tracey explained company interviewing techniques.

(Reported by Roger Pape)

A.I.E.E.-I.R.E.

Mr. John J. Raffone of General Electric spoke at the December 4, meeting of the joint student branch of AIEE-IRE. His subject was "Modern Technical Writing in Industry." There was a question and answer period after the talk, and refreshments were served after the meeting.

On January 8, the chapter elected officers to serve during the winter semester. The new officers are: Chairman—Bill Barber, Vice-Chairman—Roger Pape, Secretary—Dick Barnowski, AIEE Secretary — Bob Harper, IRE Secretary — George Fitzgerald.

Mr. Hurst of I. B. M. spoke to the group about "Data Processing." Mr. Hurst is a 1949 graduate of Rolla with a B. S. in E. E. He was appointed Manager of Salaried Personnel for the area served by the Rochester, Minnesota office of I. B. M. as of the first of this year. A group of customer engineers for I. B. M. who are located in the area also attended the meeting.

The next AIEE-IRE meeting is scheduled for February 19. The speaker will be Mr. Summers, who is the district application engineer from Westinghouse.

(Reported by Dudley Childers and Bill Barber)

ASAE

At the Dec. 11, 1956 meeting of the M. U. student branch of A. S. A. E., chapter President John Arms reminded the members of the opportunities available to those students who want to write papers and work in the chapter activities. Students may write articles for the A. S. A. E. Student Journal, which is being published at Michigan State this year. Student papers may also be entered in the annual student paper contest. Cash prizes are awarded. Members of the student branch who meet the requirements may apply for a National Student Honor Award. Full details of the Honor Award requirements and instructions for submitting papers and articles may be obtained by contacting the chapter advisors, Prof. Brooker and Mr. Curry.

The speaker at the meeting was Mr. Roy Harrington, a Project Engineer in the Development Department of Deere & Company. Mr. Harrington graduated in Ag. Engineering here at M. U. in 1950. He is presently chairman of the Quad City section of A. S. A. E. His subject for the evening was, "What Does John Deere Expect of Agricultural Engineers." Mr. Harrington showed slides of projects and explained the development of new products. He also had an interesting display of machinery layouts and calculations used in the development of some products.

Winter semester officers were elected and Savitar pictures were taken at the January 8 meeting. The new officers are: President, John Parks; Vice-President, Gene Johnson; Secretary, Glen Thompson; Treasurer, Ivan Berry; Scribe, Ed Munson.

The next meeting is presently scheduled for February 13, at 7:15 in T-12.

(Reported by Gene Johnson)

A.S.C.E.

On December 13, 1956, the stu-

(*Continued on page* 36)

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The Regurgitation Factor

By Ed Duke and Elliott Pucker

ABSTRACT

In order to evaluate the stability in relation to instability of one Ed Homo Sapien, an underlying physical and mental constant must be found. The factor which carries with it the impact of the entire engineering world will be called hereafter, the Regurgitation Factor (denoted by Rf).

INTRODUCTION

Some of the oldest historical records (4000 BC*) excavated in the valley of the Euphrates and the Nile were concerned with brewing. It was at this time that Adolf Glockenspiel started on his investigation of instability of man in order to produce the first alcohol saturation factor which is reproduced in the analytical procedure to follow. In the 23rd century B. C.* the Chinese developed the drink Kiu. Kong Long Glockenspiel at this time developed the method through experimentation to evaluate the quantity of fluid taken in, to the amount of BTU's given off in dissipated exertion. These values will not be found in the analytical procedure because neither author of this report can read Chinese—and the formula is of no importance anyway.

It was in the year 1459 in England that the Duke of Lancaster endowed each of the ladies-in-waiting of his court with eight (8—the number after 7 and before 9) gallons of beer a week. But never fear Lord Horacio Glockenspiel was near, (Hey that rhymed—fear and near) calculating the capacities of the women. His figures invoked the quantity consumed to the amount of extra curricular activity taken part in by the ladies. His data was of no practical importance until 1700 when using Sir Isaac Newton's Laplace transforms, he was able to formulate a factor which could convert the formulas to values related to male consumption. You may ask that if Horacio Glockenspiel lived in 1459 how could he be evaluating data in 1700? The answer is simple; he had a twin brother.

National prohibition in the U. S. completely interrupted industry and the intensive development of complex factors involving instability vs consumption during the period from January 16, 1920 to March 22, 1933. However, this did not prevent Otto Von Glockenspiel from continuing his studies down in the Ozarks. Old Bootleg, as he was called by those who really knew him, one bleak day in January 1932, had to pick up his do-it-yourself moonshine kit and hightail it to the wheat fields of Kansas.

It was here that Otto set up his experimental apparatus and earnestly continued his work. When he passed away in 1945 during the underworld purge in Manhattan, Kansas he was wise enough to pass his secrets along to his sister's cousin's uncle's nephew—the noted Dr. N. Sutton, AEC, CEC, APC, BBC, and IFC. Toiling away for the past 11 years at K-State, Dr. Sutton finally came up with the last back to break the camels straw. It is through his efforts, published in the "Kansas State Engineer" which now permits us to evaluate the regurgitation factor. His contribution to science was namely the fluid adaptability, flexibility and propagation of the "Chug-O-Lug Constant!!"

ANALYTICAL PROCEDURE

Evaluate the following formulas:

(1) Alcoholic Saturation Factor or sometimes called the Glockenspiel Number:

$$G = \frac{\sqrt{A}\ RB}{P^{1}}$$

Where G = required quantity of fluid in the blood stream in gallons per hour

A = Approximate size of stomach contact area.

R = ratio of alcohol content to water

P = density of the liquid

B = amount of raw fluid taken in each hour

(2) The equivalent extra-curricular consumption decimal sometimes referred to as the Glockenspiel Equivalent:

$$C_e = \int_{T_s}^{T_f} S \cos(\theta \cdot L)\, E^{x}\, dt$$

Where Ce = amount of fluid consumed in gallons per hour

Ts & Tf = times at start and finish of activity

S = movement of activity in feet

O = angle of the dangle in radians

L = locus of the tocus in degrees

ex = the value of the fluid consumed with the type of activity.

(*Continued on page* 32)

NOTE:

*B. C. indicates Before Constant, from "Glockenspiel," "The Saturation Factor." Iris, Egypt, 0.00001.

New careers for engineers, now that

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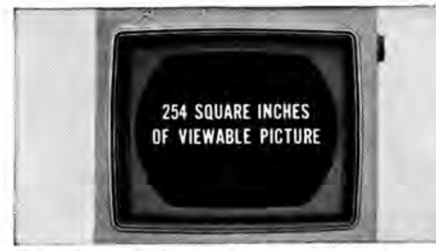

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Practical and trouble-free! Service at new low cost! Big Color is *dependable* Color. And RCA Victor Factory Service is available in most areas (but only to RCA Victor owners). $39.95 covers installation and service for ninety days.

Color TV is a common-sense investment—costs only a few cents a day. It's sure to become the standard in home entertainment for years to come—yet you can enjoy Color every night *right now!* And you can buy on easy budget terms.

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ELECTRONICS FOR LIVING

THE "R" FACTOR

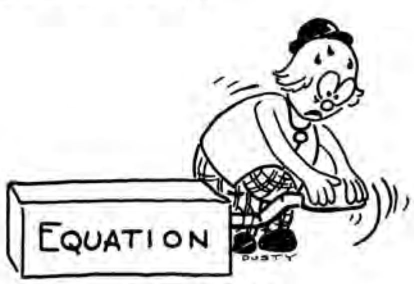
(*Continued from page* 30)

For values of this variable refer to "The Missouri Farmer's" article entitled "I Dreamt I Saw St. Pat in My Erin Go Bragh" page 101, 101,304.3, volume 6, chapter 4, paragraph 15, line 6.

(3) Conversion from Ce to a value for male subject is given by the Twin Numbers:

$$T_w = \sum_{N \to 1}^{P \to A} \int_{3C_1}^{3C_2} R \cdot J X \int_{A_1}^{A_2} X E^2 \cosh (WT)\, dt$$

The explanation of this factor is beyond the scope of this report. The evaluation and determination (and you'll need it) is left to the student. As one math instructor would say "The answer is obvious. Just plug in and crank away."



"Just Crank"

(4) The Sutton Number or Chug-A-Lug constant:

$$C = \int_{T_s}^{T_p} \left[\frac{N (S \cdot A) \sqrt{W}}{T^2} \right] dt$$

Where C = chug-a-lug constant
Ts & Tp = times for start and passing out
N = number of draughts
T = times for each chug
S = 1/b where b is number of breaths per draw
A = alcoholic content of fluid tested
W = weight of Ed Homo Sapien in slugs
dT = change of type of drink

Discussion:

Now that all past calculations have been brought up to date, it is quite easy to evaluate the regurgitation factor. It can be seen that a plot of

$$R_f = \frac{G \cdot \left[C_e \cdot T_w \right]}{C}$$

vs Time, T will give an absorption efficiency from start to incoherency. (See Fig. 1)

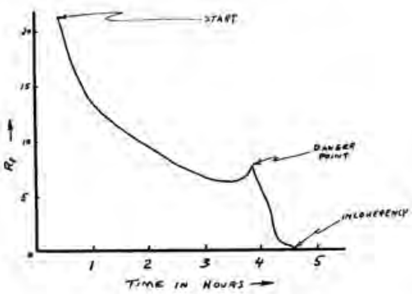


Fig. 1

A number of influencing variables must be taken into account as correction factors to this curve. Some of the more important are:

(1) Time of last meal
(2) Distance traveled to reach laboratory
(3) What seen on way
(4) Was she good looking?
(5) Number of snorts taken before reaching testing area.

With these variables in hand, the highly complicated mathematical problem was thrown into the hands of the math department who immediately threw us out. After petitioning from Engineering School to Arts and Science School we (the authors) were able to labor on the problem nearly 24 hours each day (no homework in Arts and Science.) It was finally decided that the true curve must be evaluated through experimental procedure, and the plan of attack should be similar to the method used by the Psychology Department, that is, we must keep variables constant and vary the constant which is variable unless the variable is not constant.

In only one intensive month of experimentation we had the answer. But society will deeply mourn Ed Homo Sapien, who gave his life so that we might know when to expect instability.

The results are plotted in Fig. 2 and should be read without much difficulty.

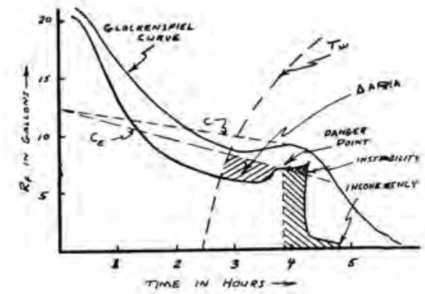


Fig. 2

Ed Homo Sapien was a typical, common, average engineer and the data found through him will closely approximate values occurring in other engineers at the University of Missouri. In a cross-country pole it was found that the consumption rate was predominately higher at M. U. than in other areas.

CONCLUSIONS

(1) The average engineer will consume 27.25381 gallons of 3.2% fluid before instability.
(2) He will do this in an average time of 4 hours, 40 minutes and 7.35 seconds.
(3) If instability does not occur in this time, go home—you will be broke soon.
(4) A point of interest—it will take approximately 10 hours, 15 minutes and 59.333 seconds to recover from conclusions 1 and 2 provided strong coffee and tomato juice are used.

Editor's Notes:

(1) References for this report—any professor or senior, or member of Shamrock Staff.
(2) For complete information concerning this highly technical (?) publication write to A. S. A. E. (American Society for Alcoholic Engineers) Box TGIF in care of the Shack, Andy's, B. & G., Den, Tiger, Greasy Hill, Tug Boat, etc. Please enclose your Q security clearance card!

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Glen Siedel, Vice President in Charge of Engineering B.M.E. Minnesota '36

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This healthy growth of Honeywell is shown in the table below.

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Year	*Sales ($000,000)*	*Net Earnings ($000,000)*	*Plant Space (Square Ft.) (000)*	*Employees*				
				Total	*Hourly*	*%*	*Salaried*	*%*
1926	1.1	.4	158	720*	540*	75*	180*	25
1931	5.4	.6	200	1,150	839*	73*	311*	27*
1936	13.5	3.0	432	3,139	2,200	70	933	30
1941	24.3	2.6	603	4,240	2,859	67	1,381	33
1946	45.9	5.7	1,284	9,474	6,490	68	2,984	32
1951	135.2	8.9	2,296	17,182	10,796	63	6,386	37
1955	244.5	19.3	3,460	25,608	14,853	58	10,755	42

*Estimated

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The ability to accept and discharge responsibility, and to plan and execute programs mean advancement. Men who get things done, get better jobs.

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Who measures this? Your immediate supervisor does. He will speed your progress by seeking your ideas and opinions, by stimulating your interest and enthusiasm and by giving you additional responsibilities as you are ready to accept them.

Then, twice a year he will review your accomplishments with you and determine your salary increases. A program like this is assurance that contributions are rewarded by compensation and advancement.

There are other factors that accelerate advancement.

Engineers predominate among our vice-presidents, divisional executives and departmental managers. So, attitudes and opinions of our scientists and engineers are understood and supported by management.

Honeywell is composed of small units working as a team. These units multiply opportunities for early managerial experience and lay the foundation for more important management assignments in future years.

HONEYWELL OFFERS MANY EXTRA BENEFITS!

The importance of benefits in career planning cannot be underestimated. Honeywell's program ranks as one of the most liberal in industry. There's free group life insurance . . . free accident and sickness insurance . . . free hospital insurance. You will find a liberal policy on paid vacations and holidays and modern pension and retirement program paying lifetime benefits.

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If you have a geographical preference either in the U. S. or abroad, consider Honeywell's many engineering and production locations. You'll find challenging opportunities for a variety of engineering specialties with Honeywell in Beltsville, Md.; Boston; Chicago; Denver; Freeport and Warren, Ill.; Independence, Iowa; Los Angeles; Minneapolis; Philadelphia; St. Petersburg, Florida; Wabash, Ind.; and Toronto, Ontario.

Abroad, Honeywell factories are located in Amiens, France; Amsterdam, Netherlands; Frankfurt, Germany; Newhouse, Scotland and Tokyo, Japan.

If you prefer sales and application engineering you'll find 127 sales and service offices in principal cities across the nation and Canada, and 45 countries abroad.

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Aeronautical Controls: Research, engineering and manufacturing plants in Minneapolis, St. Petersburg and Los Angeles.

Precision Switches: Engineering and manufacturing in Freeport and Warren, Illinois, and Independence, Iowa; research facilities in Denver.

Ordnance and Missiles: Engineering and manufacturing in Minneapolis, Monrovia, Calif., and Seattle, Wash.

Servo Components and Controls: Engineering and manufacturing plants in Boston.

Oscillographic and Photographic Equipment: Research, engineering and manufacturing facilities in Denver.

Transistors: Research, engineering and manufacturing plants in Boston.

Research: In addition to research and engineering activities carried on by various divisions, Honeywell also maintains a Research Center in the Minneapolis suburb of Hopkins. Prime concern of the Center is basic projects of interest to the entire organization.

Whichever Honeywell division or location you choose, you'll be assured of special training to help you grow in your job. This training includes regular on-the-job instruction, formal classes at the company and tuition-aid courses at nearby institutions.

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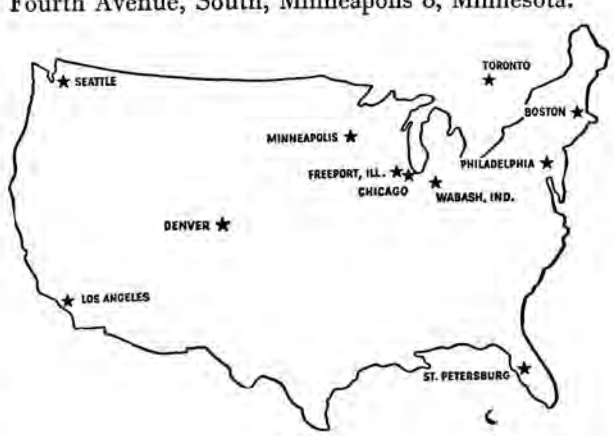
A Honeywell representative can answer your questions and give you additional information about opportunities at Honeywell. Please consult your college placement office for the date of his next visit to your campus.

Meanwhile, you will want to read a booklet titled "Your Curve of Opportunity in Automatic Controls." Write H. T. Eckstrom, Personnel Administrator, Dept. CM, Minneapolis-Honeywell Regulator Company, 2753 Fourth Avenue, South, Minneapolis 8, Minnesota.



★Indicates location of Engineering-Research facilities

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SOCIETY NEWS

(Continued from page 28)

dent branch of the American Society of Civil Engineers held their third meeting of the school year. The meeting was held jointly with the A.S.C.E. Mid-Missouri Section. A joint meeting of this kind is usually held once or twice a year.

After short business meetings by both the student and the Mid-Missouri Section, Dr. Herman Betz of the University Math Department was introduced as the evening's speaker. Dr. Betz gave a very interesting and educational talk entitled, "The Language of Science".

The January meeting is scheduled for the 15th and an interesting program has been arranged. Mr. Ruben N. Bergendoff of the well-known consulting engineering firm Howard, Needles, Tamman, and Bergendoff is to be the speaker.

Attendance this year has been quite good, but there is always room for a few more. All Civil Engineering students and anyone else interested are invited to attend the Chapter meetings.

(by Earl F. Holtgraewe)

A.S.M.E.

Dean Curtis Wilson, Dr. A. J. Miles, Chairman of the M.E. department, and 18 students, from the Rolla School of Mines were among the visitors at the December meeting of the M.U. student branch of A.S.M.E. They also attended the Pi Tau Sigma banquet earlier in the evening.

After a short business meeting, the Christian College Modeling Club presented a fashion show for the M.E.'s. Miss Betty Nan Carpenter was commentator and in charge of the show. Dr. Scorah and Robert McCann handled the arrangements for the A.S.M.E.

Dean of Women Dora Johnson, of Christian College, also was a guest of the A.S.M.E. that evening.

(material from Tom Harper)

ST. PAT'S BOARD, 1957.

The board is composed of representatives from each class who plan the activities of St. Pat's Week.

Front row: Marvin Frerking—EE Jr. rep., Jim Teegarden—ME Jr. rep., Dick Barnoski—EE&ME Jr. rep., Jerry Herdan—ME Sr. rep.

Second row: Earl Bennett—EE Soph. rep., Tom Harper—ME Sr. rep., John Trost—CE Jr. rep., Charles Jones—ME Fresh. rep., Wagner—EE Sr. Chairman of the Board.

Back row: Jim Musgrave—ME Sr. rep., Kay Kirby—EE Jr. Secretary of the Board, Stanley Pugh—ME Fresh. rep., Dave Snider—CE Soph. rep., Bill Morris—ME Fresh. rep.

Not shown: Bob McCann—ME Sr. rep.

SURVEY

(*Continued from page* 22)

- Avoid extreme recruiting practices
- Vacation work for students

What the engineer wants

- Security and progress
- Professional recognition
- The union question

THE SOLUTION of the problem of attracting and holding engineering talent—of keeping engineers happy as employees—lies not alone in industry, but must be sought first in the schools whence comes our annual crop of fledgling engineers.

It is apparent from the testimony of both industrial executives and engineers employed in industry that our engineering schools are not producing the raw material that industry needs.

CURRICULUM TOO NARROW

Both groups believe the schools should broaden the engineering curriculum to include more non-engineering studies, particularly in the field of English, the humanities, social studies and business administration.

To this end it is strongly recommended that leaders of industry maintain closer liaison with the schools, assisting administrators and faculty in the preparation of the courses of study which will produce the kind of graduates industry needs.

It is also proposed that industry offer its cooperation to the schools in setting up short courses designed to bring to the students a more nearly accurate picture of the job situations they will face after graduation, and to provide instructors from industry for such courses.

Current campus recruiting practices, which have been pushed to extreme lengths because of excessive competition due to the widening gap between supply of and demand for new engineers, are sorely in need of a thorough overhauling.

The prevalent practices of running up the young engineer's starting salary by competitive bidding, and of over-selling the company in an effort to "lure" recruits there with romantic but not always accurate pictures of the opportunities which await the job candidate, often, in the long run, defeat their own ends. Too frequently the new recruit meets disillusionment and consequent dissatisfaction.

VACATION PROGRAMS

More extensive vacation work programs for students are recommended both as a means of acquainting the job candidate with actual conditions in industry and a device to enable the prospective employer first, to evaluate his candidates and secondly, to develop and maintain contact with them long before they are thrown on the labor market.

If these recommendations are carried out, it is thought, the engineering graduate will come to the job with a background of knowledge which will more nearly fit him for the tasks ahead and he will, in consequence, be a happier and better adjusted employee, ready and willing to tackle routine and relatively unimportant assignments while he is preparing himself for positions of greater responsibility.

Some modifications in the average employer's attitude toward his engineers also seems indicated in order to bring about a situation in which the latter can work contentedly and efficiently in an employee capacity.

A separation of personnel functions as regards professional and non-professional employees seems indicated with a greater degree of recognition of the engineer's professional status.

REGISTRATION DESIRABLE

The engineer will be happier if he is given the widest variety of work assignments consistent with the company's operating procedure. He also should be encouraged to register and to participate actively not only in professional organizations but also in such activities as writing, public speaking and community affairs.

In most companies, it appears that there is a necessity for clearing out existing channels of communication between management and engineers and, in many cases, the creation of new and better channels. Few engineers seem to have kept sufficiently informed of their companies' business objectives— or even of their own personal progress in the firm.

Like most other workers, the engineer is interested primarily in security and opportunity for advancement, and all programs linked to those objectives will aid in keeping him contented. Especially desirable are comprehensive training programs designed to fit the engineer for more responsible positions.

Two out of three engineers employed in industry do not want membership in labor unions, but many feel they would benefit by belonging to a non-bargaining, interplant organization which would serve as a vehicle of expression and a means of communication. That so large a percentage favors *unions*, however, points to the necessity for immediate steps on the part of both industry and the professional societies.

OTHER DEVICES

Some of the other means used by companies participating in the survey to attract and hold their engineers follow:

- Payment of tuition, in whole or in part, for advanced study
- Engineering scholarships for employees' children
- Profit-sharing and stock bonus plans
- A policy of promotion from within the company
- Payment of initiation fees and dues in professional societies
- Merit rating systems or other means of keeping them currently informed of their personal progress within the company

ABOUT THIS REPORT

This report on "How to Attract and Hold Engineering Talent" is the result of the third of a series of Executive Research Surveys begun in 1951 by the Professional Engineers Conference Board for Industry with the cooperation of the National Society of Professional Engineers. It reflects the experience of more than 200 companies which

(*Continued on page* 42)

SURVEY

(*Continued from page* 38)

employ engineers and attitudes of 1,400 individual engineers who are employed in industry.

The purpose of the research program is to assemble and publish current information on engineer-management relations for the benefit of industrial employers of engineers and the engineering profession.

The topics under study were selected by some 100 major industrial employers of engineers. During a preliminary study, these employers were asked to select from a list of management problems those subjects on which they would like to have data derived from the experience of many companies, and from the engineers employed by those companies.

"You should see where we have to get faculty signatures."

Blarney Joins an Honorary.

"What, no *licorice* jelly beans?"

Through the combined efforts of the Shamrock Business Staff 500 of these letters were sent out to various alumni who in the past had shown interest in the Missouri Engineering Alumni Association. The response has been heartening as indicated by the following list of new members who will, of course, receive subscriptions to the Shamrock.

It is our belief, however, that this is only a start. Plans are being formulated to place the routine work involved in such extensive correspondence in the hands of the University's alumni association where the necessary equipment and staff are available.

EED

NEW MEMBERS (To date)

Name	Class of
E. E. Lushbaugh	'03
George C. Gundlock	'10
L. W. Heluireich	'11
F. T. Kennedy	'11
L. A. Nickell	'11
Frank V. Ragsdale	'12
F. G. Beckman	'13
H. A. Fountain	'13
E. M. Levy	'13
Walter A. Gardner	'14
E. V. Gmeiner	'14
S. M. Rudder	'15
L. M. Arms	'16
F. J. Burger	'16
A. M. Finley	'16
Francis Krone	'16
V. G. Cox	'17
Charles D. Grady	'21
T. E. Everly	'22
B. Harris	'22
Eugene J. McNeely	'22
A. V. Ferry	'23
R. G. Kincaid	'23
Col. Frank H. Skelly	'26
F. O. Calhoon	'27
W. N. Crumpler	'28
Charles V. Sunn	'28
Helmer H. Holmberg	'28
S. H. Pollock	'28
R. A. Currie	'29
F. E. Dawkins	'29
H. R. Gorsuch	'29
Arthur T. Bailey	'30
Capt. G. M. Gans	'31
R. J. Denton	'33
Wayne H. Lowry	'33
Dean A. Harvey	'35
Gleen O. Ladd	'35
Glenn L. Dixon	'36
Marion A. Riddle	'37
Fridolin A. Hoyer	'39
Frederic A. Lang	'40
Dwayne C. Smith	'40
D. B. Atkinson	'41
G. E. Gree	'41
B. G. Caldwell	'43
J. W. Coonrod	'44
Nicholas A. Kershaw	'47
Fred R. Frizelle Jr.	'48
Dan M. Houser	'48
J. A. Braxdale	'49
J. R. Eaton	'49
W. H. Kealing	'49
Thomas A. King	'49
Robert H. Smith	'49
Charles B. Brock	'50
Roger C. Haas	'50
J. C. Lerret	'50
Kamel Al-Imam	'51
William C. Clemmens	'52
Lt. James F. Sotherland	'55
C. D. Feild	
F. B. Scuggs	
Herschel H. Verney	

Keeping up with progress can be a full-time job, but *making* progress is the key to adventure. This is the province of the engineer, and today his

New Ideas

are sparking dramatic technical advancements. Chance Vought's respect for a new idea has attracted selective engineers for 39 years. Here, the young engineer needn't settle initially on modest goals, for lack of experience. His *ideas* can elevate him to positions of leadership. To draw technical opinions from all levels, Vought opens to each engineer a wide view of his own job and its relation to others. This broadening begins in the first weeks of

orientation. As it continues, the engineer's contributions become more valuable. Spectacular weapons like our Crusader fighter have been one result. Spectacular careers, another. If you'd like a chance to speak up and step up in a growing company, check your capacity for a Vought career. Send a resumé of your background to:

Mr. J. W. Larson, Asst. Chief Engineer, Engineering Personnel Dept. 11

CHANCE VOUGHT AIRCRAFT

INCORPORATED · DALLAS, TEXAS

BULLARNEY

By WHIT

A certain absent-minded professor was unpacking some glassware he had received from the factory. Seeing that one jar was upside down, he exclaimed, "How absurd, this jar has no mouth." Turning it over, he was once more astonished: "Why, the bottom's gone, too," he exclaimed.

♣

A bored cat and an interested cat were watching a game of tennis.

"You seem very interested in tennis," said the bored cat.

"It's not that," said the interested cat, "but my old man's in the racket."

♣

TWELVE L'IL BOTTLES

I had twelve bottles of whiskey in my cellar and my wife made me empty the contents of each and every bottle down the sink, so I proceeded to do as my wife desired and withdrew the cork from the first bottle, poured the contents down the sink with the exception of one glass, which I drank.

I extracted the cork from the third bottle, emptied the good ol' booze down the bottle, except a glass which I drank.

I pulled the cork from the fourth sink and poured the bottle down the glass which I drank some.

I pulled the bottle from the cork of the next and drank one sink out of it and then threw the rest down the bottle.

I pulled the sink out of the next cork and poured the bottle down the sink, all but one sink, which I drank.

I pulled the cork from my throat and poured the sink down the bottle and drank the cork.

When I had them all empty I steadied the house with one hand and counted the bottles, which were twenty-four, so counted them again and I had seventy-four and as the houses came around I counted them and finally had all the houses and bottles counted and I proceeded to wash the bottles, but I couldn't get the brush in the bottles, so I turned them inside out and washed and wiped them all, and went upstairs and told my other half about what I did and oh boy! I got the wifest l'il nice in the world.

♣

M.E.: "I like mathematics when it isn't over my head."

C.E.: "I feel the same way about pigeons."

♣

Don't be afraid to use your brain, it's the little things that count.

♣

Have you heard the new radio program about the girl who wanted two bathrooms? It's called "The Wife's Other John."

♣

We point with pride to the purity of the white space between our jokes.

She: Isn't the moonlight lovely tonight?

He: I'm not interested in astronomy now, and besides, I'm in no position to say.

♣

A policeman sees a drunk knocking on a street lamp pole. The policeman jokingly says, "I don't think anybody is home."

"There mush be," replies the drunk, "theresh a light upstairs."

♣

Judge: You're charged with drunkenness. Guilty or not guilty?

Engineering Student: Not guilty, sir.

Judge: Officer, why did you arrest this boy?

Cop: Well, he was standing in front of J School, throwing sticks, and yelling 'fetch' to the lions.

♣

Next to a beautiful girl, sleep is the most wonderful thing in the world.

♣

St. Peter, interviewing three college students: What school were you in?

First Student: Agriculture.

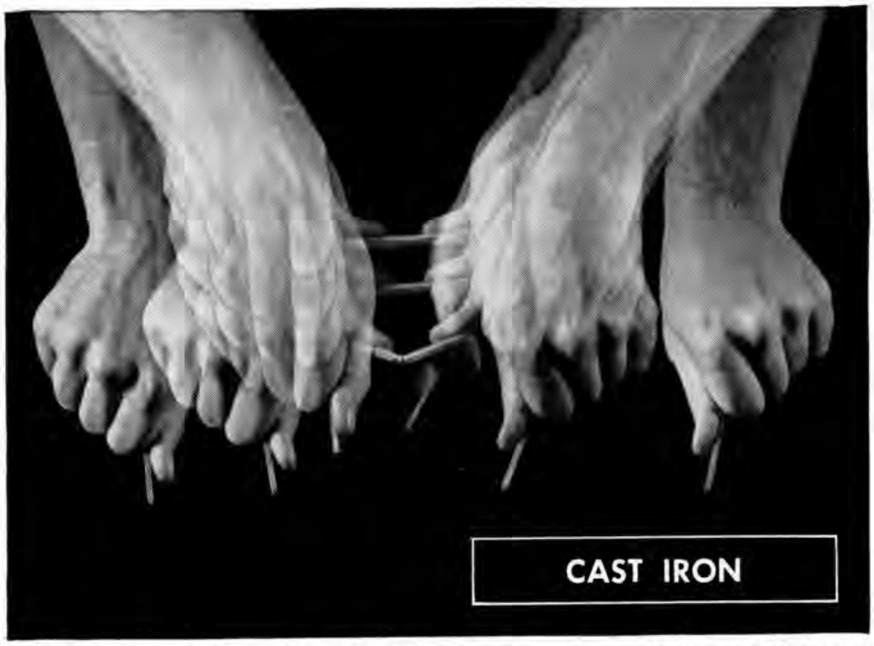
St. Peter: Go to hell.

Second Student: I was in Business School.

St. Peter: You can go to hell, too.

Third Student: I went to Engineering School.

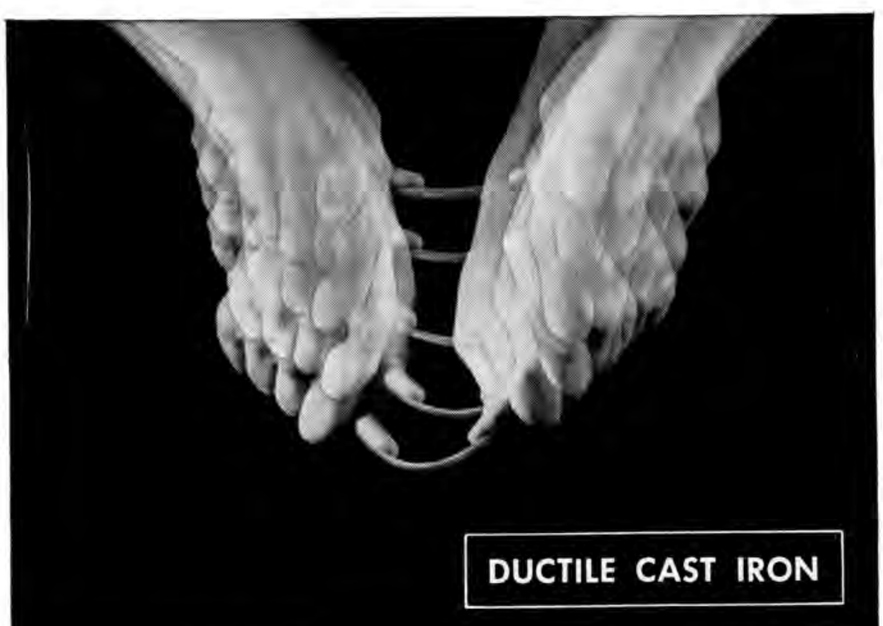
St. Peter: You can stay here. You already been through hell.



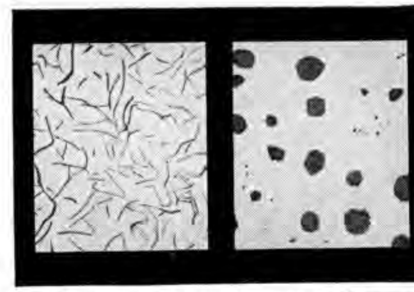
Repetitive flash photography makes it plain how ordinary (flake graphite) cast iron, when stressed, will break off short without bending.

Slow-Motion Proof

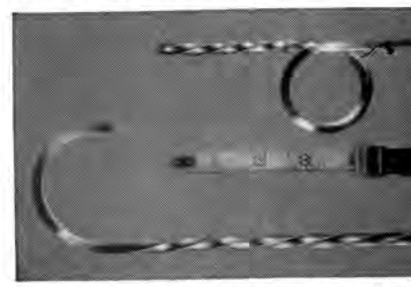
that Inco-developed Ductile Cast Iron has exceptional ductility—can be bent like mild steel



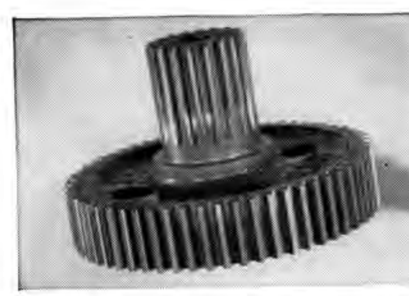
Under the watchful eye of the strobe camera, Ductile Cast Iron bends and bends. No break!



WHY Ductile Cast Iron is different: In conventional cast iron (left) the graphite is in flake form, making for brittleness. In Ductile Cast Iron (right) it's formed into tiny spheres — this makes for toughness, plus greater strength. (Magnified 100 times.)



HOW Ductile Cast Iron can be twisted and bent without breaking is shown above.



TODAY, Ductile Cast Iron is a material of many varied uses. Everything from pinking shears to plowshares—washing machine gears to jet plane parts! And industry is rapidly expanding its uses of this economical cast material.

An Inco development, Ductile Cast Iron is a new material that combines the best features of cast iron and steel.

Like cast iron, Ductile Iron has good fluidity. It's easy to cast. It machines well.

Like steel, Ductile Iron is strong *(the picture at left proves it)*. Its ductility is outstanding.

With Ductile Iron, industry is cutting costs on materials, production, maintenance. Write for "Ductile Iron, the Cast Iron that Can Be Bent." This booklet will be helpful to you in your engineering courses and also later on, when you face problems as a practicing engineer. The International Nickel Company, Inc., Dept. 128e, New York 5, N. Y.

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SHAMROCK SEZ

Well, it's that time of year again. Finals coming up in two weeks, instructors trying to finish the book before January 26th and students fighting to get course cards for next semester before Smiley closes all the sections.

The entire pre-registration procedure is scheduled by class and student number this year. It's been done before but was never rigidly adhered to. By abandoning the "first come-first served" policy, standing in line time has been cut radically. A couple of years ago lines in the Engine Building were longer than the front hall. Today they are hardly noticeable.

Cussing Smiley's method of handling course cards is a tradition here at Mizzou and probably always will be. In a school as large as the College of Engineering, though, there will always be some waiting, some sections closed and some schedules to be changed. Ye Ed may be prejudiced in his opinion of this matter, never having had to completely revise a class schedule. Also, I admire anyone who can smoke hemp rope for cigars.

Roy Wagner, Senior E.E. and Chairman of St. Pat's Board, has selected the members of the Board and they held a meeting Jan. 7. Each member selected the projects he will supervise during St. Pat's Week. The St. Pat's parade will be held again this year, having been dropped last year due to the large amounts of manpower channeled into the Industrial Exhibits. Ye Ed sincerely hopes that all the professional societies and honoraries will enter floats. With a little initiative the societies can make the parade a success.

It's getting more and more difficult to write this with my roommate grumbling about paying 75 cents for eleven sheets of yellow paper for M.E. 205. These particular eleven sheets of paper contain four problems printed at roughly ten times the cost of mimeographed problems. Considering that the illustrations are hand sketched and the copy is typed, it seems a little extravagant.

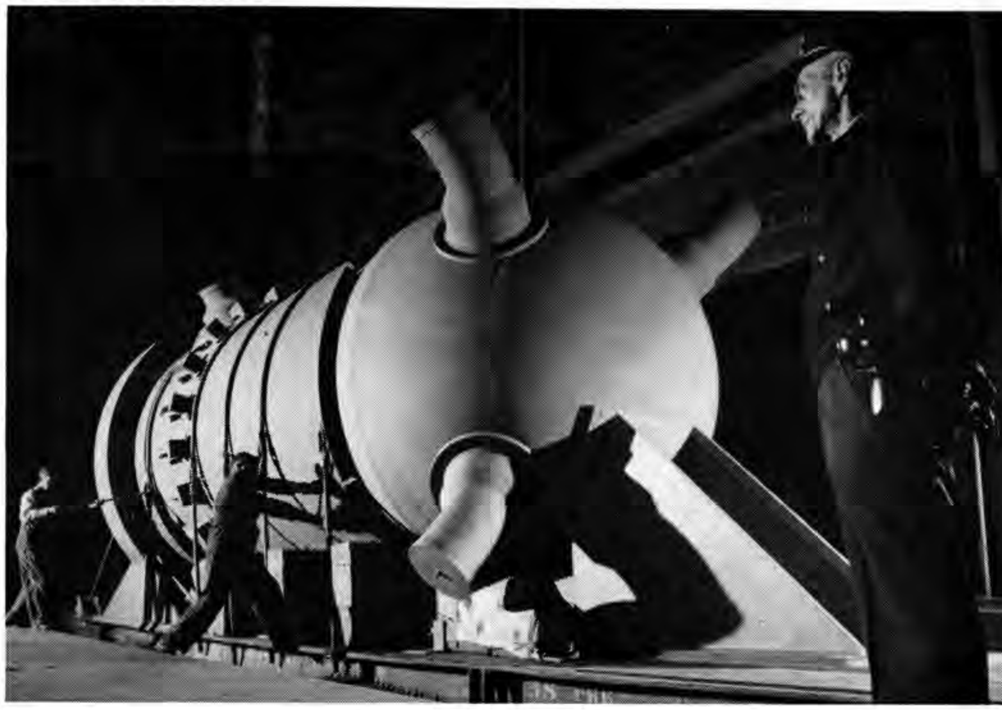
Ye Ed once had the instigator of this as an instructor and at that time had to buy special moldy green eight by five problem paper or receive an F for the course. Without bothering to buy a book, however, Ye Ed managed to get four hours of sleep a week and four hours of E for the course along with the rest of the boys. Other than being a review of about eight weeks of Physics 23, the course served only as practice in Engineering Drawing. The Editor heartily recommends M E 90 for consideration during the next curriculum purge.

On the subject of curriculum, the Dean has suggested that there may be several changes next fall. In particular, Prof. C. M. Wallis has stated that C. E. 82, M. E. 80 and 81 will be dropped from the Electrical Engineering curriculum. In their place, three hours of technical elective and two hours of humanistics will be taken. In this manner, the student receives a more technical and a more liberal education at the same time, which makes everybody happy. The top brass of the faculty seem determined to turn out well educated engineers in spite of the students.

The list of new members of MEAA got crowded out last month so you'll find it in this issue. Ol' Shamrock has been having trouble getting the cover around all the copy. This is partly due to increased advertising by industry which seems to substantiate the rumor heard the other day about there being a shortage of engineers.

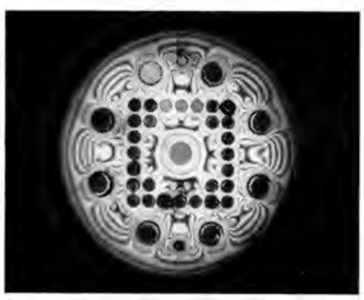
Au Revoir

PHOTOGRAPHY AT WORK—No. 25 in a Kodak Series



Nuclear reactor vessel for Shippingport, Pa. power plant designed by Westinghouse Electric Co. under contract with the A.E.C. for operation by Duquesne Light Company.

Where atoms turn into horsepower



Photograph showing patterns of stress concentration. It was taken of a plastic model of a reactor vessel loaded to simulate the strains a real reactor vessel would undergo.

Radiographs of the reactor vessel welds were made with a 15,000,000-volt betatron. Every bit of the special steel, every weld had to be proved sound and flawless.

Combustion Engineering designed and built this "couldn't-be-done" reactor vessel for America's first full-scale nuclear power station. And photography shared the job of testing metals, revealing stresses and proving soundness.

COUNTLESS unusual—even unique—problems faced Combustion Engineering in creating this nuclear reactor vessel. Nine feet in diameter with walls 8½ in. thick, it is 235 tons of steel that had to be flawless, seamed with welds that had to be perfect. And the inner, ultrasmooth surface was machined to dimension with tolerances that vie with those in modern aircraft engines.

As in all its construction, Combustion Engineering made use of photography all along the way. Photography saved time in the drafting rooms. It revealed where stresses and strains would be concentrated. It checked the molecular structure of the steel, showed its chemical make-up. And with gamma rays it probed for flaws in the metal, imperfections in the welds.

Any business, large or small, can use photography in many ways to save time and money. It can go to work in every department—design, research, production, personnel, sales, and accounting.

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.

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EASTMAN KODAK COMPANY, Rochester 4, N. Y.

DESIGNING COMPLETE PLANT LAYOUT for a new manufacturing activity are Howard Jenkins, Maine '50, and Dick Rayve, Brooklyn Polytechnic '54. This manufacturing engineering problem involves operation planning, materials handling, and designing machine tools.

EXTENSIVE ENGINEERING INSIGHT and a firm knowledge of manufacturing problems guide Tom Robinson, Alabama Polytechnic Institute '54, in purchasing materials for operating departments. Tom, at left, discusses possible application of metal products with vendors.

AT GENERAL ELECTRIC . . .

Your engineering background fits you for expanding opportunities in manufacturing

Today's engineers are going to work in manufacturing—and rightly so. The products of our rapidly advancing technology—involving mechanical, electrical, hydraulic, chemical and electronic components—call for greater engineering skill in their production. With the advent of atomic devices there will be an even greater demand for engineering knowledge in the manufacturing function.

General Electric, long a leader in modern manufacturing methods, is currently planning expansions and improvements to double its production rate in the next ten years. To meet this intensified demand, the Company has instituted a Manufacturing Training Program to develop young men for the important jobs which will result from this manufacturing growth.

You can share in G.E.'s manufacturing progress. This is a field where manufacturing engineers will apply all their technical knowledge to provide solutions for industry's many problems. Mechanical, industrial, electrical, and chemical engineers will all find wide opportunities in the varied activities of modern G-E manufacturing. For complete information on careers in manufacturing, write to John E. Jones, Manufacturing Training Program, General Electric Company, Schenectady 5, New York. 957-1

Progress Is Our Most Important Product

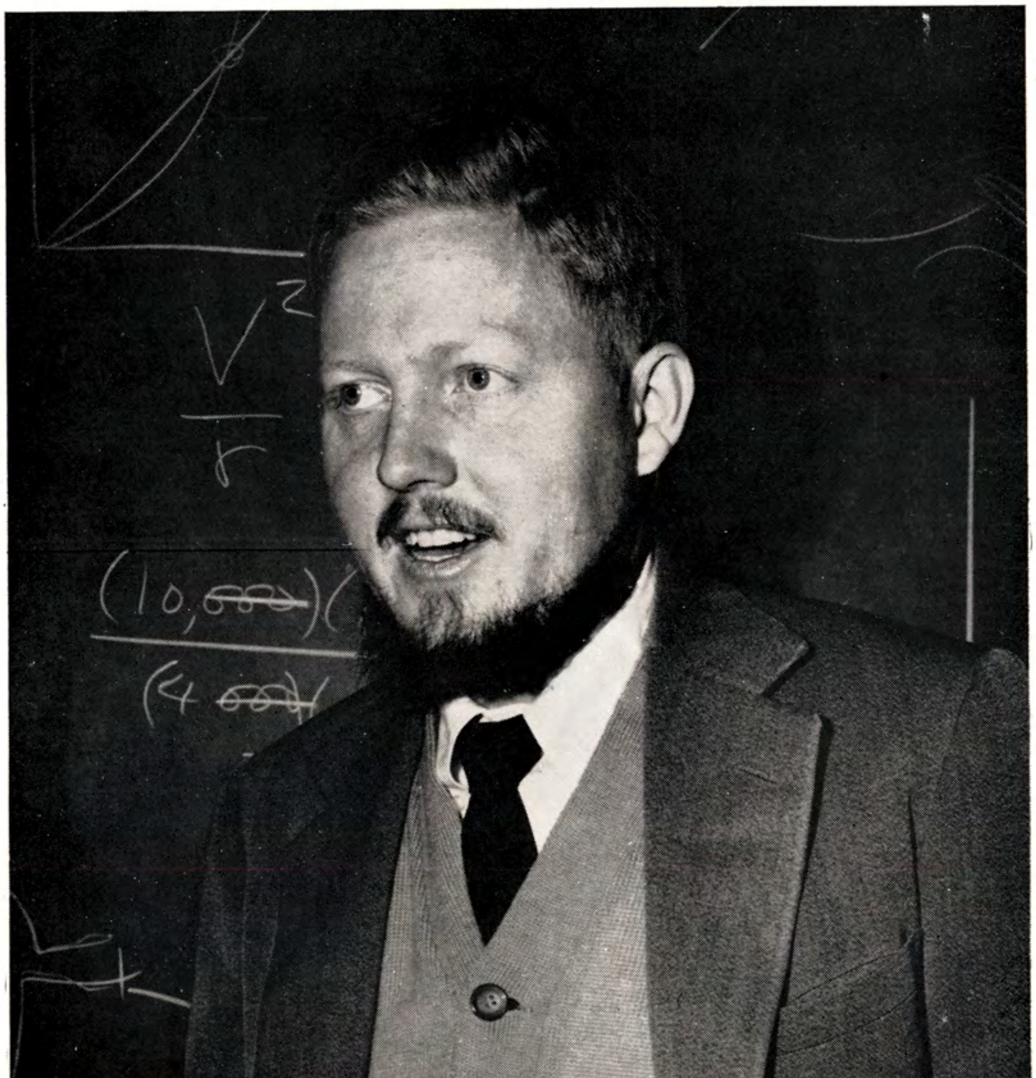
GENERAL ELECTRIC

IN QUALITY CONTROL ENGINEERING Chuck Fehlau, Bates College '49, is responsible for devising test procedures and designing test equipment for this jet fighter gun-sighting system. Chuck also audits quality control tests to assure compliance with engineering requirements.

DESIGNING AUTOMATION EQUIPMENT for a new motor production line are these G-E manufacturing engineers. The high engineering content of operations in this manufacturing development laboratory requires the technical skill of outstanding young creative engineers.

Missouri SHAMROCK

FEBRUARY, 1957



FEATURES:

Atomic Energy in Biochemistry

Tiahuanaco

Vulcan Gun

25c

ELECTRONIC GIANT SQUEEZES THE ERROR OUT OF WEATHER FORECASTING

It's bad news—but pretty soon we may be deprived of our age-old sport of taunting the weatherman for his mistakes.

Reason? A giant electronic computer is squeezing the error out of weather prediction by making numerical weather forecasting possible. Now at work at the Joint Numerical Weather Prediction Unit, Suitland, Maryland, an IBM 701 computer digests thousands of weather-influencing facts daily and computes them at almost incomprehensible speeds.

Making 16,000 additions or 2,000 multiplications every second, the computer forecasts the daily weather with an accuracy that would have required some 64,000 mathematicians thirty years ago. In addition, it encourages meteorologists to tackle problems that once discouraged them because of the staggering mathematics involved.

Forecasting YOUR future

Weather prediction is one more example of how IBM computers—in business, science, government and education—are revolutionizing our way of doing things. These mathematical marvels are destined to play an increasingly important part in the *careers* of engineering graduates. Digital computers rank in importance with nucleonics and automation in our new industrial revolution. If you are working toward an E.E. or an M.E. degree, or, if you are majoring in physics or mathematics, you'll find that IBM, as a leader in the electronic computer field, offers you the opportunities you need for a successful engineering career.

For further information about opportunities at IBM, see your Placement Director or write to R. A. Whitehorne, Mgr. of Engineering Recruitment, Dept. 3302, International Business Machines Corporation, 590 Madison Avenue, New York 22, N. Y.

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"Sea-testing" atomic subs: IBM electronic computers assure seaworthiness and crew safety by solving problems in radiation technology and vibration frequency.

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ON THE COVER:

Eminent authorities on the art of beard growing: Miss Susan Brady, Prof. Burton, and the venerable St. Pat himself . . .
Photos—J. Herdan

MISSOURI SHAMROCK

VOL. XXIII FEBRUARY, 1957 No. 5

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MEMBER
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Editorial

Engineering—*Trade or Profession?*

Most engineers regard themselves as professional men and wish to be so regarded by their employers and society as well. Many, however, believe that engineers' interests are strengthened economically and otherwise by membership in a collective bargaining association. This is due in part to the decline of the engineer from a select few to that of one of a large technically-trained labor force. Mass employment of engineers in our modern industries has in many cases forced him to become a "clock puncher." In an effort to regain some of this lost esteem and bargaining power, **"associations"** are springing up. One such is the Engineers and Scientists of America, a federation of some fourteen independent associations, formed to promote the interests of engineers in industry, yet bargaining and functioning as a union.

Unionization is wholly inconsistent with professionalism. One feature seldom played up but ever present in union contracts is the word "seniority". It is a poor substitute for initiative, ability and determination; indeed tending to pull all members down to the same level, discouraging individual effort, loyalty and ambition. It enables those of mediocre abilities to achieve salary increases at the expense of those above average. Along this line industry may be charged with encouraging unionization by failing to increase the salaries of engineers with five to twenty years of service to values commensurate with ever increasing starting salaries. For though starting rates are now high, the spread between salaries for beginners and those for experienced engineers is small.

The methods used by unions (strikes, picketing, closed shop, etc.,) as well as the emphasis placed on wages and hours and union membership rather than on abilities and quality of service are adverse to all of the ideals of professional ethics.

Although unions may offer more apparent security for those of below average ability, we as members of a **profession,** must depend upon our own initiative, special training, and hard work to provide the necessary feeling of security — a far better kind than that offered by unionization. We must have confidence in our individual merit for advancement, not the "collective" power of a group or organization.

As young graduate engineers we must strive to further the advancement of professionalism in engineering. The surest way to make even more acute the growing shortage of engineers and to seriously threaten our American Freedoms is to discourage professional competition by unionizing Engineering.

MLC

← **A step in the right direction (Reprinted from the December Issue of THE MISSOURI ENGINEER)**

No blue sky...just black and white facts

to back up our belief that

you and Collins should get together

We're going to build a proposition which we believe deserves your most serious consideration, if you are a mechanical or electrical engineer. This proposition is built on pure and simple fact—no high flown promises or broad generalities. Our proposition: you and Collins should get together. We present these facts to support it.

FACT NUMBER 1:
Collins Radio Company's sales have increased 10 fold in each of three successive seven year periods. 1933 sales were $100,000; 1940 sales, $1,000,000; 1947 sales, $10,000,000; 1954 sales, $100,000,000, and 1956 sales, $126,000,000. (Note graph.) This company *has grown, and is growing* at a phenomenal rate. Total employment is 9,000 of which 24% are research and development personnel.
You grow when the company you work for grows.

FACT NUMBER 2:
As shown in the graph at right, the employment of research and development personnel has increased steadily despite fluctuation in sales. Notice that even during periods of national sales regression Collins continued to strengthen its engineering staff.
Collins has based its growth on the solid foundation of stability in the engineering department.

FACT NUMBER 3:
At Collins, the ratio of engineers to total employees is extremely high, far higher than the average among established companies engaged in both development and production. First and foremost, Collins is an engineering company.
Engineering is king at Collins—never takes a back seat to production expediency.

FACT NUMBER 4:
Collins' reputation for quality of product is universally recognized. It has led to Collins' phenomenal sales record. At Collins there is no compromise when quality is at stake.
If you're the man we want, you'll get real satisfaction out of this quality-consciousness.

FACT NUMBER 5:
Electronics is Collins' only interest. In no way is it subsidiary to the manufacture of industrial or consumer products. Collins builds electronic equipment, not airplanes or vacuum cleaners. Every research, development and production facility is devoted to progress in electronics.
If electronics is your interest, you'll like the climate at Collins.

FACT NUMBER 6:
There is a limitless variety of fields and types of work for the Collins engineer. Recent Collins work in air and ground communication, and aviation electronics include developments in transhorizon "scatter" propagation; single sideband; microwave and multiplex systems; aircraft proximity warning indicator; aviation navigation, communication and flight control; broadcast; and amateur equipment.

There is big opportunity for your special talents.

Right now we are prepared to offer you a technical or supervisory assignment in one of many interesting fields. And the sky *is* the limit as far as responsibility and salary are concerned.

You will work in one of Collins' new research and development laboratories located at Cedar Rapids, Iowa; Dallas, Texas; and Burbank, California. Offices and subsidiary companies are located in New York; Washington, D. C.; Miami; Knoxville; Seattle; Hickman Mills, Missouri; Toronto, Canada; London, England; and South America. All your moving expenses are paid. Company benefits are tops in the industry.

We repeat—if you are a mechanical or electrical engineer, you and Collins should get together. Take the first step now, for more information, write:

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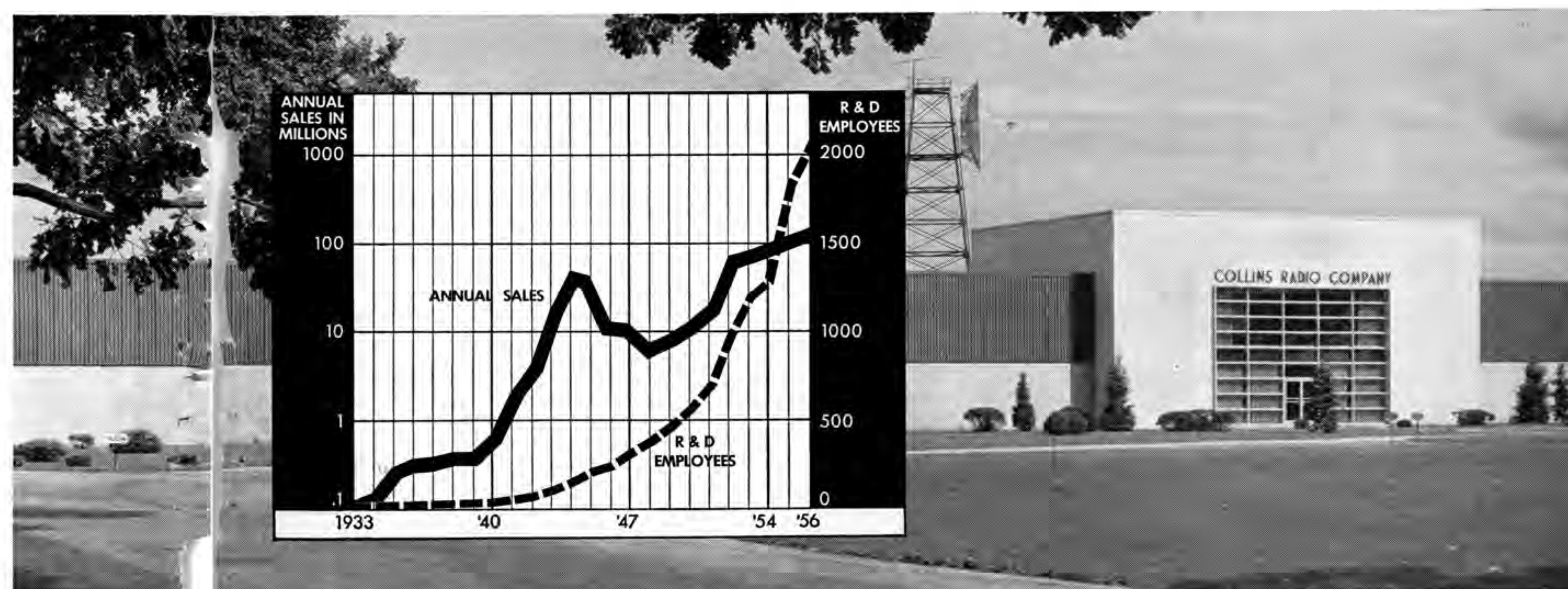
Collins Radio Co.	Collins Radio Co.	Collins Radio Co.
Cedar Rapids,	2700 W. Olive Ave.	1930 Hi-Line Drive
Iowa	Burbank, California	Dallas, Texas



This graph shows the relationship between sales and employment of engineering personnel at Collins. Notice the steady increase in research and development employment despite sales fluctuations.

Collins new research laboratory building at Cedar Rapids, Iowa. Air-conditioned, shielded against radio waves, completely equipped.

Collins CREATIVE LEADER IN ELECTRONICS COLLINS

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A Feat

In this age of mechanization hewing a 25 x 5 x 5 stone, transporting it and putting it in its desired place would be accomplished nicely by machinery and with little human effort, but how the Incas and their predecessors accomplished such a feat more than six hundred years ago is certainly amazing.

South of Lake Titicaca, on a Bolivian plateau that is around twelve thousand feet above sea level, are the remains of a most unusual civilization. The Spanish conquestators, instead of finding savages, as they expected, were amazed to find a large empire of advanced culture with very skillful and tremendously wealthy people. Tiahuanaco is a place that to a certain extent survived the looting of the Spaniards—undoubtedly they found the fifteen foot stones too heavy to take with them.

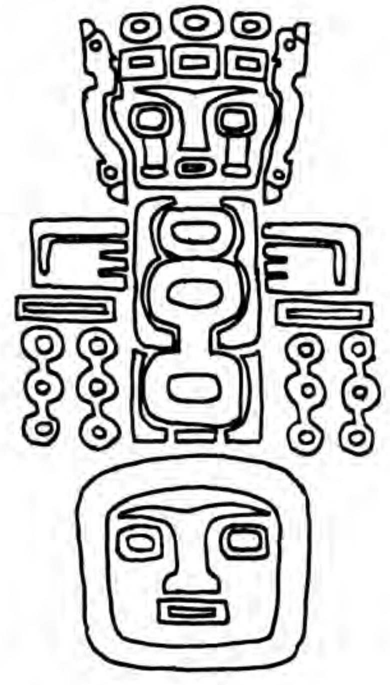
Working with only hardened bronze tools (steel was unknown to them) the builders of Tiahuanaco were able to cut large granite slabs, many of which have elaborate designs. The stones were cut so precisely that when fitted together they match up to the extent that a knife blade cannot be inserted between them. Binding material was not used in any of the structures; in order to fit blocks together, finger-like projections were made to fit into adjacent stones. Pegs of bronze were also used.

Approaching Tiahuanaco one can see a pyramid of about 150 feet in

From The Past —

TIAHUANACO

PETE LANGER, EE '57



Design on chest of monolithic statue illustrating square features.

height; actually it is a man-made fortification surrounded by three concentric stone walls. The base of the pyramid is an irregular parallelogram 460 x 650 feet. The sides of the pyramid are oriented towards the four cardinal points. At the base of the hill is a rectangular area named Calassaya, enclosed by rectangular stones of narrow width ranging in height from 11 to 15 feet, many with elaborate designs. The corners of the rectangle are marked by four massive stones ranging from 16 to 19 feet in height. Inside the enclosed area are several structures of great interest, the description of which could fill many pages.

Strange as it may sound, the source of the stone slabs has not been discovered—there are no quarries near the site; not even locations where hewing might have taken place, have been found.

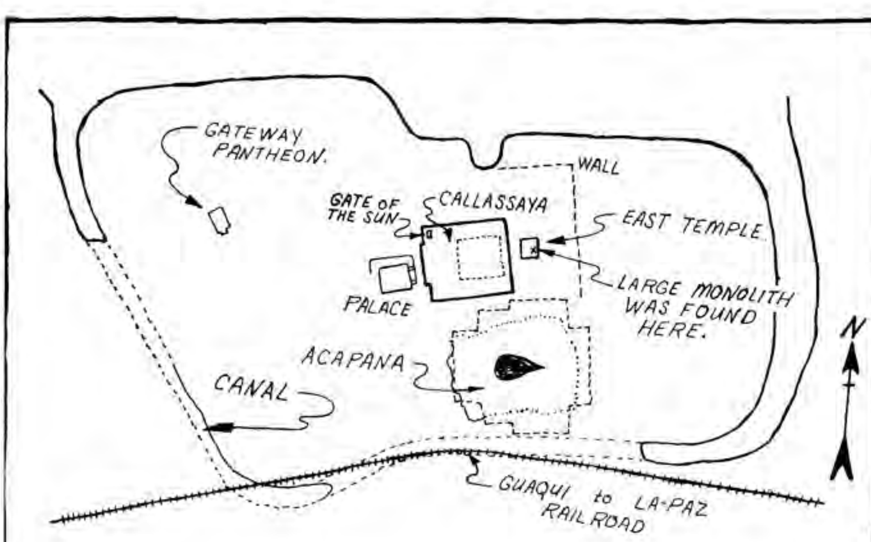
In 1932 a monolithic statue (made out of one stone) of 24 feet in length and over 4 feet wide at the shoulders was discovered by American archeologists. The statue is covered with elaborate designs such as those illustrated in the figure. Monoliths of different sizes are found in considerable numbers, the one described is one of the largest that has been found. This statue is now on display at one of the Boulevards in the city of La-Paz.

Most of the colossal ruins were not built by the Incas themselves. Opinions vary as to whether they were built by the Aymaras, Chumas, Tiahuanacos or some other ancient tribes. It is known, though, that the superior civilization of the Incas engulfed a number of small warring tribes and constituted an empire that extended over a wide territory in Peru and Bolivia.

So amazing was the Inca culture that laziness, theft, murder and other social evils were severely punished. The daily Inca salutation "Ama llulla, ama zua, ama kella" (don't lie, don't steal, don't be lazy) illustrates how much these values were emphasized. The empire had an extensive network of roads that interconnected all parts of it, even through the rugged Andes Mountains.

The sun was the principal Deity of the Incas. The sun was worshipped as the physical representation of the One who, according to them, made the stars, the earth and the sun (Pachacamac). The Incas were a very peaceful people and did not believe in human sacrifice.

The wonders of Tiahuanaco will continue to amaze present and future generations and the culture of the Incas will continue as a challenge—one that our modern society has not been able to equal.



Sketch of the location of ruins at Tiahuanaco.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Atomic Energy in *BIOCHEMISTRY*

CHARLENE KORANDO, Ch. E., '59

For generations photosynthesis has fascinated scientists whose only motive was to understand its mysteries. Without this important phenomena in nature no life could survive, for plant tissue, produced by photosynthesis, is the ultimate source of food for plants, marine life and animals. The world's coal and petroleum came from plant tissues produced ages ago by the same process which produces our forests today. In addition to these functions photosynthesis helps to replenish the earth's supply of fresh oxygen.

Now, because isotopes are available, biochemists are gleaning new knowledge of the chain of processes in which algae and land plants take in water and carbon dioxide, use the sun's energy to build up energy-rich carbohydrates, proteins and fats and release oxygen into the air.

PHOTOSYNTHESIS RESEARCH

In photosynthesis, as in studies of other life processes, the special value of isotopes is that, by following their radioactivity, scientists can trace out the things that happen in normally functioning organisms. Older and still useful research tools lack this ability. Experimenters learned some years ago, for example, how to insert fine needles in the cells of green algae without apparently killing them, but the probing put an immediate end to photosynthesis. Any experimental procedure which disrupts the cell stops photosynthesis. This drawback is overcome when tagged atoms are used to study the photosynthetic process.

The history of photosynthesis study with atomic tracers began in 1940 when the University of California Radiation Laboratory first succeeded in producing radioactive carbon 11 and carbon 14 in the cyclotron. Carbon enters into every process of life chemistry; plants utilize radioactive carbon in the same way as they do ordinary carbon; and carbon 14 maintains its radioactivity for very long periods at virtually undiminished level. For these reasons, carbon 14 is an ideal tool for photosynthesis research.

The photosynthesis studies with carbon 14 began by growing plants in an atmosphere containing radioactive carbon dioxide. The green leaves immediately begin to take in the radioactive gas and to photosynthesize it into compounds, which are tagged with the radiocarbon. It had long been known that photosynthesis produced sugars containing six carbon atoms, but the intermediate products the plant created in arriving at sugar were unknown.

Since plants require time to complete each intermediate stop, the Berkeley experimenters stopped photosynthesis after a measured period by freezing the leaves in liquid nitrogen. When the time is made

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Radioisotopes are used in research laboratories in studying the mechanism of chemical reactions.

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very short, the tagged atoms can then appear only in the earliest intermediate compounds.

To identify these compounds they use paper chromatography, a technique developed by the British in 1944. The frozen leaves are boiled in alcohol producing a green extract containing the products of photosynthesis. A small amount of the concentrated extract is placed near the corner of a large filter paper and allowed to dry. An adjacent edge of the paper then is placed in a trough filled with organic solvents mixed with water, which slowly flowed as in a wick across the paper. As this liquid passes the spot of dried leaf extract, the extract dissolves and moves with the solvent. Each compound has a characteristic speed of movement, depending on its solubility. Sugars—early products in the photosynthesis chain — move slowly whereas fats move more rapidly. This manipulation segregates the various products of photosynthesis into separate locations on the filter paper.

Since the plants had been given only a short time to assimilate radioactive carbon dioside, the spots of compounds formed during the first stages in photosynthesis were radioactive and those formed at later stages were not. The distribution of radioactive material was determined by laying a sheet of X-ray film over the filter paper. The result was a radioautogram — a may on which the location and relative radioactive intensity of each radioactive compound appeared as an exposed spot on the film. The radioautogram from a plant that had photosynthesized one minute in radioactive carbon dioxide showed at least 50 tagged compounds.

By decreasing the time to two seconds the plant had time to produce only two or three tagged compounds. The first stable organic chemical a plant produces in photosynthesis is phosphoglyceric acid, which contains three carbon and one phosphorus atoms, oxygen and hydrogen.

Next after phosphoglyceric acid, the plants produce triose phosphates also containing three carbon atoms. This material is then changed, in several steps into fructose phosphates, with six carbon atoms. The way in which this merger or condensation was accomplished in the plants was determined by breaking down the compounds and locating the radioactive carbon atoms at each structural position in the molecules. It was found that the six-carbon sugars were formed by a head-to-head combination of two three-carbon pieces — perhaps the reverse of the sequence by which six-carbon sugars are broken down in animals and yeasts.

When plants were allowed to photosynthesize two minutes, the radioactive carbon tag appeared in most of the numerous amino acids which go into the building of protein molecules, and even in proteins and fats. This showed that carbon fixed by photosynthesis goes very rapidly into all constituents of the plant.

BIOSYNTHESIS OF TAGGED COMPOUNDS

How some vegetable nutrients and drugs do their work in animal and human bodies has never been clear, but radioactive tracer research is beginning to illuminate some of the obscurities. To prepare tracer forms of these plant compounds, laboratories grow a variety of food and medicinal plants in an atmosphere containing radioactive carbon dioxide.

Argonne National Laboratory has grown soybeans, alfalfa, sugar beets, opium poppies, digitalis, tobacco, onions, and other plants under conditions that make them take up and fix radioactive carbon. The plant tissues are dried, assayed for radioactivity, and various tagged substances are extracted, including sugars, organic acids, starch, amino acids, proteins, pigments, and alkaloids.

Dextran is of special interest as a substitute for blood plasma, particularly in the event of a large-scale catastrophe that could exhaust the supply of natural blood plasma. Dextran's fate in the body is not sufficiently clear, however, and its secretion, utilization, and deposition in the body are being investigated with this carbon-tagged material.

In the first step of producing a standardized form of tagged dextran, Argonne exposed canna leaves to radioactive carbon dioxide in the

(*Continued on page* 20)

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presence of light, then extracted the sucrose by the synthesized. Dextran was prepared from the tagged sucrose by the fermentation action of Leuconostic mesenteroides, a species of bacteria. Using similar methods radioactivity-tagged carbohydrates, such as starth and raffinose, and four sugars—sucrose, fructose, galactose, and glucose have been prepared. It has even been found possible to tag particular carbon atoms in the molecule.

RADIATION AND HEREDITY

Ever since the Austrian abbot, Gregor Mendel first published his classic paper describing the tiny material units of inheritance—invisible even through a microscope—which are called genes — scientists have studied and tried to identify the genes through effects on the offspring.

For a score of years, scientists have studied radiation effects on heredity through patient and ingenious experiments that involved hundreds of thousands of plants or animals over hundred of generations. They have related the observed mutations to alterations in minute parts of the germ cells. However, they know little about just how radiation acts to produce the changes that result in mutations.

This is an age when people are using many forms of powerful radiation in science, in medicine, in industry, in warfare. It is urgently important to learn everything possible about how radiation affects heredity.

Mechanisms of Genetics

Within the nucleus of the germ cell, the genes are arranged like beads along rod-like bodies called "chromosomes". The chromosomes vary among different plants and animals, and even at different stages of growth, but the longest of them is about one-hundredth of an inch and can readily be seen with the aid of a conventional microscope.

Each kind of plant or animal has a set number of chromosomes in its cells. Man has 24 pairs, a total of 48 in each cell of the body. The fruit fly has 4 pairs, corn 10 pairs, pink bread 7 pairs.

Mitosis and Meiosis

A body cell reproduces itself by a process of division called "mitosis." In this process, the cell forms two identical sets of 48 chromosomes and their thousands of genes. These twin sets move to opposite ends of the cell, and when the cell divides, each of the two daughter cells possesses a complete set.

In the development of sexual cells —eggs and sperms in plants and animals—the division is a different process called "meiosis". In this process the sexual cell splits up its 48 chromosomes and passes on only 24 of them to the daughter cell. Then when an egg cell is fertilized by a sperm—each one containing only 24 chromosomes—the resultant cell will contain a total of 48 chromosomes — the resultant cell will contain a total of 48 chromosomes. In its further divisions as the fertilized cell reproduces itself to build a new individual, it will duplicate over and over again those 48 chromosomes which are a composite of the sets inherited from the parents.

Mutation Changes

The precision with which genes normally duplicate themselves during cell division is living matter's greatest achievement. Changes from the normal which are recognizable occur less than one time in a million. But such changes do occur and they are known as "mutations"—favorable or unfavorable.

Mutations which reduce the total numbers of a species, or which reduce the vigor of individuals, are called unfavorable. A favorable mutation is a change which makes the individual better able to cope with its environment. While favorable mutations are rare, they do occur and are believed to be the basis of evolution. More frequently mutant genes produce unfavorable effects in the organism. They tend to be eliminated by natural selection.

In 1926 Professor H. J. Mueller,

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of Indiana University, discovered that the rate of mutation in the genes of the fruit fly could be greatly increased by treatment with X rays. High-energy radiation may produce genetic effects in living cells in three ways:

(a) Indirectly through production of substances that have secondary genetic effects. For example, X rays produce hydrogen peroxide, poisonous to living cells. They also produce free ions, or electrified parts of molecules and atoms which may recombine in different ways.

(b) Through direct effects on such organic molecules as the genes. Direct ionization of the molecules, the chief effect of radiation, may result in breaking chemical bonds which permanently alters genes.

(c) Through the breaking of chromosomes. Chromosome threads are about seven-milionths of an inch in diameter. Scientists have calculated that it takes only about 20 ionizations across the diameter of such a thread to break it.

When chromosomes are broken by ionizing radiation, the ends may try to rejoin and so restore the original condition. However, if more than one break occurs, the fragments may form new combinations known as aberrations which affect heredity.

The tropical pink bread mold lends itself particularly well to studies on the nature of gene action. The mold reproduces rapidly by nonsexual spores or by a 10-day sexual cycle. Different strains can be isolated and the mechanism by which genes pass from generation to generation is easily followed in the laboratory. From a simple medium containing sugar, nitrate, phosphate, sulfate and the B-group vitamin, biotin the mold synthesizes some 20 amino acids, 10 or more vitamins, and a host of other carbon compounds—many of them the kind of molecules out of which human bodies construct protoplasm for cells.

Scientists produced many mutant types of the mold by exposing it to strong radiation. Some mutants could not grow on a medium which nourished normal strains because in the process of mutation the mold had lost the ability to carry out certain chemical reactions. The "offspring" of the mutant mold inherited this inability.

Two important conclusions have resulted from the studies of the mold:

(a) Geneticists believe that genes affect particular chemical reactions that enable individuals to develop and function, and probably they establish the patterns of the formation of particular enzymes which act as catalysts in these reactions.

(b) The genes, as well as the basic chemical reactions of many kinds of living beings are strikingly similar and thus the influence of genes, duplicated in every body cell, upon protein patterns in the body may be a key to the mechanics of heredity.

Genetic Studies of Corn

Of the higher plants whose heredity has been studied, corn is one of the best known. Plant geneticists have investigated many mutant strains and located many of the genes related to specific changes. The 10 chromosomes of corn are relatively large and easily studied at certain stages of development, and unusual forms and sizes can be readily identified.

Seeds of corn, exposed to atomic bomb radiation at Bikini showed three types of effects:

(a) abnormalities in the development of the plant,

(b) chromosome breaks and cross-linkage (aberrations)

(c) gene mutations.

About 500 progeny lines of inheritable chromosome breaks and cross-linkages have been established and are being studied. Abnormalities in the plants grown from irradiated seed were greatest in those that received most radiation.

Such aberrations provide a new kind of genetic tool that may well prove to be highly valuable in corn breeding programs. In further improvement of corn strains, experimenters may find it desirable to transfer specific traits from one strain to another. For example, a strain may be ideal except that it is susceptible to corn smut. Another strain may be smut resistant but otherwise undesirable. An understanding of the way in which smut resistance and other traits are transmitted would point the way toward combining the desirable traits of two lines in a single strain.

Thus, not only have radioisotopes enabled scientists to probe into the

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secrets of nature; they have made it possible to develop hybrid strains with greater productive capacity than existing varieties.

EFFICIENT USE OF FERTILIZERS

American farmers spend 750 million dollars a year for commercial fertilizers to improve the productive capacity of their land. Isotope research already has found ways to get greater returns in crop yields from this money.

Until recent years, the effects of fertilizers could be determined only by comparative measurements of growth, bulk, and yield of fertilized crops. With isotopes, it became possible for the first time to glean other highly meaningful data — whether, for example, the phosphorus content in mature plants actually came from fertilizer or was drawn from phosphates naturally present in the soil. Isotopes enabled scientists to trace nutrients through soil, into roots, and thence to determine at what stage in its growing cycle the plant needs fertilizer most; to know where and how fertilizer should be placed to give the plants the maximum benefit; to establish what kinds of fertilizers work best in the country's varied soils; and to answer other practical questions about the techniques of fertilizer use.

Long-lived radioactive calcium was employed to study the behavior, fate and availability of this element in calcium carbonate. Preliminary results with two types of soil suggested that the calcium from even the more soluble sources may not be completely exchanged with the available soil calcium after a year's time. The crops themselves determined to a large extent the rate at which calcium in the fertilizer became available for use. It was possible to distinguish between the amount of native soil calcium and that of added fertilizer calcium which was being removed by the rainwater and the crops.

Agricultural researchers "tag" fertilizers with radioactive phosphorus. Then by exposing the leaves of plants to film, they can tell how well the nutrient has been distributed through the plant and thus how effective is the fertilizer.

BIOLOGICAL SOURCES OF PLANT NUTRIENTS

Aside from minerals applied in chemical fertilizers, plants receive nourishment from organic matter in the soil. Algae and residues of previous crops are sources of phosphorus. Certain soil bacteria supply nitrogen.

A study was designed to determine the conditions under which plants obtain maximum phosphorus contribution from the roots, plowed-under plants, or other residues of previous crops. The decomposition of these residues into forms that new plants can use depends on the activity of microbes, which are sensitive to chemical conditions in the soil.

The investigators tagged barley plants with radioactive tracers by growing them in pots containing radioactive phosphorus. The plants were harvested and separated into their principal parts, such as hay, straw, grain, and hulls, which were used as manures in pots of several soils. Rye grass was grown in these pots under variable concentrations of carbon and nitrogen. The efficiency of the various soils and treatment in making phosphorus from residues available to new plants was determined by measuring the yields, phosphorus content, and radioactivity of the ryegrass, and by comparing them with control results obtained by fertilizing with phosphoric acid.

Some of the findings were:

(a) Rye grass obtained maximum phosphorus from the straw of barley harvested at a stage of medium maturity.

(b) In medium-mature barley plants, the concentration of phosphorus was higher in the tops than in the roots, but in mature plants the tops and roots equalized.

(c) Doubling the amount of applied phosphorus, either as barley residues or as inor-

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ganic fertilizer in the control tests, greatly increased the phosphorus content of the rye grass but rarely doubled it.

(d) The uptake of phosphorus from barley residues was less in virgin and comparatively rich soils than in over-cropped and phosphorus-poor soils.

(e) For optimum activity of the microbes that break down the residues and best delivery of phosphorus to the next crop, there is a critical ratio of carbon and phosphorus in the soil, which in turn is influenced by the nitrogen content—all of which can be regulated by supplemental treatments of the soil.

This study is directly aimed to yield fundamental knowledge but it has foreseeable applications. It points, for example, toward an answer to the question of how long to let "green manure" crops grow before plowing them under, and what supplements should then be added to the soil.

Algae as a Fertilizer

Arizona investigators are studying the fact that algae growing on irrigated land in that area may add as much as 6 tons of organic matter to an acre of soil in a year, and that these low-order plants are rich in phosphorus. The problem was to measure the availability of this potential nutrient source to crops.

To prepare tracer material, green algae were incubated in a solution containing radioactive phosphorus. The algae were introduced into samples of three Arizona soils, and parallel control samples were prepared by treating them with phosphoric acid tagged with radioactive phosphorus. Barley seedings then were grown for 16 days in each soil specimen under various controlled concentrations of phosphorus, carbon, and nitrogen. The phosphorus content of the dead algae appeared to be as available to barley seedlings as the phosphorus from water-soluble phosphoric acid. Measured by weight of the harvested seedlings, there was no significant difference between plants fed from the organic and the inorganic phosphorus source.

STUDIES OF CROP PESTS

Fungi and insects inflict 6 billion dollars of damage a year; weeds are a further source of loss. While dusts and sprays hold down losses, rusts, smuts, molds, mildew and insects develop resistance to poisons and new compounds must constantly be formulated.

By building radioactive isotopes into the chemical structures of pest-killing preparations, researchers gain clearer knowledge of their basic action, their advantage and limitations. Radioisotopes are peculiarly useful in this field because insecticides and weed-killers are ordinarily used at such low concentration that detecting them by other means is difficult or impossible. As tags on tion, their advantages and limitasects, isotopes are used to "label" these species and map their patterns of dispersion.

Fungi and Fungicides

A series of tests were devised to determine whether fungicides were absorbed by crop leaves and what the poisonous effects on fungi were. In non-tracer tests of dimethyldithiocarbamate, an organic fungicide produced by du Pont, fungus spores

Fungicides to protect the farmer's fruit crops are "tagged" with radioactive chemicals to see how much is absorbed by the fungus spores.

set out on the upper side of apple leaves failed to germinate when the lower sides were sprayed with the chemical. A similar property in glyoxaldine, produced by Union Carbide, was deduced from the fact that scab fungus was killed when it was set out on leaves that budded after mature leaves had been sprayed. Isotope-labeled fungicides confirmed that both compounds are absorbed by leaves and distributed widely through the tissue. They also indicated that the leaves converted part of each compound into carbon disulfide.

Insecticides

Radioisotopes play a part in testing complex organic insecticides

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

VULCAN—

GOD OF FIRE

Edited by JIM WILHELM, M.E., '57

FIRE GOD—New "Vulcan" gun (left), named after Roman God of Fire, fast firing 20 millimeter aircraft cannon, developed and manufactured by General Electric under Army Ordnance direction for U.S. Air Force, is shown with its famous 19th-century predecessor, the Gatling Gun.

A rapid-firing 20 millimeter weapon, one of the first specifically designed for present supersonic jet aircraft, was recently developed by the General Electric Company. The new 20 millimeter cannon, called the Vulcan Gun, fulfills the requirement of a weapon capable of firing at an extraordinarily high rate in the short time available to shoot at fast moving targets.

The Vulcan has borrowed three design features from the original Gatling gun, patented in 1862. They are a rotating cluster of six barrels, a external power source, and an electric drive.

The six rotating barrels in both weapons provide the necessary characteristics for producing an extremely high rate-of-fire, easy maintenance, cooler operating temperatures and high reliability.

Both the Gatling and Vulcan Guns have an external power source for operation. External power source for the Gatling machine gun came from human energy as the operator turned the crank handle. The new Vulcan automatic cannon is externally powered by either electricity or hydraulic fluid.

Not many people are aware of the fact that Richard J. Gatling was issued a patent in 1893 for an electric motor which powered his weapon and which was mounted in the rear of the gun casing. The 1893 electric driven version of the Gatling Gun fired at the then fantastic rate of 3,000 rounds per minute. The new Vulcan can expend more shells in sixty seconds than an infantry company of 400 men can shoot in twenty seconds.

←

SHOT IN THE DARK—Vulcan's tremendous destructive firepower is exhibited in night firing tests. The brilliant ball of fire, looking like a small atomic bomb, is from exploding gasoline. Ricocheting tracer bullets can also be observed on both sides and the top of the exploding gasoline.

BY COMPARISON—Army Ordnance personnel are seen through this huge aperture made by 20 millimeter shells fired from the Vulcan, rapid firing automatic cannon. They are holding a smaller target which registered bursts from Vulcan's Civil War ancestor, the famous Gatling Gun.

The present Vulcan Gun consists of 448 parts, as compared to some 779 in earlier models, making it possible to field strip the gun and reassemble it in thirty minutes.

In addition to having a high firepower to weight ratio, Air Force tests have proven that the Vulcan Gun operates satisfactorily at temperatures as low as –67 degrees Fahrenheit, and can also use standard lubricants in existence today. The Air Force is also testing the new automatic cannon in some of its jet aircraft.

FIRE GOD ON ICE—Here, G.E.'s Vulcan defies arctic cold and performs satisfactorily at temperatures down to 70 below zero. Tested under arctic and high altitude conditions the gun showed its remarkable versatility.

at Pratt & Whitney Aircraft in the field of Materials Engineering

The development of more advanced, far more powerful aircraft engines depends to a high degree on the development of new and improved materials and methods of processing them. Such materials and methods, of course, are particularly important in the nuclear field.

At Pratt & Whitney Aircraft, the physical, metallurgical, chemical and mechanical properties of each new material are studied in minute detail, compared with properties of known materials, then carefully analyzed and evaluated according to their potential usefulness in aircraft engine application.

The nuclear physics of reactor materials as well as penetration and effects of radiation on matter are important aspects of the nuclear reactor program now under way at P & W A. Stress analysis by strain gage and X-ray diffraction is another notable phase of investigation.

In the metallurgical field, materials work involves studies of corrosion resistance, high-temperature mechanical and physical properties of metals and alloys, and fabrication techniques.

Mechanical-testing work delves into design and supervision of test equipment to evaluate fatigue, wear, and elevated-temperature strength of materials. It also involves determination of the influence of part design on these properties.

In the field of chemistry, investigations are made of fuels, high-temperature lubricants, elastomeric compounds, electro-chemical and organic coatings. Inorganic substances, too, must be prepared and their properties determined.

While materials engineering assignments, themselves, involve different types of engineering talent, the field is only one of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program — with other far-reaching activities in the fields of mechanical design, aerodynamics, combustion and instrumentation — spells out a gratifying future for many of today's engineering students.

Engineer measures residual stress in a compressor blade non-destructively, using X-ray diffraction. Stress analysis plays important part in developing advanced aircraft engine designs.

The important effects of gases on the properties of metals have been increasingly recognized. Pratt & Whitney chemists are shown setting up apparatus to determine gas content of materials such as titanium alloys.

P & W A engineer uses air jet to vibrate compressor blade at its natural frequency, measuring amplitude with a cathetometer. Similar fatigue tests use electromagnetic excitation.

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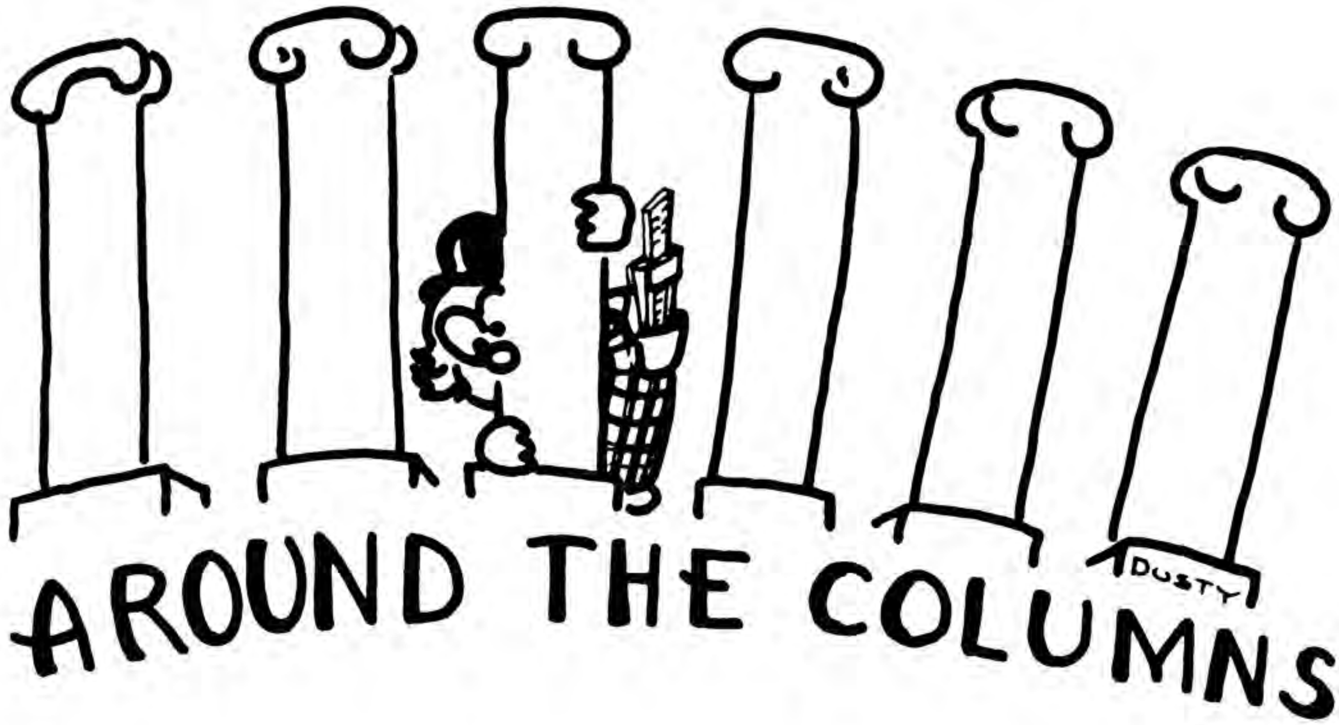

by JOE WOLF, M.E. '58

ST. PATRICK WAS AN ENGINEER

Fivescore and one year ago our fathers brought forth on this university a new college, conceived by St. Pat, and dedicated to the proposition that "Erin Go Braugh."

Soon we will be engaged in a great engineers' week, testing whether this college, or any college so conceived and so dedicated, can long live up to its tradition. We have but a few days before that week. We have come to dedicate a portion of those days as a working-space for those who here gave their time, that that week may live. It is altogether fitting and proper that we should do this.

But, in a larger sense, we can make better—we can improve—we can enrich—this week. The brave men, engineers and profs, who struggle here, have consecrated it not above our power to add or detract. The ags will little note nor long remember what we say here, but they will never forget what we will do here. It is for us, the followers and knights of St. Pat, to be dedicated here to the unfinished work which they who have gone before us so nobly advanced. It is for us to be here dedicated to the great task remaining before us—that we here highly resolve that this engineers' week will be the greatest ever; that this college, under Croft, shall have a new birth of freedom; and that an engineers' week of the engineers, by the engineers, for the engineers, shall not perish from this campus.

ST. PAT'S BOARD COMMITTEES FOR 1957

Bar-B-Q, Baumgardner, Brunkhorst; Parade, Kretzschmar; Serenade and Midnite Show, Jones; St. Pat's Ball, Troost; Column Guard, Frerking; Knighting Ceremony, Pape; Beard and Buttons, Harper; Campus Stunt, Pugh, Bennett, McCann; Green Tea, Kirby; Convocation, Buell; Banquet, Martin; Tickets and Burrall, Barnoski; Lab Exhibits, Snider; Sales, Alexander; Queen Contest, Wagner; Alumnae Luncheon, McCann; Publicity, Herdan, Schooley; Queen Guard, Whiteaker; Edict, Hats, Pins, Ties, Musgrave.

All persons having suggestions or who are willing to work on any of the above committees may contact the committee chairman by leaving a note with their name, address, telephone no., and committee they want on, in the Shamrock mail box in the front office and it will be promptly forwarded to the proper committee.

WATER AND SEWAGE SCHOOL

The annual water and sewage works operators school was held at the University of Missouri January 28 to February 1. The school is sponsored cooperatively by the State Division of Health, the College of Engineering, the Adult Education and Extension Service, and the Missouri Water and Sewage Conference.

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Meet Bill Hancock

Western Electric development engineer

Bill Hancock is a graduate of Pennsylvania State University where he majored in industrial engineering. Bill joined Western Electric as a planning engineer in November, 1951, at the Kearny Works in New Jersey. Later, he was assigned to the new Merrimack Valley Works in North Andover, Massachusetts, as a development engineer. Here Bill is shown leaving his attractive New England home for his office while his wife, Barbara, and their daughter, Blair, watch.

Bill's present assignment at Western Electric: the development of methods and machinery for assembling one of today's most promising electronic developments – electronic "packages" involving printed wiring. At a product review conference Bill (standing) discusses his ideas on printed wiring assemblies with fellow engineers.

Bill and his supervisor, John Souter, test a machine they developed to insert components of different shapes and sizes into printed wiring boards. The small electronic packages prepared by this machine are being used in a new transistorized carrier system for rural telephone lines.

Sailing off the north shore of Massachusetts is one of Bill's favorite sports. He also enjoys the golf courses and ski runs within an easy drive from where he lives and works.

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Extra-Curricular Engineering—

SOCIETY NEWS

GENE JOHNSON, Ag.E. '57

ETA KAPPA NU

Officers for the coming semester were elected at the January 17 meeting of Eta Kappa Nu. They are:—B. W. Sherman, president, E. C. Hausmann, vice-president, C. D. Gentry, Recording Sec., K. M. Jobe, treasurer, R. L. Barnoski, Corresponding Sec., and M. E. Frerking, bridge correspondent. Prof. J. R. Tudor is the faculty advisor.

Plans were discussed for activities for next semester. The slide rule class, sponsored by Eta Kappa Nu, will begin shortly after the beginning of next semester.

CHI EPSILON

On Thursday, January 3, 1957, Chi Epsilon held its regular semester initiation ceremony in the engineering building. The new initiates are: Charles Bryan, Arthur Kuhler, Donald Hiatte, Bill Hopkins, Gordon Scott, Ed Teter, Ernest Thompson, Sam Webb, Dick Wells.

Following the initiation, a banquet in honor of the initiates was held at Moon Valley Villa. Those attending were the initiates; members; Professor Karl Evans, faculty advisor; and Professors Bill Sangster and Mark Harris.

After the banquet a short program and meeting took place back at the engineering building. Each initiate gave a short impromptu speech on humorous topics selected beforehand by the members.

After the regular short business meeting, the officers for the following semester were elected. They are as follows:

President, Bob Farmer; Vice President, Bob Angerer; Secretary, Dick Wells; Treasurer, Art Kuhler.

Bob Farmer resigned from his office of Associate editor of the Transit, which is a yearly job instead of for one semester, to resume the presidency. Jack Moberly was elected as the new Associate editor, for the rest of this year.

ENGINE CLUB

Dwight Kistner was the lucky engineer at the January 8 meeting of the Engine Club. He left with a lettering set, the door prize of the evening and a good knowledge of what industry expects of a graduating engineer and what he, as a new engineer, should look for in industry.

Mr. J. W. Wells from Alcoa of St. Louis presented the lively and enlightening program of the evening. Afterward he conversed informally with a group of engineers who had particular questions to ask him.

A.S.C.E.

The American Society of Civil Engineers Student Chapter held its monthly meeting on January 15. Included in the business portion of the meeting were some of the first steps taken in preparation for Engineering Week. Don Cornelison was named Chairman of the Float Committee and two other members, Bill Hopkins and Charles Bryan were named to be in charge of Civil Engineering Lab Exhibits.

The program for the evening consisted of a talk, accompanied with slides, by Mr. Ruben N. Bergendoff of Howard, Needles, Tammen and Bergendoff, Consulting Engineers. His talk, entitled "The New Interstate Highway System", proved to be one of the finest presented for several years.

The next meeting is scheduled for February 26, and the program for that night will be presented by a representative from the Peter KeWitt Construction Company.

Everyone interested is invited to attend this meeting and all the other meetings of the Chapter. Civil Engineering students should find the meetings most informative and interesting.

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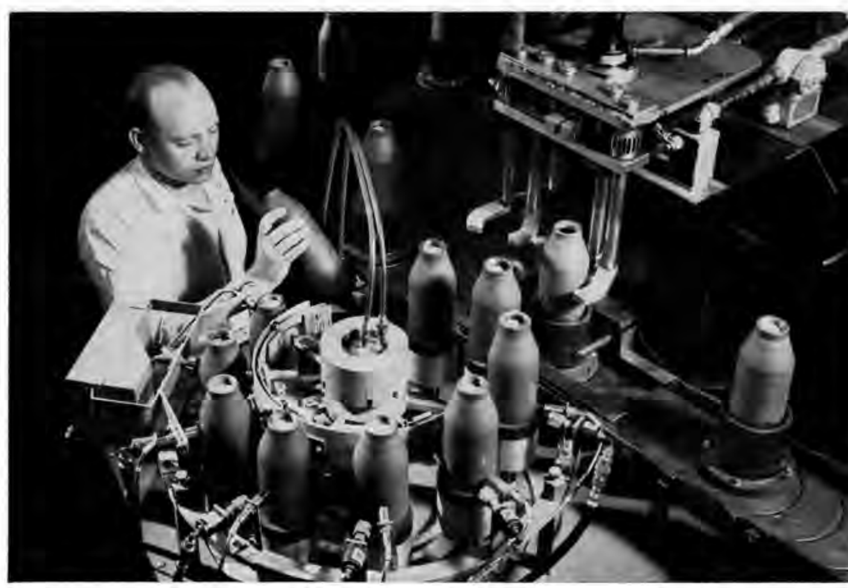
NEWSTUFF

JIM WILHELM, M.E. '57

GYROSCOPE

A new type gyroscope—believed to be lighter and more rugged than the conventional rotating-type gyro now generally in use on aircraft—has been developed by Westinghouse Electric Corporation.

A gyroscope is a device used to stabilize aircraft in flight; that is, it corrects any deviation from the desired flight path, whether the deviation results from a rolling, yawing, or pitching motion. The convential gyro is based on a rotating method of stabilization which is based on the same principle as a spinning top. This new gyro is based on a method of stabilization used by the common housefly and other two winged insects. The fly is equipped with small organisms called "halteres" which, by vibrating rapidly, govern its balance during flight. The Westinghouse gyro is based on this same principle of vibrating masses.



ROBOT X-RAY INSPECTOR

A "robot with X-ray eyes", built by the General Electric Company, is being tested by the Army Ordnance Corps. The machine automatically inspects the explosive charge in each artillery rocket as it comes off the production line, and automatically marks any that have defects in them.

The eyes of the new Robot X-Ray inspector are cadmium selenide crystals that are sensitive to X rays. Cadmium selenide is a member of a whole new family of semi-conductive elements that are playing a vital role in the nation-wide trend toward industrial automation. This crystal, when it is excited by receiving X rays, can unleash the flow of large quantities of electrical current. In testing the new machine, newly made rockets are transported on a conveyor to a circular inspection platform. In the center of this platform is a conventional 250,000 volt X-ray machine, which sends X-ray beams fanning out to the six inspection stations located around the

(*Continued on page* 38)

STEAM TURBINE CASING

A portion of one of America's most advanced electric powermakers has recently been manufactured by General Electric Company. This is the steam turbine casing enclosing the supercritical pressure section of the world's first commercial supercritical pressure steam turbine-generator unit. The turbine will operate using steam at the initial conditions of 4500 psi and 1150°F. Forty 4½-inch bolts and nuts around the perimeter of the turbine casing and four 6-inch bolts and nuts on either side of the turbine shaft hold the upper and lower turbine casing together to prevent leakage of steam. The turbine-generator is rated at 125,000 kilowatts.

NEWSTUFF

(*Continued from page* 36)

rim of the platform. At each inspection station there is a cadmium selenide crystal.

Each rocket moves around this circular platform from one station to the next, rotating as it goes and also moving up and down. At each station, it receives the X-ray beam in a different part of the rocket. If the rocket's explosive charge is sound and uniform, it permits the passage of only a normal amount of X-ray beam and the rocket passes on, approved, to the next station. However, if the explosive charge contains flaws or defects, the X-ray beam passing through the rocket and striking the cadmium selenide crystal will increase. This increase excites the crystal into action, and it releases an electrical current that feeds back to an electronic brain (digital computer) very accurate information on just how much of the X-ray beam is passing through the rocket. The digital computer quickly evaluates this information and determines whether the amount of X-ray beam passing through the rocket indicates a defect serious enough to justify rejecting the rocket. If it does, the computer sends out an electrical signal that causes a mechanical arm to strike the rocket and mark the place where the defect is located.

When the inspected rockets leave the circular platform and return to the line, those with marks on them are removed. They are not scrapped, but salvaged for reworking.

Incorporating more than 250 vacuum tubes, the Robot X-ray Inspector is controlled by a large and complex instrument panel that includes eight digital computers (one for each inspection station, plus two spares).

The Ordnance Corps has approximately $125,000 invested in the machine. However, this cost includes a great deal of original design and development work which would not be repeated for future machines.

AROUND THE COLUMNS

(Continued from page 30)

The intensive five-day course ended with licensing examinations for water and sewage plant operators of all classes. An advanced, third-year section was offered for the first time this year. This advanced course was planned primarily for experienced operators who had attended previous schools.

The school provided an intensive week's training and information to operators, superintendents, and engineers on the fundamental sciences and technical knowledge required for competent operation of water and sewage works. There was laboratory work in addition to lectures.

Classes were given in chemistry, biology, bacteriology, public health, water supply, hydraulics, sewage treatment, mathematics of water and sewage, plant administration, and plant safety. Those completing the course received certificates.

IBM GIFTS

A. N. Hurst, technical assistant in the International Business Machines Corporation's Endicott (New York) factory, addressed the University of Missouri chapter of the American Institute of Electrical Engineers at a meeting on January 8 in the Memorial Student Union. He spoke on Data Processing Equipment.

During the evening Mr. Hurst presented to Dr. Clifford M. Wallis, professor and chairman of the Department of Electrical Engineering in the University, with four new IBM electronic digital computer kits for experimental purposes. He also presented Prof. Wallis for use in the College of Engineering approximately 100 transistors.

"Presentation of the equipment is in line with IBM's historic thinking," Mr. Hurst said, "in regard to assisting colleges and universities obtain the most advanced equipment possible for their laboratories.

"The IBM electronic experimental kit is an example of a laboratory instrument used in the design of basic circuits for a large computer," he added. "Its outstanding value in design work led to its use as a training aid for electronic engineering students who are learning the principles and concepts of modern high-speed digital computers and data processing machines.

"The study of electronic computers is most fitting as these devices serve as useful and powerful tools in the present business and scientific world."

The basic circuits that are used with this kit are the building blocks of present-day computers, Mr. Hurst said. By joining together these building blocks in single or multiple groups, the student can assemble a series of high-speed electronic computer circuits.

HIGHWAY RESEARCH CONVENTION

On January 8, William M. Sangster, Associate Professor of Civil Engineering at the University of Missouri, went to Washington, D. C., where he read a paper on "A Progress Report on Investigations of Head Losses at Junctions In Storm Drains," at the annual meeting of the Highway Research Board, a subdivision of the National Research Council.

The report relates to a research project being carried on here at the University of Missouri under sponsorship of the Missouri State Highway Department and the U. S. Bureau of Public Roads, and financed by grants from the State Highway Department.

The study, begun in 1953, is to analyze various factors which cause water to pile up in and overflow junction boxes where storm drains meet or where they change direction, and to determine the extent of water retardation so that measures may be taken in future building of such junction boxes to prevent overflow.

An engineering student, Robert W. Angerer of Jefferson City, accompanied Prof. Sangster to the four-day meeting in Washington. Each year the State Highway Department sponsors the trip to this professional convention for one outstanding student in the Department of Civil Engineering.

1954 AUSTIN-HEALY

This car is owned by Ralph Mills, a junior in the education school. This car was modified for track racing.

The engine was originally 100 horsepower but was increased to about 135 horsepower. The engine, a four cylinder overhead valve with a 3.29 inch stroke and 3.35 inch bore with a compression ratio of 7.5 to 1 originally. It is now equipped with a Leman's kit, this includes a ¾ full race cam, 10 to 1 aluminum pistons and was electronically balanced. The motor also has two 2 inch Jaguar carburetors with an air scoop and a hot electrical system.

The car has a close ratio overdrive, high-speed differential, 12 to 1 steering (2 turns from lock-to-lock), Italian made brake and clutch lining and racing tires.

MOBILES

PAUL KRETZSCHMAR, ME, '58

1957 M G MODEL A

This car is owned by Louis McCouley, a junior in the education school. This car is the original stock model with no modifications except for spoke wheels.

The engine is a in-line four cylinder with overhead valves. The bore is 2.875 and the stroke is 3.5 inches with a compression ratio of 8.3 to 1. The horsepower is 68.

The car weighs about 2,000 pounds and is 156 inches in overall length with a 94 inch wheel base. It has a four forward speed transmission.

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BIOCHEMISTRY

(*Continued from page* 26)

which are being developed to cope with pests that develop resistance to older insecticides. One problem in making compounds useful in orchards has been the development of solvents which, while coating leaves evenly, will not interfere with the absorption of the compound by the insect that eats it.

The cockroach, which can be bred easily and which reacts, as many crop-destroying insects do, to insecticides, was first used to test these compounds. The workers labeled with P 32 four phosphorus-containing organic insecticides and prepared wach in different solvents. Measured doses of the compounds were injected in roaches by micrometric needle. After definite time intervals, the roaches were frozen to death in crushed dry ice, dissected, and tested for radioactivity.

Though the insecticides were known to be of different toxicities, all four materials were found in the roach bodies in about the same amounts. This led to the conclusion that the differences in toxicity were not caused by differences of permeability among the four compounds.

Further experiments were made to test the possibility that a low excretion rate would account for the higher toxicity, but the most toxic of the four also showed the highest excretion rate. The workers found, however, that the more water-soluble the compound, the more air was concentrated in the abdomen. This correlation indicated that the compounds may be transported in the roach's blood stream, which has a high percentage of water.

Action of Weed-killers

Studies are being made at Oregon State College of two weed killers with opposing toxic properties. One is the widely used 2,4-D, which kills wild onion, Canada thistle, and other broad-leafed weeds at concentration levels that do not injure grains and pasture grass. The other is I. P. C. which shows promise as a killer of quack grass and other noxious grasses at low concentrations that do not harm flax, clover, and alfalfa.

Seeking an explanation of the lethal action of 2,4-D on broad-leafed plants, the Oregon workers studied its absorption and distribution in the soybean. This valuable reacts to 2,4-D in much the same way as broad-leafed weeds. A solution of 2,4-D labeled with radioactive carbon was applied to the primary leaf on 30 bean plants grown in the greenhouse, at a time when those leaves were fully expanded and buds of other leaves were still small. Plants were harvested in groups at intervals of 2, 8, 48, 96, and 144 hours after application. The plants were dried and sectioned and the treated and untreated leaves, terminal buds, stems, and roots were separately assayed for radioactivity.

Among plants harvested after 2 hours, radioactivity in all parts was equal, indicating rapid migration of the herbicide. At 8 hours and above specific activity in the stem exceeded that in all parts except the treated leaf. This demonstrated a concentration of the weed-killer in the stem. Concentration in the roots increased progressively from 8 hours upward.

It was thought that the compound inhibited the uptake of soil

(*Continued on page* 49)

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BIOCHEMISTRY

(*Continued from page 46*)

phosphorus. Bean plants were grown in a solution of radiophosphorus, and half of them were treated with 2,4-D. After 5 days, the plants were harvested and the parts assayed for radiophosphorus. Radioactivity in the plants treated with 2,4-D was less than half that in untreated plants. This test confirmed the phosphorus-inhibiting action of the weed killer.

A third experiment, in which radiotagged 2,4-D was applied to the primary leaves of oat plants, explained the resistance of this narrow-leafed grain to the compound. When harvested after 96 hours and radioassayed, the various sections of the plants showed only small amounts of the compound absorbed by the primary leaf and still less translocated to other parts.

DOMESTIC LIVESTOCK

On experimental farms, radioactive isotopes are helping researchers learn more about nutrition. The isotopes are injected into cattle feed. By tracing the radioactive rays, it is possible to determine the type and quantity of minerals that cows need in their diets to build bones and muscles and also to combat diseases. This research will show farmers how to cut feed costs and get more meat on the hoof.

Even hens are being fed radioactive foods so that nutrition studies can be made. Rays given off by the isotopes help researchers follow the food through the body and into the eggs. As a result, poultrymen hope to get more and better eggs.

Thus, we see that atomic energy is not primarily an instrument of war, but is a powerful instrument of peace. It has proved to be an indispensable tool in the scientist's search for knowledge, a necessary implement in the biologist's investigation of cause and effect and a helpful aid in the worker's gathering of information.

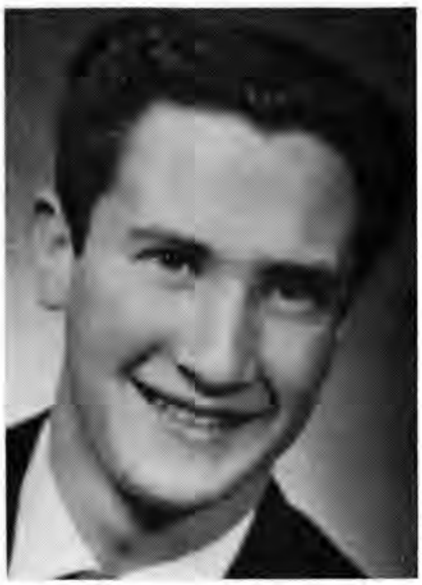
Note: The author wishes to acknowledge the following sources of information: Atomic Energy Commission publications, "Atomic Energy and the Life Sciences" and "Some Applications of Atomic Energy in Plant Science" and Union Carbide's booklet "The Atom in our Hands". Pictures were furnished through the courtesy of Union Carbide and Carbon Corp.

Here radioactive atoms are being used in studying cattle nutrition as part of the University of Tennessee-AEC agricultural research program.

Modern and advanced engines log up hundreds of test hours daily in Standard's automotive laboratory at Whiting. Radioactive carbon traces deposits in the guarded engine (foreground).

Staff Page

ROGER ALLEN, C.E. '60



One of the new faces on the Shamrock this year belongs to Elliot Pucker, a member of the Editorial Staff. He is a senior in Electrical Engineering and a member of Alpha Epsilon Pi fraternity.

Kansas City, Mo. is Elliot's home town. He spent his high school days at Passeo High and was active in the Radio Club and school paper. Kansas City Junior College was his next stop. During his two years there he took part in their co-operative student program, working for Westinghouse Electric and attending school alternately.

His byline will be found under "Mizzou Memos", a feature that keeps track of alumni activities, and a series of character sketches of Engineering Faculty Members.

Elliot plans to graduate in August of 1957. After receiving his degree he intends to go into transistor research.

The distinction of being the youngest and most inexperienced Shamrock member goes to Roger Allen, a member of the Editorial Staff. A freshman in Civil Engineering from Ferguson, Mo., Roger is a recent graduate of Ferguson High School.

His high school activities included feature editor of the school paper, Vice-President of the Senior Class, and Prom Magazine Reporter. He was elected to the National Honor Society and the Quill and Scroll.

As a junior staff member, he is writing the biographies of staff members and the interviews with the engineering students who were selected for "Who's Who in American Colleges".

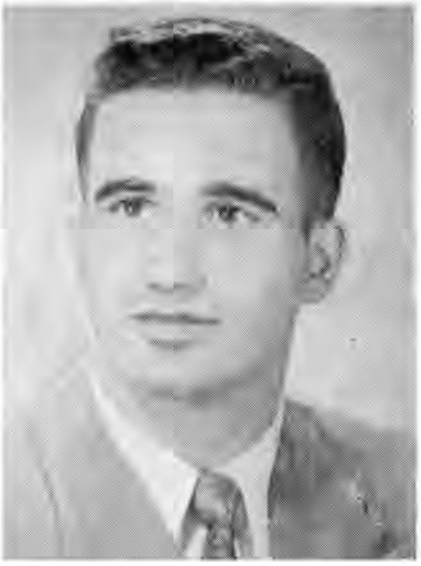
A pledge of Delta Upsilon Fraternity, he intends to be around for at least four years and is aiming at a career as a Structural Engineer.

The man behind the camera for Shamrock this year is Jerry Herdan, who is working as Associate editor and staff photographer.

Jerry is from Kansas City, Mo. and a graduate of Southwest High School. While at Southwest, he worked on the newspaper and yearbook.

This is his fifth year on the campus, having inserted a year of Arts and Science courses between his freshman and sophomore years of Engineering School. He has been staff photographer for the past three years and has worked for Savitar and Showme in the same capacity. Other campus activities include Engineer's Club, A.S.M.E. and St. Pat's Board.

This June he will receive his degree in Mechanical Engineering, which will enable him to work in the Nuclear Power Field.



As business manager of this year's Shamrock, Ed Duke can usually be found behind the typewriter in the office pecking out bills for all of our advertisers. However, that isn't the only place that he may be, as evidenced by his wide range of interests and abilities.

Although he lived in University City, Mo., he attended Soldan High School in St. Louis. While there he received five varsity letters and wrote for the school paper.

On campus, his activities have been both social and professional. A member of Alpha Epsilon Pi fraternity, he has been on the Interfraternity Council and worked as a dormitory social chairman. Professionally speaking, Ed is President of the A.S.M.E. and belongs to the Society for the Advancement of Management and the Engineers' Club.

With all of these activities plus an excellent grade average, a fellow inevitably picks up a few honors. Ed is no exception, he has been elected to Pi Tau Sigma, Phi Eta Sigma, Scabbard and Blade, Omicron Delta Kappa, and has won three scholarships while here.

Ed is a senior and will receive his degree in Mechanical Engineering and a commission in the U. S. Navy this June. When he is returned to civilian status he is planning on working in the power or propulsion industries.

MARCH INTERVIEW SCHEDULE

March 1	Allis-Chalmers	Milwaukee, Wisc.	EE, ME, IE (any engineers interested in Allis-Chalmers) (summer work)
March 1	Lockheed	Burbank, Cal. & Marietta, Ga.	ME, CE, EE, Math., Physics
March 1	Kraft Foods Co.	Chicago	CH.E, Chemistry
March 1	Dunn Engineering Associates, Inc.	Cambridge, Mass.	EE, Physics, Math.
March 4	Eli Lilly & Co.	Indianapolis, Ind.	CH.E, ME, IE, EE
March 4	Interchemical Corp.	Chicago	CH.E, Chemistry summer work for Jrs.)
March 4	Electro-Voice	Buchanan, Mich.	EE, ME, Physics
March 4	White Sands Proving Ground	WSPG, New Mexico	ME, CE, EE, Physics, Math.
March 4	Howard, Needles, Tammen & Bergendoff	Kansas City	CE
March 5	Temco Aircraft	Dallas, Tex.	ME, EE, CE, Physics, Math.
March 5	Curtiss-Wright	Wood-Ridge, N. J.	CH.E, ME, EE, CE
March 5	Zenith Radio Corp.	Chicago	EE, IE, Physics
March 5	Gardner-Denver Co.	Quincy, Ill.	ME, EE, Bus. Admin.
March 5	Metal & Thermit Corp.	Rahway, N. J.	ME, CH.E
March 5	Mare Island Naval Shipyard	Vallejo, Calif.	ME, EE, CE
March 6	Harrington & Cortelyou	Kansas City	CE
March 6	The Marley Co.	Kansas City	ME, IE, CH.E, CE
March 6	U.S. Naval Air Dev. & Material Center	Johnsville, Pa.	EE, ME, Physics, Math.
March 6	Rural Electrification Admin.	Washington, D. C. & Mo.	EE (Summer work)
March 6	Frisco Railroad	Various locations	CE (Jrs. for summer)
March 6	Creole Petroleum Co.	Venezuela, S.A.	ME, CH.E, EE, Geology
March 7	Carter Oil Co.	Tulsa, Okla.	EE, ME, CH.E, Chem., Physics, Math.
March 7	Bell Telephone Co.		Summer work for Jrs. & permanent employ. for Srs.
March 7	Tidewater Oil Co.	Tulsa, Okla.	ME, CH.E
March 7	St. Joseph Light & Power Co.	St. Joseph, Mo.	EE, ME
March 7	Minneapolis-Honeywell	Minneapolis, Minn.	EE, IE, ME, Physics
March 8	D-X Sunray Oil Co.	Tulsa, Okla.	CH.E, ME, CE, Chem., Accounting
March 8	Wyandotte Chemicals Corp.	Wyandotte, Mich.	CH.E, ME, IE, CE, EE, Chemistry
March 8	Arma	Garden City, N. Y.	EE, ME, Physics
March 8	Olin Mathieson Chem. Corp.	E. Alton, Ill.	CH.E, ME, IE, EE, Physics, Chemistry
March 8	Lincoln Lab. (Mass. Inst. of Tech.)	Lexington, Mass.	EE, Physics, Math.
March 8	Collins Radio Co.	Cedar Rapids, Iowa	EE, ME, IE
March 11	Emerson Research Lab.	Washington, D.C.	EE, ME, Physics
March 11	North American	Columbus, Ohio	ME, EE, CE, Math., Physics
March 11	Monsanto Chem. Co.	St. Louis	CH.E, ME, EE, Chemistry
March 12	Convair	San Diego, Cal.	CH.E, EE, ME, IE, CE, Physics Math.
March 12	Stewart-Warner	Chicago	EE, ME, IE, CH.E, Chemistry, Physics
March 12	Pittsburgh-Des Moines Steel	Des Moines, Iowa	ME, CE
March 12	Corps of Engineers	Kansas City	CE, ME, EE
March 13	Universal Atlas Cement Co.	Hannibal, Mo.	EE, ME, IE, CE, CH.E
March 13	Texas Instruments Inc.	Dallas	EE, ME, Physics
March 13	Nordberg Mfg. Co.	Milwaukee, Wisc.	ME, EE
March 13	Johnston Motors	Waukeegan, Ill.	ME, EE
March 13	Los Alamos Scientific Lab.	Los Alamos, N. Mex.	ME, EE
March 14	Schlumberger Well Surveying Corp.	Houston, Texas	ME, EE, Physics
March 14	Hughes Res. & Dev. Labs.	Culver City, Cal.	ME, EE, Physics
March 14	City of Milwaukee	Milwaukee, Wisc.	CE
March 14	Fluor Products Co.	Whittier, Cal.	ME
March 15	Continental Oil Co.	Houston, Texas	CH.E, ME, IE, CE, EE, Physics, Chemistry
March 15	IBM	New York	ME, EE

March 15	ACF Industries	New York	CH.E, ME, IE
March 15	Soil Conservation Service	Columbia, Mo.	CE
March 25	Ill. Div. of Highways	Springfield, Ill.	CE
March 25	North American Aviation	Los Angeles, Cal.	CE, EE, ME, Math., Physics
March 25&26	Bureau of Reclamation	Denver, Colo.	EE, ME, CE
March 25	Armour & Co.	Chicago	Chem, Biochem., Food Tech.
March 26	Commonwealth Edison	Chicago	EE, ME, CE, CH.E
March 26	Panhandle Eastern Pipeline Co.	Kansas City	CH.E, CE, ME
March 27, 28, & 29	Pittsburgh Plate Glass Co.	Crystal City, Mo.	Seniors for permanent & Jrs. for summer

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Convince 'Em

Confuse 'Em

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cut 'em
out and
put 'em
up on
your
wall

Tentative Schedule Of Events

ENGINEERS' WEEK 1957

Sunday, March 17

10:30 a.m. Assemble in front of Engineering Building
11:00 a.m. Burrall Class in Stephens College Auditorium

Monday, March 18

10:00 p.m. Serenade (Meet at Engineering Building)
11:30 p.m. Midnight Show (Uptown)

Tuesday, March 19

8:00 p.m. Reception for Queen Candidates (Engineering Student Wives)

Wednesday, March 20

5:00 p.m. Barbecue at Rollins Springs

Thursday, March 21

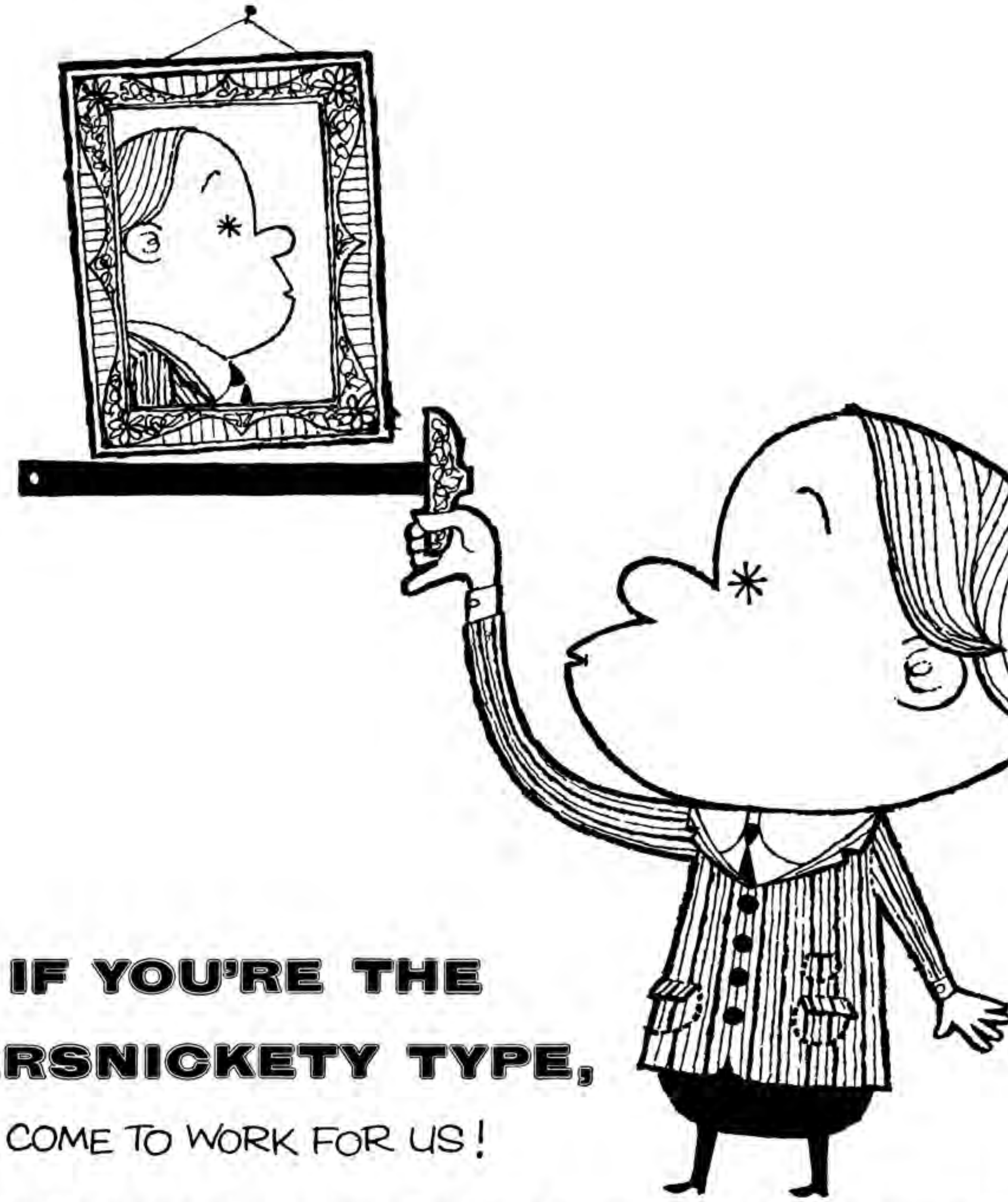
9:00 p.m. Assembly of Campus Stunt and Column Guard

Friday, March 22

All Day Alumni registration in Dean's Office
9:00 a.m. Campus Stunt — Engineering Building
9:30-10:30 Convocation, Jesse Auditorium, Science Student Teacher Recognition Day
9:45 a.m. Judging of Beard Contest
4:00 p.m. St. Pat's Parade
5:00 p.m. Knighting Ceremony—Engineering Building
6:30 p.m. Alumni-Faculty Dinner for Achievement Award Recipients (Student Union)
6:00-10:00 p.m. Laboratory Exhibits and Open House
ASCE dinner

Saturday, March 23

All Day Alumni Registration in Dean's Office
10:00 a.m. Engineering Convocation (Jesse Hall)
Awarding of Student Honors and Engineering Achievement Medals
12:00 noon Alumni Luncheon (Grill Room, Student Union) Ladies Invited.
Annual Business Meeting
Annual Meeting of Engineering Foundation
1:00-4:00 p.m. Laboratory Exhibits and Open House
2:00-4:00 p.m. Green Tea in Engineering Library — Students, visitors, Ladies and faculty invited.
6:00 p.m. Student-Faculty-Alumni Banquet—Student Union
9:00 p.m. St. Pat's Ball in Rothwell Gymnasium
10:00 p.m. Coronation of Queen of Love and Beauty



BULLARNEY

By WHIT

IT'S THE TRUTH . . .

Some girls go in for necking—others go out for it.

One thing a girl learns in college is how to refuse a kiss—without being deprived of it.

Being a man is difficult—if only for the reason that we must deal with women.

Lying is permissible on two occasions—when flattering a woman and when trying to save one's life. The hardest thing for a man to remember are the girls he told he would never forget.

A woman looks upon a secret in one of two ways. Either it is not worth keeping, or it is too good to be kept.

Some girls look upon a bachelor as cowardly, cruel and a wholly selfish man who is cheating some nice woman out of a profitable divorce.

♣

M.E.: A gal and an automobile are alike. A good paint job conceals the years, but the lines tell the story.

♣

"Won't your wife hit the ceiling when you come home tonight."

"She probably will, she's a hell of a shot."

♣

And then there was the Arts student who let his EE roommate fix him up for a date with Allis-Chalmers.

"Frequent water drinking," said the specialist, "prevents you from becoming stiff at the joints."

"Yes," said the Engineer, "but some of the joints don't serve water!"

♣

Host: "There are my grandmother's ashes over there."

Guest: "Oh, so the poor soul passed away?"

Host: "No, she's too damned lazy to look for an ash tray."

♣

He asked for burning kisses,
She replied in accents cruel:
"I may be a red-hot mama,
But I ain't nobody's fuel!"

♣

"How long did it take your wife to learn to drive?"

"It'll be ten years this fall."

♣

Did you hear about the cannibal's son?

He liked the gals best when they were stewed.

♣

Man of the hour: Engineer whose girl friend told him to wait a minute.

♣

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

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

Alimony: A system by which, when two people make a mistake, one of them continues to pay for it.

♣

Ch. E.: "Is my face dirty, or is it my imagination?"

E.E.: "Your face is clean. I don't know about your imagination!"

♣

Professor: "Tell us what you know about nitrates."

Engineer: "I don't know much about them except that they're cheaper than day rates."

♣

"Drink broke up my home."

"Couldn't stop it?"

"No, the damn still exploded."

♣

It was the C.E.'s first date with the Coed.

"No, thank you, I don't smoke."

"Let's go down and sip a beer or two."

"I'd rather not. I never touch liquor."

"Well, let's go down to the stadium for a while."

"No, I'd rather go out and do something new — something exciting."

"O.K. Let's go down to the dairy building and milk hell out of a couple of cows."

♣

"I wish that we'd get a few shipwrecked sailors washed ashore," mused the cannibal king. "What I need is a good dose of—salts."

SHAMROCK SEZ

Next month the annual Student Government Association election will be held. SGA on the Missouri campus is the governing body of all campus activities and the liaison between student and the administration. All students are members of SGA and are encouraged to take an active part. Although most engineers are kept pretty busy with classwork, the president of SGA elected last spring was an engineer. The previous year an engineer was vice-president and it is not only possible but probable that an engineer will be elected an officer of SGA this year. In the past four years, engineering representatives to the SGA council have included two Editors of the Shamrock, the president of Pi Tau Sigma and the president of Tau Beta Pi.

It is the opinion of some that SGA is merely another campus activity which signifies little and accomplishes nothing. The present SGA, however, does what it is allowed to do very satisfactorily and the only factor keeping it from having greater ability to give the students what they want, is lack of student support. Last year, only 346 out of over a thousand engineering students voted, the year before, 364 out of less than a thousand students voted.

Since the power of SGA is delegated by the administration, it is easy to see why SGA is not given more authority since it is only supported by a minority of the students. Several people, including ye Ed would like to see SGA given more responsibility and the student body more freedom of self-rule. It seems that college would be an ideal place for students to practice the democracy under which we live.

Even though the engineering voting is higher than the all-campus average, engineers should not be content to sit back idle when they could be improving their situation.

In the next few weeks the names of the candidates will be posted in the Engine building, so won't you stop and look, consider the candidates and then take a couple of minutes to vote on election day and give your support to our engineering candidates.

Last month Ol' Shamrock dug into its profits and gave several hundred dollars to students who would have been unable to continue in school without it. The Shamrock Awards were first conceived in about 1953 and the first awards given a year or so later. The awards are not to make attending college easier for a person who can earn his own way, but to make a college education possible for someone who cannot pay all of his own way. Although there are no stipulations, it is hoped that recipients will repay the awards when they are able and thus make the fund self-perpetuating. The only requirements needed are passing grades, but a check of this year's recipients later showed that all were above 2.50 g.p.a. which makes Ye Ed feel the money was well spent.

All student engineers who intend to make engineering their profession and not just be apprentice meter readers or some such, will be interested to know the Engineer-In-Training exams given by the Missouri Society of Professional Engineers will be April 27.

Surely, all students who have the least little bit of pride that they are an engineer will take the E.I.T. exam and go on until they are registered professional engineers. As long as a man has toiled his way through four or more years of college, it is surely worth while to be recognized by society, the state of Missouri and his fellows as a professional engineer.

—Au Revoir

PHOTOGRAPHY AT WORK—No. 18 in a Kodak series

What's their credit rating?

With Photography and Air Mail working together, the Credit Clearing House of Dun & Bradstreet, Inc., speeds vast quantities of information across the country overnight.

Even if Dun & Bradstreet reporters photographed every business they investigate, it would not be among the biggest uses of photography this famous credit organization employs.

One most important way makes last-minute credit information in the apparel trades available thoughout the country overnight. Current data and analysts' opinions on more than 150,000 apparel retailers are microfilmed, transferred to micro-cards and flown daily to Credit Clearing offices.

It's another example of photography and Recordak microfilming saving time and money. They are working for railroads, banks, oil companies and countless other businesses and industries both large and small.

Behind the many photographic products becoming increasingly valuable today and those being planned for tomorrow lie intriguing and challenging opportunities at Kodak in research, development, design and production.

If you are interested in these opportunities in science and engineering—whether you are a recent graduate or a qualified returning serviceman, write to the Business and Technical Personnel Department.

Eastman Kodak Company, Rochester 4, N. Y.

A Southern wholesale confectioner had received an order for $10.00 worth of candy bars from the Horsie Hollow Candy Shop. It was a first order, and when the credit manager didn't find the name listed in the Reference Book, he phoned the Dun & Bradstreet office for a report on the venture.

The reporter assigned to the case located the concern on a dirt road, and he took a snapshot of the premises and its busy proprietors which inspired this illustration. He interviewed the owners and wrote a report which was forwarded to the wholesaler.

It informed him that the enterprise was operated as a partnership by two neighbors who were both "eleven years of age and unmarried"—also that "although the owners are men of limited means, they have a high standing in their community." The financial statement indicated assets of $13.25 in merchandise and cash, with a valuation of $35.00 for the building consisting of a remodeled turkey coop.

The partners were reported as experienced with a five-year record of selling lemonade and cookies with their home pantries as the principal sources of supply. There was no indebtedness as their mothers' terms were strictly C.O.D. The wholesaler took a more liberal attitude and shipped on regular terms. The bill was paid in ten days, and the wholesaler opened an account in his ledger for the "Horsie Hollow Candy Shop."

Kodak
TRADE-MARK

MISSOURI

SHAMROCK

MARCH, 1957

FEATURES

25c

Robert Lautzenhiser, class of '49, speaks from experience when he says:

"The broad experience and growth possibilities available at U. S. Steel offer a great future with unlimited opportunities."

Following his graduation with a B.S. degree in Metallurgical Engineering, Robert Lautzenhiser joined U. S. Steel as a Junior Metallurgist at the Waukegan Works of the American Steel & Wire Division. Here, he became familiar with the many types of wire and wire products produced, through the practical performance of various physical tests in the metallurgical laboratory.

The knowledge Mr. Lautzenhiser gained of the characteristics of stainless steel wires led to his advancement, in April, 1950, to Product Metallurgist. In this capacity, his duties were of the customer-contact nature. His responsibilities in this work included consultation and the advising of customers regarding the proper steels for their projects.

Mr. Lautzenhiser received his appointment as Product Metallurgist for stainless steel wire in April, 1954. His work on this relatively new product, in which he developed exceptional skills and abilities, resulted in his advancement to Division Metallurgist in July, 1955.

Mr. Lautzenhiser feels that the graduate engineer gains much from the well-planned and complete training program at U. S. Steel. "Furthermore," he says, "the friendly atmosphere and unusually cooperative personal relationships throughout the company are a big help in acquiring the knowledge that leads to advancement and success in one's chosen field."

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

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UNITED STATES STEEL PRODUCTS . . . UNITED STATES STEEL SUPPLY . . . *Divisions of* **UNITED STATES STEEL CORPORATION, PITTSBURGH**
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ON THE COVER:

Carolyn Louise Wilkerson, St. Patrick's Queen of Love and Beauty.

—Photos Courtesy Smith Studio

MISSOURI SHAMROCK

VOL. XXIII MARCH, 1957 No. 6

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MEMBER
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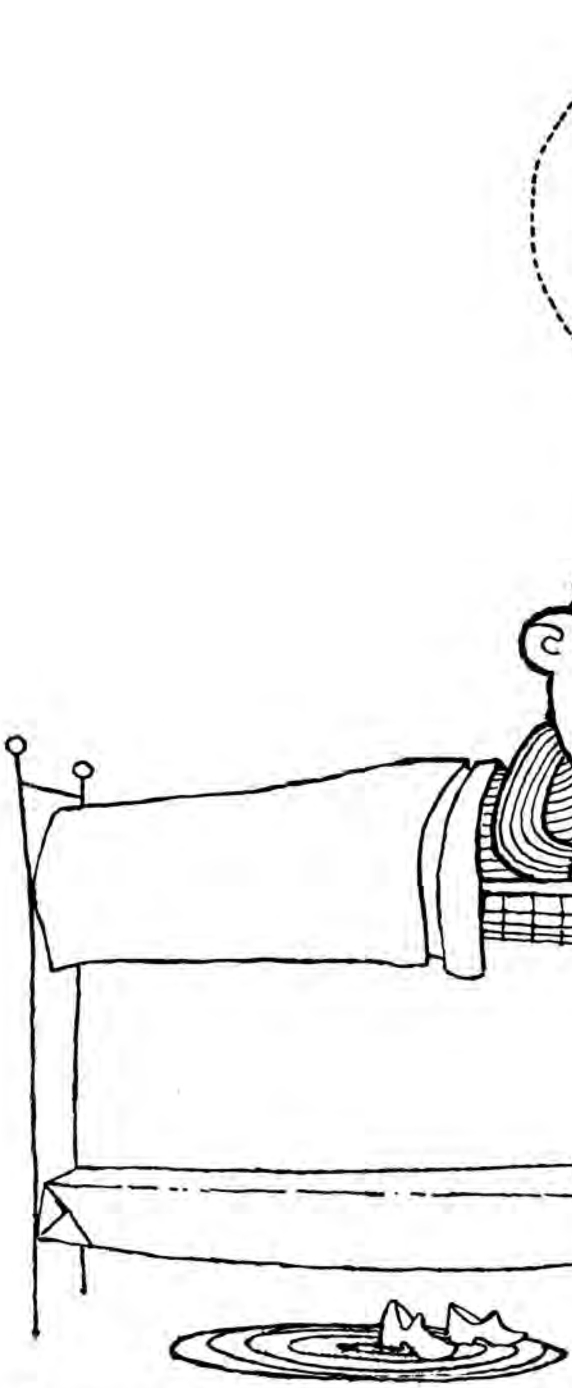

IF YOU'RE THE DISCONTENTED TYPE,

COME TO WORK FOR US!

We want YOU! The kind of engineer who's never contented with the usual, "accepted" way of doing things. The kind of engineer who's always searching for an approach that's new, different, better. The Creative Engineer!

What company offers the most to this "discontented" type of engineer? We believe it is The Standard Oil Company of Ohio! We are engineering-minded. Seven per cent of all our employees are engineers. One-half of the president's staff—our top management—are engineering graduates. Our training programs for engineers are among the most complete in the country. And as a Standard Oil of Ohio engineer, you would be working in one of America's largest and most challenging growth industries—oil!

So before you decide on any company, look into Standard Oil of Ohio—where creative engineering counts! Contact the placement director of your school. Or write Mr. E. G. Glass, Standard Oil Company (Ohio), Midland Building, Cleveland, Ohio.

THE STANDARD OIL COMPANY (OHIO)

James B. Walker *received his B.S. in mechanical engineering from North Carolina State College in June, 1954, and was working toward his M.S. in the same field when he was called for military service.*

Jim Walker asks:

Can a mechanical engineer make real progress in a chemical firm?

"Pick" Pickering answers:

You might call that a leading question, Jim, but the answer leads right into my bailiwick. I came to Du Pont in 1940, after taking a combined mechanical and electrical engineering course. So I had what you might call a double reason for wondering about my future with a chemical firm.

I soon learned that the success of a large-scale chemical process hinges importantly on mechanical equipment. And the success of this equipment—especially for a new process—depends on (1) Research, (2) Development, (3) Plant Engineering, and (4) Close Supervision. The net result is that a mechanical engineer at Du Pont can progress along any one of these four broad highways to a top-level position.

My own Du Pont experience includes mechanical engineering work in fields as varied as atomic energy, fabrics and finishes, and nylon manufacture. Every one of these brought with it a new set of challenging problems in construction, instrumentation and power supply. And every one provided the sort of opportunities a man gets in a pioneering industry.

So, to answer your question, Jim, a mechanical engineer certainly has plenty of chances to get somewhere with a chemical company like Du Pont.

H. M. Pickering, Jr., *received a B.S. in M.E. and E.E. from the University of Minnesota in 1940. He gained valuable technical experience at Hanford Works, in Richland, Wash., and in Du Pont's Fabrics and Finishes Plant at Parlin, N. J. Today, he is Assistant Plant Manager at Du Pont's Seaford, Del., plant, where nylon is made.*

DU PONT
REG. U. S. PAT. OFF.

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. . . THROUGH CHEMISTRY

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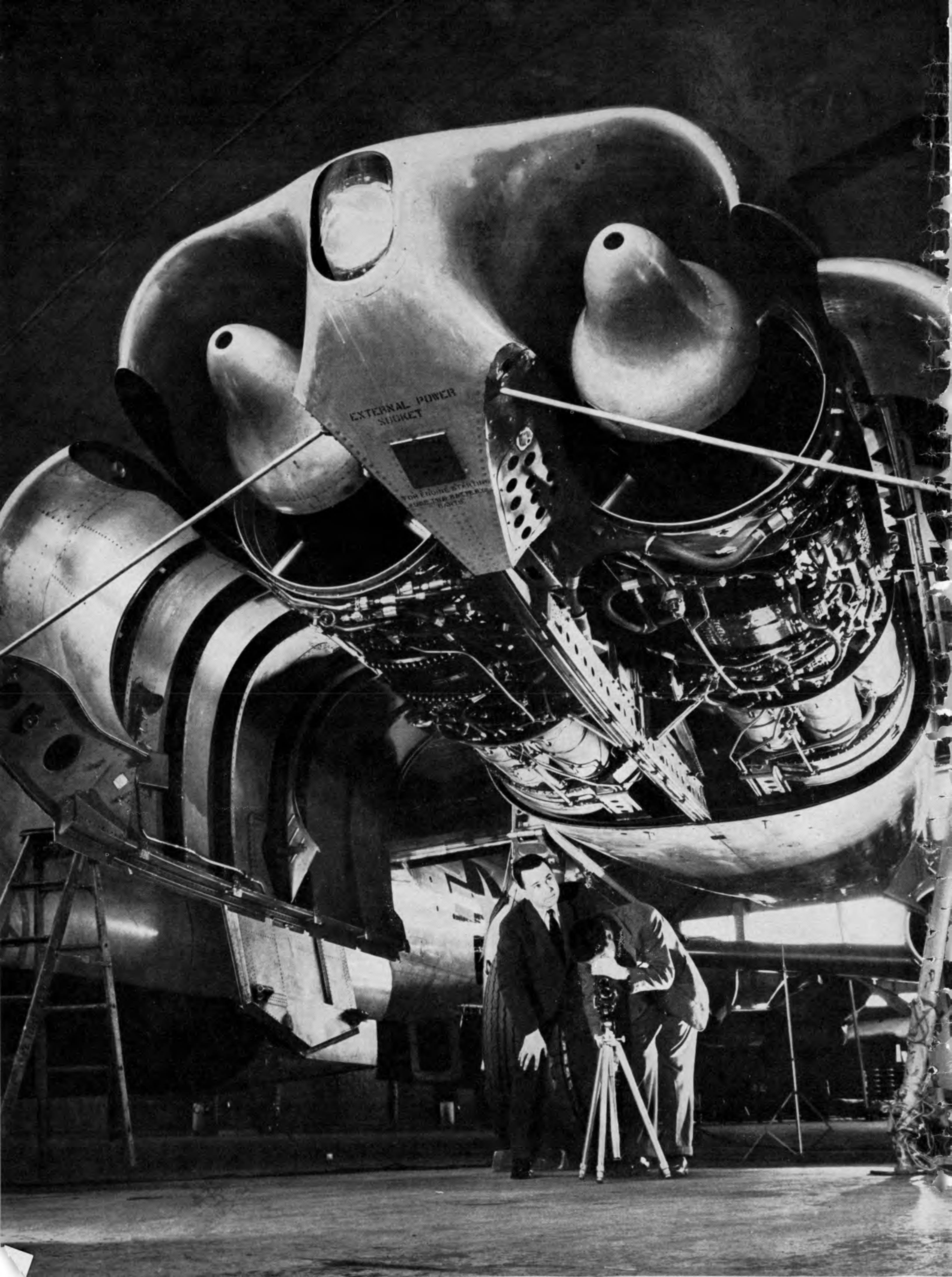
WANT TO KNOW MORE about working with Du Pont? Send for a free copy of "Mechanical Engineers at Du Pont." This 24-page booklet describes in detail the four broad categories of jobs mentioned by "Pick" Pickering. Typical pioneering problems in each of these four categories are outlined. This booklet briefs a young mechanical engineer on how some of the newest and most challenging problems in his field were solved. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Del.


EXTERNAL POWER
SOCKET

Editorial

REGISTRATION

Probably few graduating engineers realize the meaning and purpose of registration. The philosophy and legal basis of registration may be explained briefly as follows.

Modern civilization has found it necessary to regulate the practice of persons whose activities are connected with the protection of the health, welfare, rights, and property of the public. Medicine, Law, and Engineering are the three professions most responsible for such service.

Since a profession is judged by the competence of all who use its name, it is imperative that the profession have the power to bar the unfit and unprincipled from practice in its name. Early attempts at registration received strong opposition. It soon became evident, however, that having the force and sanction of the law behind the desire of the profession to maintain high and honorable standards was indeed a good thing.

Thus, we see that protection of the public provides legislative justification. Protection of the profession, its standards and its standing, is an associated, although inseparable benefit.

The first registration act was passed in 1907, by the state of Wyoming. It provided that engineers offering their services where life, property and welfare of the public were involved, must prove their qualifications to the state. More than half of the engineering profession is presently registered as compared with the strictly mandatory registration in the other professions.

For graduates, the "Engineer-In-Training" registration is available. It allows a written examination to be taken just before or shortly after completion of their college studies. Successful completion of the examination entitles them to a certificate so stating. This does not authorize the practice of engineering, but it attests that they possess the theoretical requirements for registration. After acquiring the necessary four years experience one needs only to complete the final portion of the examination to become certified.

Registration should be considered an important step towards a greater profession. Registration is very important in achieving complete recognition of engineering as a profession of high ethical and technological standards.

MLC

←

Frontispiece—

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

Atomic Energy in MEDICINE

By CHARLENE KORANDO, Ch.E., '59

Alfred Nobel, Swedish Chemist and engineer amassed an immense fortune from the discovery and manufacture of dynamite and other explosives. He never intended for his inventions to be used for man's destruction. Yet he expressed his benevolence and belief in the future of humanity when, at his death, he left the bulk of his fortune in trust to establish five prizes to be awarded annually to men who had made outstanding contributions in the fields of physics, chemistry, medicine or physiology, literature and peace.

Eighty years later the United States unleashed an explosive many times as powerful. No one man could claim the discovery of this instrument of destruction. It was the result of the united efforts of the most skilled and ingenious scientists of the nation. To control the use of this power, to explore its nature, to seek out its applications and at the same time protect us against its dangers presented a series of tasks never encountered before.

The Atomic Energy Act of 1946 authorized the Atomic Energy Commission to undertake this gigantic project. This last aspect of the problem—protection from radiation—was assigned to the AEC Advisory Committee on Biology and Medicine.

Since its operations began, in January 1947, the Commission has authorized contracts and research fellowships and assisted in the purchase of equipment and establishment of laboratories where radioisotopes could be used. It has financed projects using the "tracer" technique, it has produced and priced isotopes on the basis of actual production cost, and it has made all isotopes used in cancer research and therapy available free of production costs. At Argonne's Radiobiology Experiment Station, radioactive compounds useful in research are being synthesized in growing plants and will be distributed as part of the isotope program. Oak Ridge, Berkeley Radiation Laboratory, Los Alamos, and three private firms are also synthesizing radio-labeled compounds for tracer research. Training programs, conducted at Oak Ridge, are helping qualified scientists to acquire the new techniques.

TRACER RESEARCH

In laboratory research, radioisotopes have their greatest value as "tracers". Radioactive carbon, for example, enters into life processes almost exactly like stable, or natural carbon. By means of counters or photographic film to record carbon's emission of beta particles, scientists can trace the movement of the element through living tissue and through complex chemical reactions.

THE BODY'S BUILDING BLOCKS

In its functioning, the body uses a variety of building blocks. Proteins—complex molecules manufactured in the body from amino acids. The enzymes, catalysts of cellular reactions and some hormones also are proteins, and proteins are required to bind vitamins into useful compounds. Carbohydrates, essential fuels for the body, are burned to produce energy and maintain life and also enter importantly into body structure. Lipids—the fats and fatlike substances, which are at once a source of energy, a tool of regeneration and a component of certain hormones. Nucleic acids combine to form nucleo-proteins which make up

Pellets of radioactive cesium are the radiation source for this teletherapy unit used for cancer research at the Oak Ridge Institute of Nuclear Studies.

the nuclei of the cells in the body. In addition to these building blocks, other important key substances include the various blood constituents and the electrolytes—such minerals as potassium, sodium, and calcium.

BLOOD

The blood, containing plasma and cells, is the circulating distributor of chemicals and oxygen throughout the body. Anemia, a disease characterized by a deficiency in the quality or quantity of the blood has been the subject of much study.

Dosages of iron often correct the deficiency. Measurements of iron in the human system, by means of the radioactive isotopes, show that the body loses only a very small fraction of this metal and that the daily requirement is only about one to two one-thousandths of a gram, but even under forced feeding the system assimilates very little. However, the human system salvages about 90 to 95 per cent of the iron when red cells die and reuses this iron to form new cells. These facts indicate why blood transfusion is such an effective means of administering iron. They point also to factors which must be considered in management of a national blood donor program. Iron therapy is just as necessary for the donor, for repeated donations without such treatments will produce anemia.

Experiments have also shown that new red cells in the bone marrow can assimilate iron for a few days, but that mature red cells cannot. Folic acid and liver extracts increase the ability of the young cells to take up iron.

But certain types of anemia do not yield to this treatment. Occasionally this type is caused by a failure of the pituitary gland, located just beneath the brain, to secrete enough of its essential growth hormone.

Treatment with hormones has been found to correct all phases of anemia in the pituitary cases except for the deficiency in the hemoglobin —the coloring matter of the red corpuscles which transmits oxygen to the cells and carries away the oxidation waste products to the lungs, and which uses iron as one of its constituents. At Boston University, scientists of the School of Medicine removed the pituitary gland of laboratory rats, injected the radioactive iron, then traced the distribution of the iron through their organs and bodies and com-

(*Continued on page* 18)

MEDICINE

(*Continued from page* 17)

pared this distribution with that of normal rats. They concluded that the hemoglobin deficiency was not caused by lack of iron.

The scientists therefore pushed their experiment into the other constituents of hemoglobin—in particular the protein fraction. They found that they could prevent anemia even after removal of the pituitary gland of rats by feeding them a high protein diet, coupled with hormone therapy. They are now preparing to use radioactive carbon to label glycine, one of the amino acids used by the body to manufacture the hemoglobin protein, so as to trace this phase of blood metabolism.

BODY SALTS

Electrolytes, the mineral salts essential to health and to many body processes, often are lost rapidly after severe injury, surgical operations or generalized severe infection. These changes in body chemistry are of the greatest importance to survival, healing and convalescence.

It has never before been possible to estimate closely how much potassium was in a man's body, hence, to know the percentage of this essential substance he is losing. Now, by making a minute injection of radiopotassium, then measuring the ratio of this isotope to ordinary potassium in the patient's excreta, doctors can make a very precise calculation.

The dosage of radiopotassium used in the tests was infinitesimal. Scientists have calculated that a millicurie of carbon 14 contained in one hundred-thousandth of an ounce of the element can be accurately measured when spread through as much as 10 tons of animal tissue—in, for example, 20,000 guinea pigs. This amount of radiopotassium used to measure a patient's loss of this trace element thus, need be only a very small fraction of one hundred-thousandth of an ounce.

Using radioactive metals to follow "trace" elements, Harvard Medical School scientists have found that chromium enters into many tissues of the body. It penetrates blood cells within a matter of minutes, and stays firmly bound, possibly for the life of the cell. A program under way now is seeking to determine which cells and, if possible, what portion of each cell the chromium enters. Other research is tracing the function of calcium in the nerves, and the role of zinc in insulin formation.

A non-radioactive variety of water—heavy water—has been used in this same group of experiments to determine, by an isotope dilution method similar to that used with potassium, the amount of water in the body. The method is much more difficult since the experimenters are unable to use the radioactive counter, and must determine the presence of heavy water by extremely delicate and accurate tests. They have calculated that the amount of water varies widely with the body. The total amount of water may range anywhere from 60 to 80 per cent of total body weight.

PROTEINS

The synthesis of proteins, observed hitherto only in the living animal or plant has long been one of nature's secrets. To learn how the process occurs investigators must be able to make the process go on outside the body in reaction vessels. A project at California Institute of Technology succeeded in producing protein synthesis outside the body in glass receptacles. Rabbit bone marrow cells, rat diaphragm, and guinea pig liver were used. All three tissues take up a number of different amino acids, among them glycine, leucine, and lysine which are building blocks of proteins. Since each of these acids has been tagged with radiocarbon, the protein molecules formed are labeled in three places. This fact helps to locate the position of other amino acids and to work out a detailed pattern of amino acids in protein. It is variation in pattern which underlies such differences as anti-body behavior structure, and catalytic activity.

It was found that the incorporation of amino acids into the proteins of these tissues can be made to proceed outside the body at the same rates and under similar physiological conditions as within the body. The process requires energy obtained from the burning of food materials.

Upon further analysis of the process investigators found that the different components of the cell, the nucleus and organized molecules in the cell outside the nucleus, participate in the process, each in a different way. One set of molecules behaves like an engine, it drives the machine. Another set is the machine which does a specific job provided it is driven by the engine.

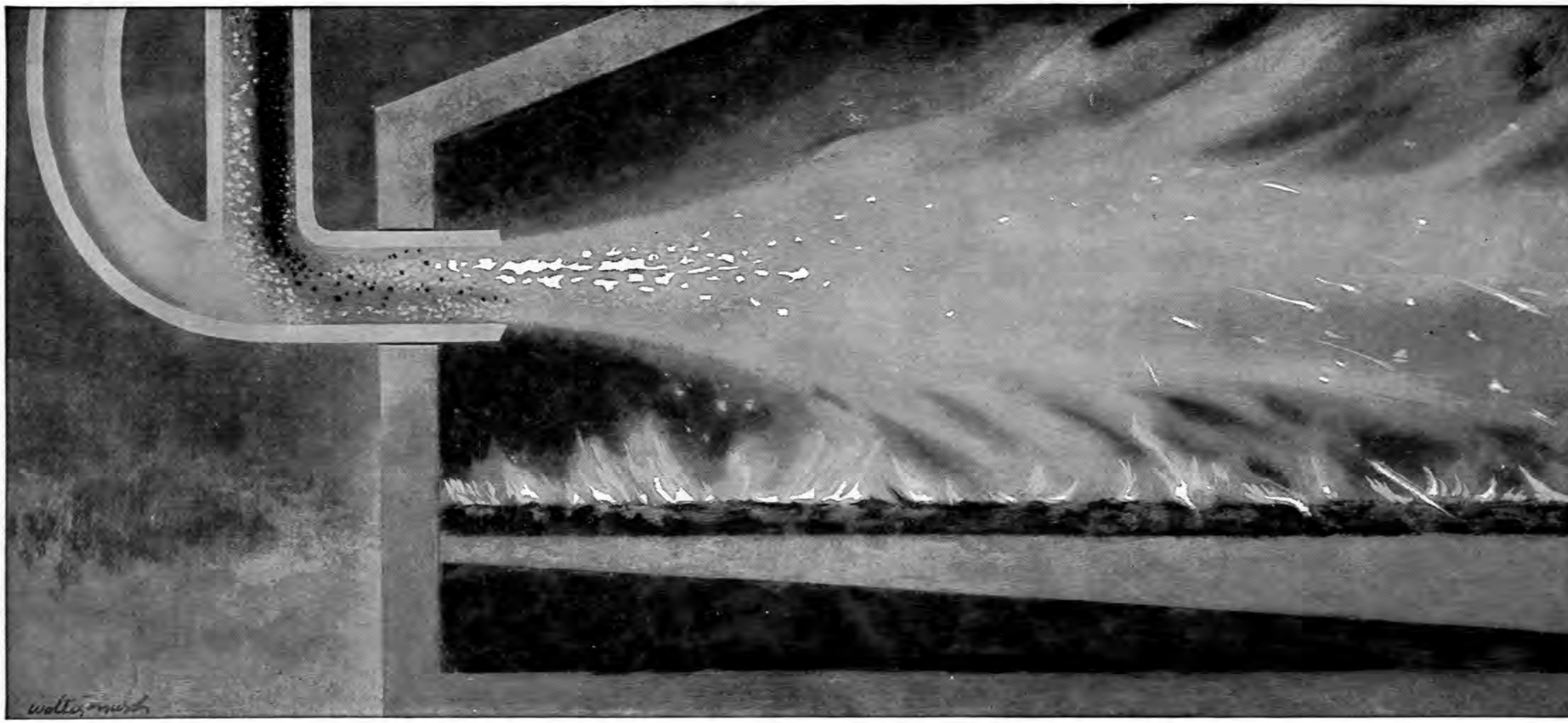
It was also possible to follow the breakdown of lysine. The first step was the formation of a hitherto unknown amino acid, aminoadapic acid. Research investigators also found what appears to be one of the most important sub-units of animal protein — a peptide, or union of amino acids, present in the liver of all animals. It contains nearly all the amino acids and takes up the tagged acids rapidly. This protein component is a major product of digestion of animal protein foods.

Radiocarbon is being used at Oregon State College to trace the relationship of carbohydrates to amino acids, and further to attempt to determine whether as is believed, certain amino acids are related to the water-soluble vitamin, pantothenic acid, which is the "anti-gray hair" part of the vitamin B complex.

LIPIDS

The combustion of the lipids supplies a good part of the body's energy. An understanding of the way the lipids are formed and broken down into the products that are "burned" by oxidation for energy and of the effect upon this process of certain drugs and diseases is of the utmost importance to a clear picture of human life processes. It has particular importance to people suffering from diabetes.

(*Continued on page* 46)



An artist's inside look at 1000-ton-a-day oxygen flash smelting furnace of Inco-Canada at Copper Cliff, Canada.

Inco shows

How ores are made to smelt themselves

Important fuel savings . . . plus tonnage sulfur recovery
. . . with new oxygen flash smelting process

This is the hot, flaming heart of a new Inco-Canada furnace for treating copper concentrate.

It's an *oxygen flash* smelting furnace. *That means conservation of fuels, conservation of sulfur. That also means efficient extractive metallurgy.*

In this new process, you separate oxygen from the air. You blow this oxygen—and fine copper sulfide concentrate—into white-hot furnaces.

The oxygen reacts with the concentrate. Iron and sulfur burn, creating heat. The ore smelts itself, eliminating need of other fuels: copper collects in the matte, iron and rock in the slag.

And the previously wasted furnace gases? These sulfur-rich gases are collected and sold for production of liquid sulfur dioxide, *up to 300 tons a day.*

Oxygen flash smelting is another advance in extractive metallurgy. It's part of a continuing program *to step up production, to keep costs down, through maximum utilization of ores.*

See the new film: "Milling & Smelting." 16 mm color prints loaned to engineering classes and student technical societies. Write Dept. 129e:

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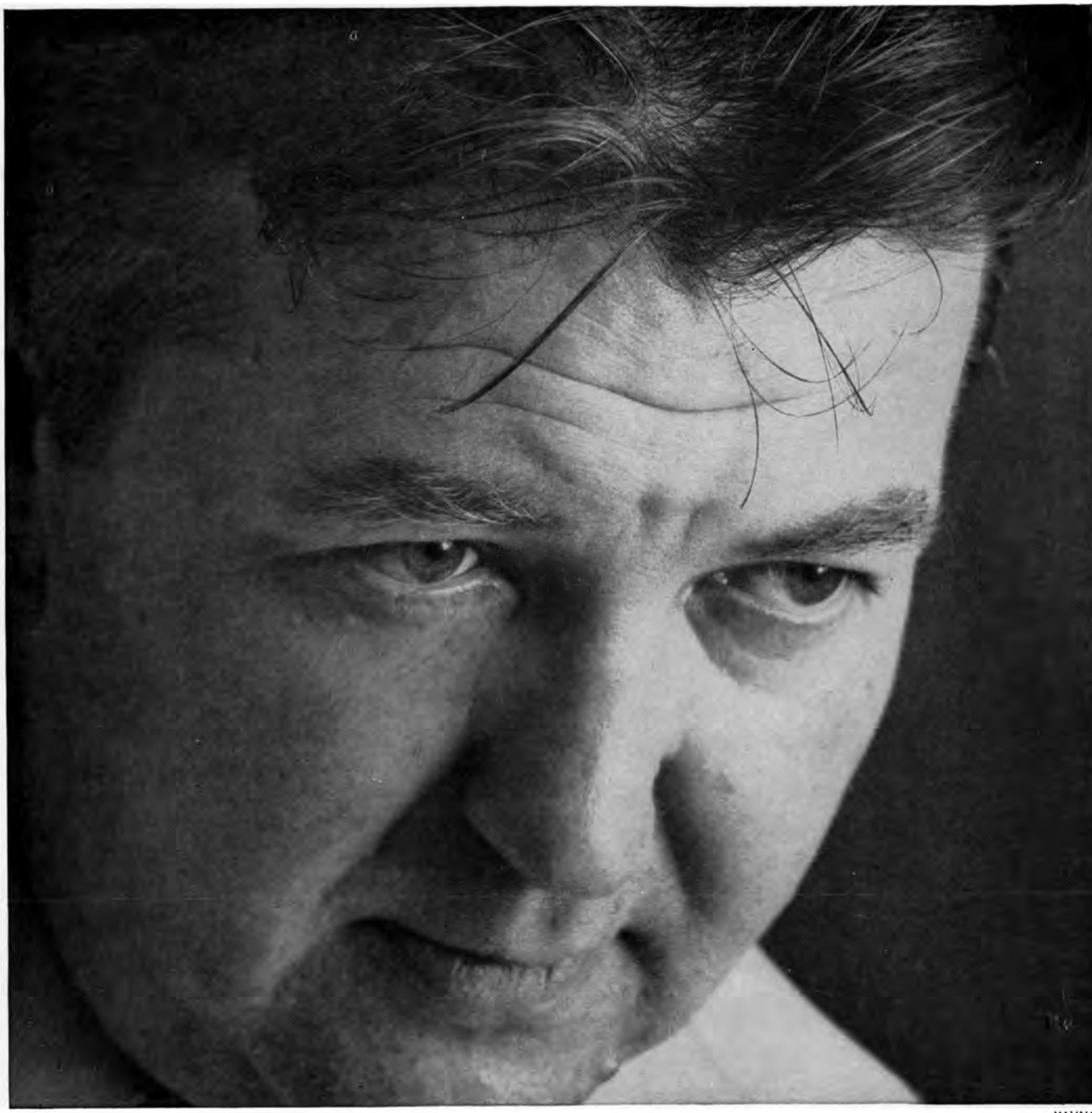

YAVNO

...on the second language

"Our first language is English. Our second is Mathematics. Not all of us are truly bilingual, but probably all are versed in a few concepts of Mathematics — that of a function, for example. The majority of us know those fields of mathematical analysis which developed with the physical sciences well enough to use them as the principal tools of our professions. A minority of us — the professional mathematicians — have pushed on to ground which may never become a public park, but parts of which are clearly exciting. Some strive to master electronic computers which already compress thousands of arithmetical operations into a second. Others, with the sharpest tools of modern Mathematics, carve out fields for use where human elements and decisions are paramount, and for use on problems which could be solved by enumeration, if life were long enough — life of the Universe, that is."

—*J. D. Williams, Head of the Mathematics Division*

THE RAND CORPORATION SANTA MONICA, CALIFORNIA
A nonprofit organization engaged in research on problems related to national security and the public interest

DIGITAL COMPUTER ARITHMETIC

R. C. SANFORD, B.S.EE '53

Editor's Note:
Having been an editor of Shamrock some years ago, Robert knows well how hard it is to keep the few pages between the ads filled. Old Shamrock really appreciates things like this . . . MLC

In this era of H-bombs and electronic marvels, people have become inured to the idea of computers doing much of the work in the fields of science and engineering. A few decades ago, the thought of electrical or mechanical "brains" substituting for the mental processes of humans was ridiculous. Yet, even then, the common desk adding machine was considered a useful tool. Today's electronic digital computers are only bigger, faster, and more complex versions of the familiar desk calculator. However, they frequently use procedures that differ considerably from the ones we use in "every-day" arithmetic.

A question often asked is "Do computers actually think?" This, of course, depends on the definition of the word "think". If we mean the exercise of free will or the ability to conceive new ideas, the answer is no. If we mean the use of previous knowledge or the application of logic to solving mathematical problems, the answer is certainly yes. The important point is that the knowledge and logical choices are limited to those put into the computer by man. Moreover, no matter what the problem to be solved, it must be translated into a mathematical form suitable for the computer; this also must be done by man. Machine intelligence is thus limited and controlled.

Since a computer must come up with the same answer we should get if we performed a particular computation, it seems natural to provide the computer with the same reasoning processes we would use. Actually, in designing and building computers, man has found that "every-day" arithmetic involves processes of which we are seldom aware, and some that are quite inefficient.

Take storage, for example. When we add two numbers, we don't realize that storage is involved. Yet, what exactly do we do? We add the two right-hand digits, write down a digit, and remember temporarily whether a 0 or a 1 must be carried to the next column. Again we add two digits, plus the proper carry, and repeat the process. Once finished, we may keep the paper or throw away all but the answer. Three degrees of storage have been used, but we were not aware of it. Remembering the carry digit was temporary storage, the written work was intermediate storage, and the answer we kept is in semi-permanent storage.

The problem of storage is a major factor in computer design. How much is needed, how long must it be used, and how do we provide for it? Much work has been done on storage methods and devices. Programs (operating procedures) and logical choices that are permanently wired into the computer are also a form of storage.

Perhaps the concept of "logic" in a computer is new to the reader. But think a moment. In subtraction, in division, in algebraic addition—in all these operations we exercise logic in deciding if a number is smaller or larger than another, or is positive or negative. A machine must do the same if it is to perform these operations. The difference is that our logic is that of free choice; that of the machine is only what we put into it.

We ordinarily speak of a desk calculator as an "adding machine" because adding is our most common calculation. And we are right! Most arithmetical, and many algebraic and transcendental equations can be solved with just addition. Therefore, the basic unit of any digital computer is an adder. In solving problems, a computer uses one or more adders, plus the storage of numbers on devices called registers. In each operation, the result appears on an accumulator; this is really just another register used for intermediate or semi-permanent storage.

A computer accepts one number in the register of an adder, and the number to be added is put into a second register. Relays click, or electron tubes or transistors conduct, and the result is stored in an accumulator. Is this all? Certainly not. First of all, our process of adding digit by digit, known as *serial* addition, takes a lot of time. Sometimes, when we add two identical numbers like 421 and 421, we come up with the answer without having to go through the usual steps. Almost automatically we add 4 and 4, 2 and 2, 1 and 1, and come up with 842. This simultaneous process is known as *parallel* addition and is the method used by most computers.

Next, suppose a six-digit machine was told to add 963 and 842. In this case:

$$\begin{array}{r} 000{,}963 \\ +000{,}842 \\ \hline 001{,}805 \end{array}$$

(Continued on page 22)

COMPUTERS

(*Continued from page* 21)

Two columns require a carry of 1 into the next left-hand column. Doing this serially, in our head, we have no trouble. Trying to do it all at once, as a machine would, we have trouble with the carry. In the machine, another register temporarily stores the carry of each digit, and this is subsequently added to the sum:

```
  000,963
 +000,842
 --------
  000,705—sum
 +001,100—carry digits
 --------
  001,805
```

As far as the machine is concerned, this is an entirely different operation from addition and requires special internal arrangements. But suppose that entering the number –842 into the machine tells it to add the complement of 842; this is 842 subtracted from 1,000,000 or each digit subtracted from 10. The machine then adds:

```
  000,963
 +999,158—complement of 842
 --------
 1,000,121
```

Since the first digit is outside the machine's six-digit range, it is ignorer and the answer is 000,121 as in subtraction.

Occasionally, the sum plus the carry digits produces additional carry digits and still another register is needed.

Now, suppose our machine was told to subtract 842 from 963, or alternatively, that is, should add—842:

```
  963
 –842
 ----
  121
```

We have now achieved both addition and subtraction by using just adding devices. What happens if we must add algebraically, or subtract a large number from a small one? For example, if we subtract 963 from 842 (add –963 to 842), we get:

```
  000,842
 +999,037—complement of 963
 --------
  999,879
```

This is not the answer we want, but is the complement form. The complement of this answer is 1,000,-121 — correct except for the sign. Whenever the answer appears in the complement form, the discarded first digit (called the "overflow" digit) of the correct answer can indicate that the sign should be negative. It can also be used to indicate that two numbers to be added will give an answer outside the machine's range.

If we use serial addition, these methods are satisfactory, although slow. When, however, we wish to use parallel addition, we encounter trouble in using complements. Each digit must be subtracted from 10 to provide the so-called "tens complement". This requires "borrowing 1" from the next left-hand column and is mechanically and electrically difficult. To solve this problem, each digit can be subtracted from 9 instead of 10, giving a "nines complement".

Using the nines complement, our answer is 1 short. One method to avoid this is the "end-around carry" where the overflow first digit is carried "around the end" and automatically added to the right-hand digit to give a correct answer. Other difficulties arise in specific problems with specific adding methods, and many schemes have been devised to cope with them. Perhaps the simplest is the use of binary counting. In binary notation, each digit is either a 0 or 1 and binary addition is far simpler than decimal addition since it has fewer digit values and fewer rules.

Aside from addition, multiplication is our common form of computation. But what is multiplication? Nothing but a series of additions of the same number! For example, if we multiply 963 by 8, we write:

```
  963
   x8
 ----
 7,704
```

or we can use successive addition:

```
  963
  963
  963
  963
  963
  963
  963
  963
 ----
 7,704
```

Here, successive addition looks much longer than the usual method. But, if we perform the actual multiplication, including all carries and storage of carries and sub-answers, we have:

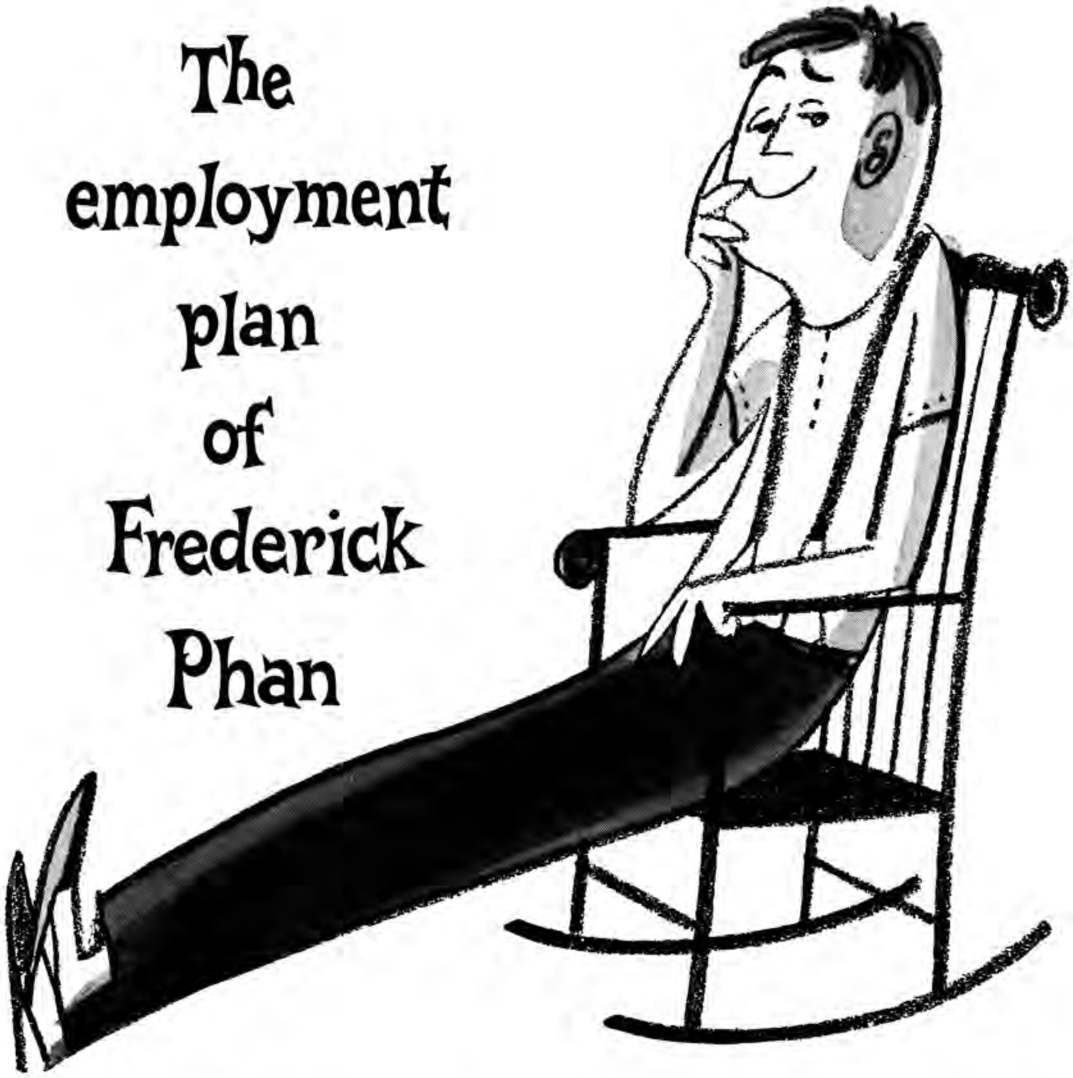
```
  963
   x8
 ----
  284
 7 42 —carry
 ----
 7,604
 0 1  —carry
 ----
 7,704
```

The process requires almost as many operations as successive addition, and uses several storage registers and adders. Successive addition uses only one register and one adder; sometimes these are combined into a single device. For space reasons, desk calculators use successive addition, while big digital computers generally use the other method because some steps can occur at the same time and it is somewhat faster.

Problems involving money or counting require an exact answer. Other problems involve measurements, which are never exact. Had we measured a surface and found it to be 9.63 by 8.42 feet, the last digit in each measurement would be suspect. It *might* be exact, but chances are that it is not. Multiplying to get the area gives 81.0846. Keeping the digits 46 gains us nothing, since they depend on our inexactly measured last digits. Mentally we "round off" by dropping the last two digits. Had the 4 been 5 or greater, we would have changed the 8 to a 9. Many com-

(*Continued on page* 38)

The employment plan of Frederick Phan



Mr. Phan had a plan. It was really a very simple thing. His idea was to let tomorrow take care of itself. And Mr. Phan, too. People gave Mr. Phan credit for courage but not for such things as groceries, rent and clothing.

Fortunately, most engineers insist on building their own futures. They're not inclined to wear destiny like a millstone. And when they come blessed with a far-ranging spirit and an extra portion of creative ambition, we like to have them with us here at Chrysler.

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

We'd like you to have the facts about an engineering career at Chrysler Corporation. They're all contained in a fully illustrated booklet which you may have absolutely free. Whatever your particular field may be—research, metallurgical, chemical, electrical or mechanical—this booklet will give you a complete rundown on the opportunities awaiting you at Chrysler.

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Carolyn, Queen of Love and Beauty ...and her attendants

CAROLYN LOUISE WILKERSON

Hear ye! Hear ye! Laddies of the green; Noble St. Patrick has dubbed his Queen!

The Queen of Love and Beauty has begun her reign! She is Carolyn Louise Wilkerson. She is a charming brown-eyed lassie with a friendly smile and a gentle manner which makes her seem like the girl next door. The lucky people who really live next door to her live on Bass St. right here in Columbia.

Carolyn is a freshman in the College of Agriculture, majoring in Home Ec. She is pledged to Gamma Phi Beta but presently lives at the above mentioned address. Our queen is eighteen years old and is pinned. Knowing of the avid interest in figures which is common to all engineers, we obtained the following information concerning her. Carolyn is 5 feet 2 inches along the vertical axis and weighs 116 pounds. Her other measurements are 36—24—36.

Carolyn says the beards distinguish Engineer's Week, if not the engineers.

We wish to congratulate Carolyn on behalf of the Engineers; she is truly a charming Queen of Love and Beauty.

CAROL JUNE DIEKROEGER

A petite and pretty miss, June is nineteen and a junior in Arts and Science. Her major is English Literature and she has no definite plans for the future. She is 5 feet 4 inches tall, weighs 115 pounds, stands 34—24—35 soaking wet.

June graduated from Kirkwood High School in Kirkwood, Mo. and now resides at the Delta Delta Delta house. Her hobbies are spectator sports, swimming, horseback riding, sewing and reading. She is not engaged, pinned or going steady. She attended Smith College in Northampton, Mass., for one semester before coming to Mizzou. She likes Mizzou boys and Mizzou parties better. She also likes the beards and thinks St. Pat's is a wonderful tradition.

SANDRA LYNNE HARMON

Spanky, as she is known to her friends, is a home town girl, having attended Hickman High School in Columbia. She is a brunette, has brown eyes and is a freshman in Education. Her major is English and she plans to teach English and art in high school after graduation. Spanky is a member of Kappa Kappa Gamma and her hobbies include: swimming, water skiing, dancing, drawing and she loves school.

This is not Spanky's first acquaintance with engineers, as she had an uncle, "Grumpy" Peterson, graduate with BSEE two years ago. She is eighteen years old, 5 feet 2 inches tall and weighs 111 pounds. Other statistics are 34—23—34. She is not engaged, pinned or going steady. Her comment on the beards: "They make everyone look like Abe Lincoln, and they aren't as scratchy as they look".

JOYCE CAROL BALTIS

This twenty-one year old lass comes from Kansas City and graduated from Westport High School. Joyce is a junior in Education, majoring in elementary education. She plans to teach after graduation. She is a member of Zeta Tau Alpha and is not engaged, pinned or going steady. Her hobbies include: playing the piano, bowling, swimming and dancing.

Joyce is 5 feet 3 inches tall, 112 mass and by the tape, 33—24—35. "Jug", a nickname given her by her father, thinks the beards are fine, but not for the year 'round.

EARLINE LORETTA RAY

Earline is a fair haired young lassie whose beauty might best be described as "classic". She has blue eyes, blonde hair and all of the other attributes which make a graceful picture for the lucky laddies to behold. She is a freshman in Ag school and is majoring in Home Ec. After graduation, she plans to teach in high school.

Earline is nineteen years old and is a pledge of Delta cubed sorority. She calls Afton, Mo. her home, having graduated from Afton High School. Her hobbies include water skiing, tennis, ice skating, sewing and cooking. And, take note, she is not going steady, pinned or engaged. She thinks the beards are cute and distinctive, and make the boys look like men.

Earline measures 5 feet 5 inches among the Y coordinate, has 115 units of gravitational attraction and measures 34-24-34.

Laboratory Hints

The first step in any laboratory set up is to read the information sheet given out by your lab instructor. Included in this information there usually is a circuit diagram. Examine this diagram carefully. Then collect all the meters, cables, etc. necessary for the hook up. You will find that wiring your circuit is a joy with the clear diagrams supplied by the instructor.

Wiring the test set up is a joy

Measuring voltage is a simple matter
—just wet your thumb and first finger . . .

Several hours later you will have finished wiring and hooking up your meters. The next problem is to get voltage to the test set up. After patching on the power panel it is still doubtful whether the voltage is that desired. A simple method of checking voltage is to moisten the thumb and first finger of the right hand . . . place the first finger on one voltage point and the thumb on the other. If you are knocked flat on your tail the voltage is 110 volts D C. If you oscillate up and down the voltage is 110 volts A C. If you are knocked clear across the room you probably have tried to measure 220 volts.

Laboriously Collected From Last Year's Reports

by STANISLAUS J. HAMMERSCHLUG

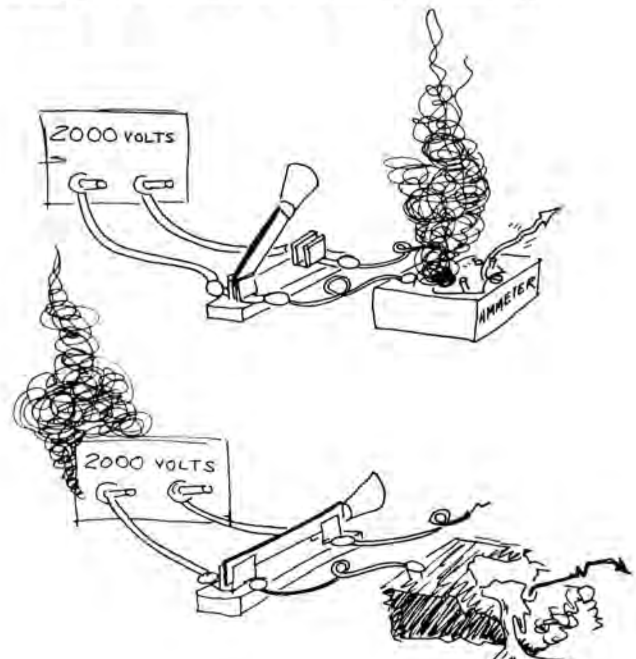
Procedure Demonstrated

by BLARNEY O'TOOLE

At this point it would be wise to insert a few safety measures. First, do not measure 220 volts with the bare hand . . . wear a glove. Second, always keep one hand behind your back and one hand in your pocket. This last measure prevents coming into contact with high voltage accidentally. Of course, it is a little difficult tightening nuts with your toes . . . but safety first you know.

Always keep one hand behind your back —and one hand in your pocket

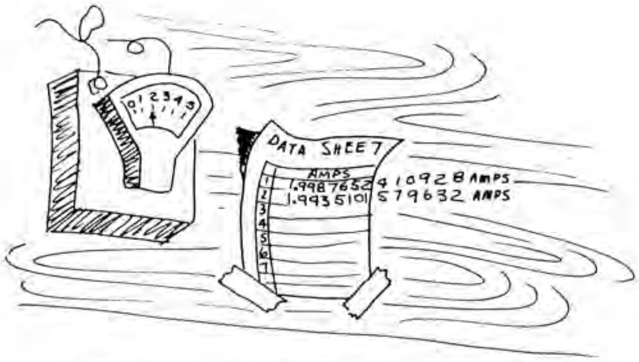
Always put a shorting switch across an ammeter



And use it

Protecting yourself should be your first concern. However, the delicate instruments need protection also. Always put a shorting switch across an ammeter . . . and keep it closed unless actually making a reading.

(Continued on next page)



Your data should be as accurate as your meters

You are now ready to take meter readings. This is a simple process and does not need elaboration here. Your data should be as accurate as your meters, however.

And remember, if all else fails, present your lab instructor with a bouquet of shamrocks on St. Pat's Day. This will probably convince the instructor that you have school spirit and he will pass you even though you did follow these hints.

Present your lab instructor with a bouquet of shamrocks on St. Pat's Day

What's doing...

Vacuum melting has opened up new horizons for development of alloys. Here, a Pratt & Whitney Aircraft metallurgist is shown as he supervises preparation of an experimental high-strength nickel-base alloy, melted and cast under high vacuum.

Induction melted heat of high-temperature alloy being poured in P & W A's experimental foundry. Molten metal is strained into large water tank, forming metal shot which is remelted and cast into test specimens and experimental parts. Development and evaluation of improved high-temperature alloys for advanced jet engines is one of the challenges facing metallurgists at P & W A.

at Pratt & Whitney Aircraft in the field of Materials Engineering

The development of more advanced, far more powerful aircraft engines depends to a high degree on the development of new and improved materials and methods of processing them. Such materials and methods, of course, are particularly important in the nuclear field.

At Pratt & Whitney Aircraft, the physical, metallurgical, chemical and mechanical properties of each new material are studied in minute detail, compared with properties of known materials, then carefully analyzed and evaluated according to their potential usefulness in aircraft engine application.

The nuclear physics of reactor materials as well as penetration and effects of radiation on matter are important aspects of the nuclear reactor program now under way at P & W A. Stress analysis by strain gage and X-ray diffraction is another notable phase of investigation.

In the metallurgical field, materials work involves studies of corrosion resistance, high-temperature mechanical and physical properties of metals and alloys, and fabrication techniques.

Mechanical-testing work delves into design and supervision of test equipment to evaluate fatigue, wear, and elevated-temperature strength of materials. It also involves determination of the influence of part design on these properties.

In the field of chemistry, investigations are made of fuels, high-temperature lubricants, elastomeric compounds, electro-chemical and organic coatings. Inorganic substances, too, must be prepared and their properties determined.

While materials engineering assignments, themselves, involve different types of engineering talent, the field is only one of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program — with other far-reaching activities in the fields of mechanical design, aerodynamics, combustion and instrumentation — spells out a gratifying future for many of today's engineering students.

Engineer measures residual stress in a compressor blade non-destructively, using X-ray diffraction. Stress analysis plays important part in developing advanced aircraft engine designs.

The important effects of gases on the properties of metals have been increasingly recognized. Pratt & Whitney chemists are shown setting up apparatus to determine gas content of materials such as titanium alloys.

P & W A engineer uses air jet to vibrate compressor blade at its natural frequency, measuring amplitude with a cathetometer. Similar fatigue tests use electromagnetic excitation.

World's foremost designer and builder of aircraft engines

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

EAST HARTFORD 8, CONNECTICUT

No blue sky...just black and white facts to back up our belief that you and Collins should get together

We're going to build a proposition which we believe deserves your most serious consideration, if you are a mechanical or electrical engineer. This proposition is built on pure and simple fact—no high flown promises or broad generalities. Our proposition: you and Collins should get together. We present these facts to support it.

FACT NUMBER 1:
Collins Radio Company's sales have increased 10 fold in each of three successive seven year periods. 1933 sales were $100,000; 1940 sales, $1,000,000; 1947 sales, $10,000,000; 1954 sales, $100,000,000, and 1956 sales, $126,000,000. (Note graph.) This company *has grown, and is growing* at a phenomenal rate. Total employment is 9,000 of which 24% are research and development personnel.
You grow when the company you work for grows.

FACT NUMBER 2:
As shown in the graph at right, the employment of research and development personnel has increased steadily despite fluctuation in sales. Notice that even during periods of national sales regression Collins continued to strengthen its engineering staff.
Collins has based its growth on the solid foundation of stability in the engineering department.

FACT NUMBER 3:
At Collins, the ratio of engineers to total employees is extremely high, far higher than the average among established companies engaged in both development and production. First and foremost, Collins is an engineering company.
Engineering is king at Collins—never takes a back seat to production expediency.

FACT NUMBER 4:
Collins' reputation for quality of product is universally recognized. It has led to Collins' phenomenal sales record. At Collins there is no compromise when quality is at stake.
If you're the man we want, you'll get real satisfaction out of this quality-consciousness.

FACT NUMBER 5:
Electronics is Collins' only interest. In no way is it subsidiary to the manufacture of industrial or consumer products. Collins builds electronic equipment, not airplanes or vacuum cleaners. Every research, development and production facility is devoted to progress in electronics.
If electronics is your interest, you'll like the climate at Collins.

FACT NUMBER 6:
There is a limitless variety of fields and types of work for the Collins engineer. Recent Collins work in air and ground communication, and aviation electronics include developments in transhorizon "scatter" propagation; single sideband; microwave and multiplex systems; aircraft proximity warning indicator; aviation navigation, communication and flight control; broadcast; and amateur equipment.
There is big opportunity for your special talents.

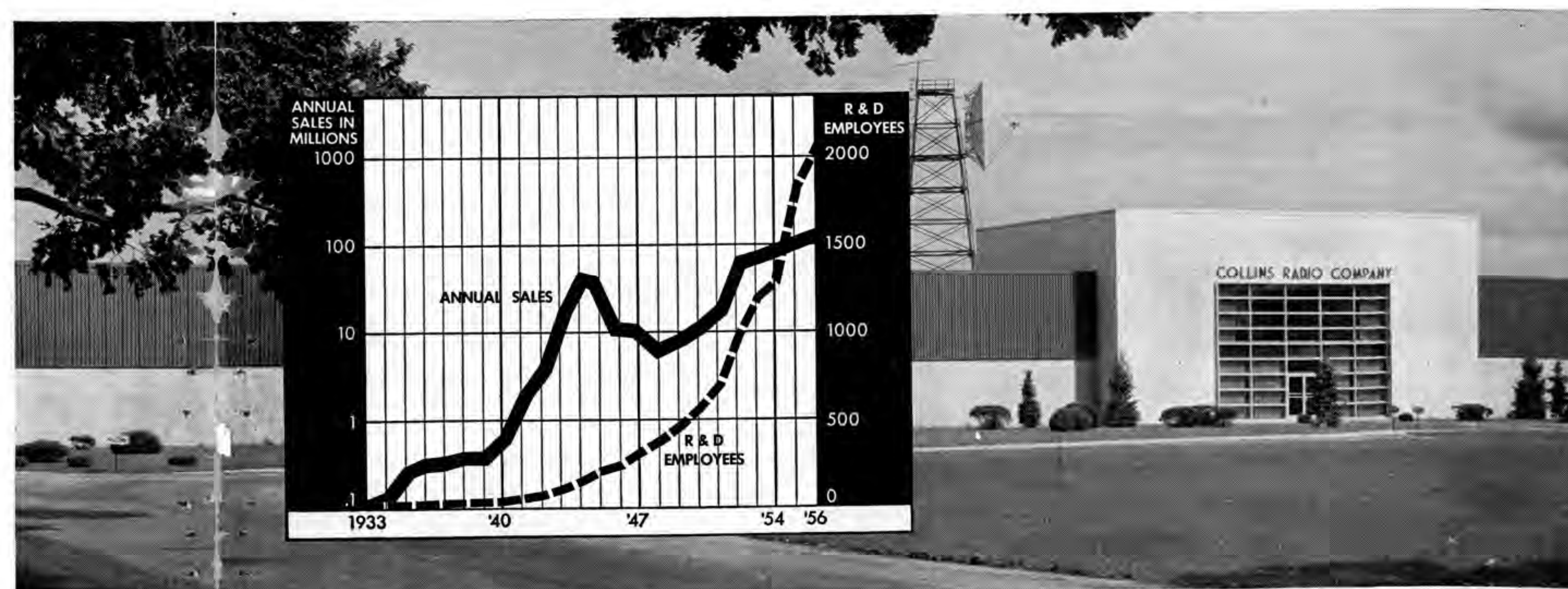
Right now we are prepared to offer you a technical or supervisory assignment in one of many interesting fields. And the sky *is* the limit as far as responsibility and salary are concerned.

You will work in one of Collins' new research and development laboratories located at Cedar Rapids, Iowa; Dallas, Texas; and Burbank, California. Offices and subsidiary companies are located in New York; Washington, D. C.; Miami; Knoxville; Seattle; Hickman Mills, Missouri; Toronto, Canada; London, England; and South America.

All your moving expenses are paid. Company benefits are tops in the industry.

We repeat—if you are a mechanical or electrical engineer, you and Collins should get together. Take the first step now, for more information, write:

L. R. Nuss	Fred Aiken	Harold McDaniel
Collins Radio Co.	Collins Radio Co.	Collins Radio Co.
Cedar Rapids, Iowa	2700 W. Olive Ave.	1930 Hi-Line Drive
	Burbank, California	Dallas, Texas



This graph shows the relationship between sales and employment of engineering personnel at Collins. Notice the steady increase in research and development employment despite sales fluctuations.

Collins new research laboratory building at Cedar Rapids, Iowa. Air-conditioned, shielded against radio waves, completely equipped.

Collins CREATIVE LEADER IN ELECTRONICS COLLINS

COLLINS RADIO COMPANY • CEDAR RAPIDS • BURBANK • DALLAS

Extra-Curricular Engineering—

SOCIETY NEWS

GENE JOHNSON, Ag.E. '57

ENGINE CLUB MEETING
Feb. 13, 1957

The Engineer's Club met on February 13, 1957. The most important business transacted was the choosing of the five finalists in the queen contest. These five are Joyce Baltis, June Diekroeger, Sandra Harmon, Earline Ray, and Carolyn Wilkerson.

The Club decided that St. Pat's Ball would be open only to engineering students. Subscriptions—$1.50 for Engine Club members and $2.75 for non-members. It was also decided that the barbecue would be open only to Club members.

(reported by Roger Pape)

ASAE

Prof. R. M. Eastman, Director of Engineering, Placement, spoke to the student branch of the American Society of Agricultural Engineers at the February 13 meeting of the society. He spoke on interviewing and the present demand for engineers. After his very informative talk, Prof. Eastman answered questions from the members about placement.

The program at the February 26 meeting was a student-faculty panel discussion on the topic, "The Agricultural Engineering Curriculum". Ed Munson served as moderator. Prof. R. E. Stewart and Prof. T. O. Hodges represented the faculty. Don Pepper and Richard represented the students on the panel.

The society had a "Ladies Night" on March 12. Members and their guests saw a highly interesting movie entitled "Man With a Thousand Hands". The film showed the construction of a dam, a processing plant, and a power plant in British Columbia. It showed how the courses of a river and streams were changed to accomplish the construction.

Ag engineers interested in sales work should be especially interested in the program for March 26. Mr. John W. Tschantz will speak to the society on "The Engineer's Future in Sales Work". Mr. Tschantz is District Representative for the Central Sales Division of the Caterpillar Tractor Company.

There are refreshments at each meeting.

(reported by Gene Johnson)

ASCE

The Student Chapter of the American Society of Civil Engineers held its latest meeting on February 26. A turnout of between 80 and 90 persons was present to enjoy a fine program presented by Mr. E. S. Lindquist of the Peter Kiewit Construction Company. Two films were shown and they dealt with the building of large bridges undertaken by the Kiewit Construction Company.

There has been no formal meeting scheduled for March: mainly because of Engineer's Week. However, Chapter members will be busy in preparation for St. Pat's Week as a float is being planned for the parade. Civil Engineering Laboratory Exhibits also will be handled by some A.S.C.E. members. The Chapter will be trying to do a good job on its Lab. Exhibit this year in order to match last year's first prize exhibit.

The dates of future meetings of the Chapter will be posted in sufficient time before the meetings. Anyone interested may attend.

(respectfully submitted:
Earl F. Holtgraewe, Sec.)

CHI EPSILON NEWS

On the evening of February 26, Chi Epsilon members entertained Mr. E. S. Lindquist and his assistant, Mr. Sands, at a dinner in the Grill Room of the Student Union. Mr. Lindquist, manager of the Wichita Office of Peter Kewit and Sons, was the guest speaker at the ASCE meeting that evening.

At the Chi Epsilon meeting the week before, it was decided to work with ASCE jointly on a float for the Engine Parade.

(reported by Susan Brady)

ASME

The student branch of the American Society of Mechanical Engineers met twice in February and has had one meeting so far in March.

On February 11, Ken Musser from the Guide Lamp division of General Motors spoke to the society on the subject "Process Engineering at Guide Lamp". The Savitar picture of the ASME group was taken at this meeting. Refreshments were served.

Joe Ferrer and Bill Morrow from

(*Continued on page 42*)

NEWSTUFF

By JIM WILHELM, M.E. '57

ATOMIC HONEYCOMB

The first atomic reactor ever operated in the northeastern United States has been started up and shut down a record 10,000 times for experimental purposes. The Preliminary Pile Assembly, shown in the above figure, which is operated at the Knolls Atomic Power Laboratory by General Electric has also produced much information about various types of reactors.

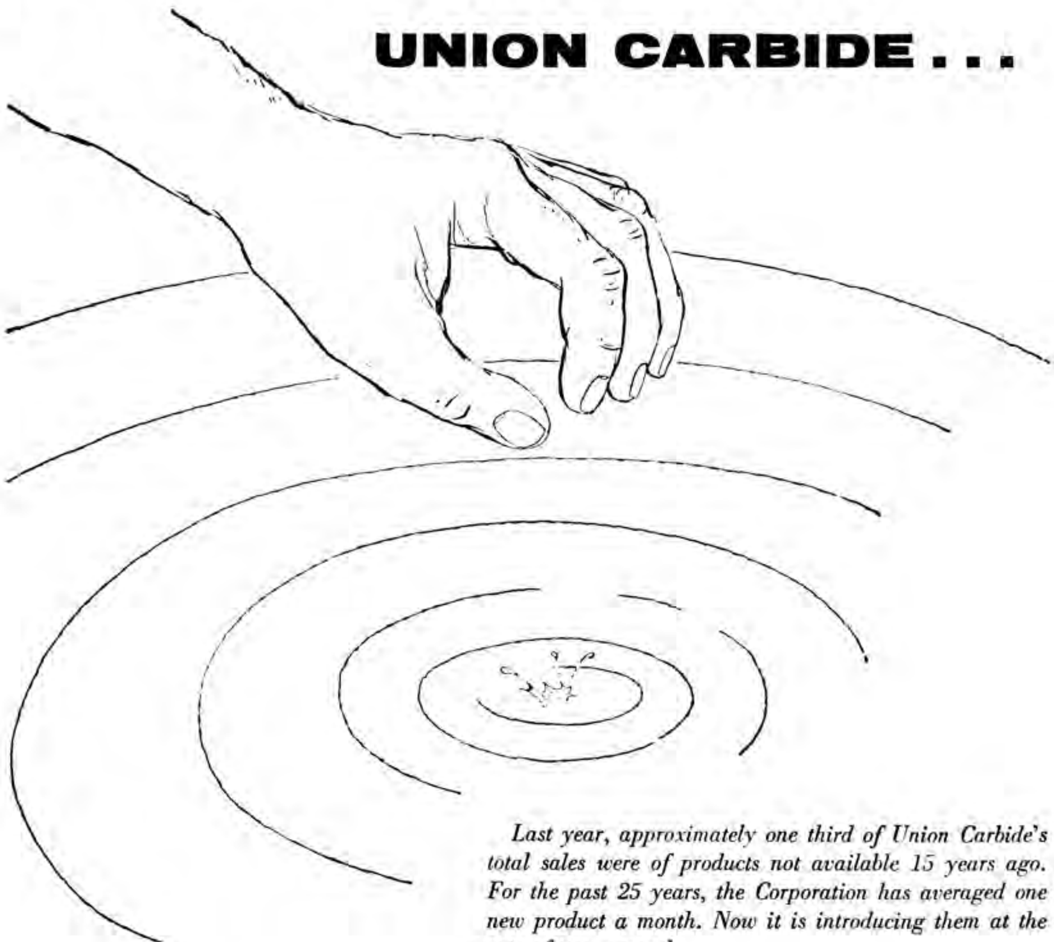
Scientists and engineers have designed and constructed reactors for the prototype power plant for the submarine Seawolf and the actual Seawolf power plant at the Knolls Atomic Power Laboratory. Currently they are designing the Submarine Advance Reactor for use in the world's largest submarine, the Triton, now under construction.

The Preliminary Pile Assembly, which can be shut down and restarted in 15 minutes to facilitate rearrangement of fuel elements, has simulated the performance of a large variety of reactors. This has been accomplished through relatively simple design modifications of the fuel elements in one or both of the hexagonal reactor tube bundles.

On the basis of calculations or previous experiments, an appropriate number of uranium-aluminum fuel discs are loaded into fuel rod sub-assemblies which are then inserted into the two vertical faces of the reactor tube bundles. In addition to the fuel discs, the fuel rods contain discs of other materials which simulate the structural materials, coolant and moderator which are proposed in the reactor design. For ease of handling, these discs are held together by tie rods which extend through central holes in the discs.

When the fuel rods have been loaded into the proper geometric pattern, the two halves are moved together by remote controls which are located in a separate room behind a four-foot thick concrete wall. After the halves have been brought together, control rods are moved into positions which cause the reactor to become chain-reacting.

Quick access to the reactor cell following an experiment and changeover of fuel elements are possible since the Preliminary Pile Assembly is operated at only about one-watt power, which limits the induced radioactivity to a minimum value.



COMPUTERS

(Continued from page 22)

puters are used only for problems involving measurements, and are therefore arranged to "round off" the answer. If the machine ignores all digits that are to be dropped, it can be made simpler and faster. Such a machine would multiply in reverse order from normal, making the important digits available first and dropping the unwanted ones:

```
     9.63
    x8.42
    ----
  2 84
 74 2
    642  — drop the 2
  3 21
     826 — drop the 2 and 6
     110 — drop the 0
 -------
 81.08   — answer to two
           decimal places
```

This process has been simplified here by omitting some of the carry operations.

Division is still more complicated; it requires multiplication and subtraction in a specific sequence, plus logic. The divisor is entered into the machine on a multiplier. The machine must exercise logic in deciding on the largest value by which the divisor can be multiplied, just as we do mentally. The product is subtracted from the dividend, leaving a remainder. The process is repeated until the answer is complete, any remainder being stored on an additional register. For example:

```
963) 810,846 (800—first divisor
---          ---
  –770,400
  --------
     40,446 ( 40—second divisor
              ---
    –38,520
    -------
      1,926 (  2—third divisor
              ---
     –1,926
     ------
      0,000 (842—complete ans.
             ----
```

Some machines use repeated subtraction, shifting to the right when the logic device says the answer would be negative if there were one more subtraction. This would seem to be simpler, but it involves the use of complements at each subtraction and therefore more steps.

In our every-day life, we use the four processes of simple arithmetic —addition, subtraction, multiplication, and division. Science and engineering use still another process classed as simple arithmetic—extracting a square root. A machine can of course be programmed to extract a square root by the same method we were taught in school. There is, however, a much simpler method of successive approximations known as the "mechanic's rule", using repeated division.

If a number is divided by its exact square root, the quotient will also be the square root. If the divisor is slightly larger than the square root, the quotient will be slightly smaller, and vice versa. In any event, the average of the divisor and quotient will be a closer approximation to the square root than either of them. The process, then, is simply that of dividing, taking an average, and dividing again; this is repeated until the root is found to the desired accuracy. For example, find the root of 708,964. The number is set off with commas in the usual manner, forming pairs of digits each way from the decimal point. The largest digit that can be squared and subtracted from the first pair is 8. We now *divide* the number by 8 until we have at least two significant figures in the quotient:

```
8) 70,89,64 (880
-           ----
 -64
 ---
   6 8
  -6 4
  ----
     4
```

The true root must be between 88 (0) and 80 (0), so we take the average 84 (0) as a new trial divisor and divide again until we have three significant figures:

```
88) 70,89,64 (844
--           ----
   -67 2
   ----
     3 69
    -3 36
    -----
       33 6
      -33 6
      -----
       00 0
```

Since there is no remainder, we might think that the problem is solved, but the divisor and quotient are not the same number and we still have an unused digit in the dividend. So—we divide by the new average between 844 and 840:

```
842) 70,89,64 (842
---           ----
    -67 36
    ------
      3 53 6
     -3 36 8
     -------
        16 84
       -16 84
       ------
        00 00
```

The divisor and quotient are now the same and the desired root is 842. Although this seems complicated, most computers are programmed for this method because it is considerably simpler and takes fewer logical operation than the usual "schoolboy" method.

Once we have a machine programmed for the elementary arithmetic operations, by further programming and an understanding of the processes of advanced mathematics, we can arrange for it to do much of our mathematical work. Just as addition is the tool needed for other operations, so these simple operations are the tools needed for more advanced calculations.

Pocket-size pound of pleasure!

New RCA Transistor Radio

Drop a gentle hint (like enclosing this ad in your next letter home), and come graduation time you could be getting this amazingly ingenious radio.

It's a new RCA Victor Transistor Six, and this one you can really take along anywhere. It's smaller and lighter than the average textbook—and lots more fun.

You can carry it easily in pocket or purse. It weighs a mere 16 ounces, yet delivers a roomful of sound anytime you wish.

The RCA Victor Transistor Six is battery-powered and uses six long-lasting transistors. The cabinet is long-lasting, too. It's the fabulous, *guaranteed non-breakable* "IMPAC" case. Cabinet colors include antique white, charcoal and spruce green.

And note the price—now just $49.95!

This beautiful little bargain is typical of the extra value engineered into every product of RCA. For, almost without exception, these achievements in electronics begin at the David Sarnoff Research Center in Princeton, New Jersey. Here the scientists and engineers of RCA continually seek—and very often find—practical and dramatic new ways to bring you ever-better "Electronics for Living."

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Faith an' Begorra!
Aren't these
a befittin' bunch
o' beauties now!

SANDRA HARMON

SOCIETY NEWS

(*Continued from page* 34)

Hamilton Standard division of United Aircraft Corporation provided the program for the February 25 meeting. They talked about jet aircraft fuel controls. Hamilton Standard gave some very nice tie clips to the ASME members who attended. You missed refreshments, too, if you didn't attend.

The program for the March meeting was presented by Dr. Thornton from Midwest Research Laboratories. Dr. Thornton's subject was, "How Industrial Research Has Changed".

The mechanical engineers' inspection trip will be on April 15, 16, and 17. The M.E.'s will visit six companies in St. Louis. The names of those companies will be announced at the next ASME meeting.

(reported by Tom Harper)

A I E E

It was decided to have a float in St. Pat's week parade. Messrs. Borr, Seigelhorst, Cravens, and Gatliff were selected to head the float activity.

The group voted to have a spring picnic the second week of May 1957. Mr. W. Roder is in charge of the refreshments and the location while Mr. El Haussman is to head the entertainment program.

Roger Pape introduced the guest speaker, Mr. Ferris Summers, Engineering Manager of Westinghouse, who spoke on "Your Future in Electrical Engineering". A question period followed, after which the meeting was adjourned and refreshments were served.

Mr. Greiwe of Allis-Chalmers will discuss present day motor applications at the March 12 meeting.

(reported by Charles Butler)

♣

And then there was the rather forlorn engineer who, on seeing a pigeon flying overhead exclaimed, "Go ahead, everyone else does."

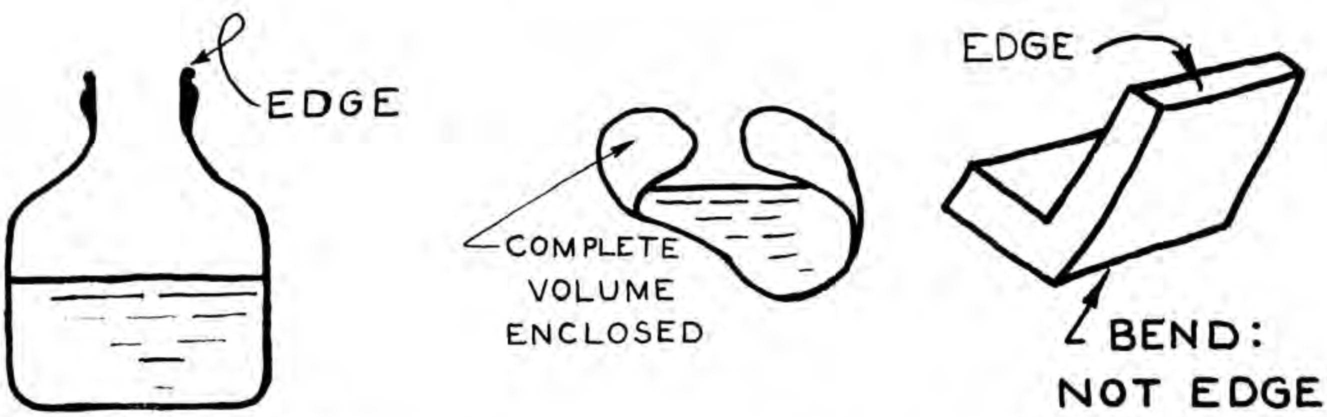
Ye Olde Jom-met-ree Shoppee

by

Randy Gardner, EE '58

Design me a pitcher to hold me my beer
Said a mathematician to one engineer:
No volume may be there completely enclosed.
An idiot's question this problem has posed,
But for the requirement—no edges appear
And constant wall thickness should be added here.
No volume enclosed and no edges appear,
Yet out of this pitcher a man may pour beer?

Incorrect solutions



The **ANSWER** has nothing to do with infinity or a Carrolian play on words. Solution next month.

Highlights of your future with Honeywell

Campus-like Honeywell Research Center in Hopkins, Minneapolis suburb

Preview your career with a summer internship

Dr. Finn Larsen, Director of Honeywell's Research Center, M.A., Physics, 1941, Drake; Ph.D., Iowa State, 1948.

"Honeywell is now interviewing students for its summer intern program."

"We believe a man makes a much better choice in his career if his decision is based on actual work experience. And, at Honeywell, the experience can be matched exactly to his individual needs and interests.

"This is made possible by Honeywell's wide diversification in the field of controls. Honeywell makes more than 12,000 different systems and controls. They are precision products whose development and manufacture require extensive use of all kinds of engineering skills. And they are used in virtually *every industry known today*. Thus, the man who enters Honeywell's summer program gets a real working knowledge, not only of controls, but of many related industries.

"Many of Honeywell's 14 separate divisions will offer assignments under the summer internship program. The location and name of each division and activity is listed at the bottom of this ad."

Terms of program

Honeywell's program is geared to students one year from graduation in any branch of engineering, chemistry, mathematics, physics, business administration or accounting.

Assignments will be made in Design and Development, Industrial Engineering, Quality Control, Quality Analysis, Production Coordination, Personnel Administration, Financial Control, Marketing and Market Analysis.

There are also special assignments in the Honeywell Research Center for graduate students in Physics, Chemistry or Engineering who are one year from completion of their work.

If you are enrolled in this program you will work at Honeywell from mid June to early September, approximately 12 weeks. Included in the weekly schedule will be discussions and meetings, as well as practical work assignments.

Applications being accepted now!

In order to give maximum benefit to the members of this program, Honeywell must limit the number enrolled. If you wish to apply for an assignment, send your name, address, school, the course in which you are enrolled, plus the number of years completed to:

Dr. A. Lachlan Reed
Director, Industry Education Relations
Minneapolis-Honeywell Regulator Company
Dept. TC29A
Minneapolis 8, Minnesota

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MEDICINE

(*Continued from page* 18)

Radiophosphorus is used at Bowman Gray School of Medicine to study the formation of certain liver fats which contain phosphorus. A number of powerful drugs failed to affect the process appreciably, though some reduction in the formation of the fats resulted from slowing thyroid activity. Apparently, the liver has the power to continue production of these fats under very adverse conditions. However, very marked decreases were observed after administration of compounds which presumably reduce the availability of the fat-building materials. The drugs also are being used to clarify the exact pathways through which the phosphorus fats are formed in the liver.

These processes may be important for understanding the causes of certain liver diseases, and the formation of the phosphorus fats in the blood is being studied in human patients.

In another study, the harmful effects of radioactive phosphorus are being investigated to find out whether changes in diet may increase the resistance of animals to the harmful effects of internally administered radioactive elements.

Using a long pipette and tongs, a hospital technician transfers radioactive phosphorus from a shipping container into a dosage bottle. This isotope is used in treating certain blood diseases, such as leukemia.

NUCLEIC ACID MOLECULES

Nucleic acids are composed of simple organic nitrogen ring compounds, sugar molecules and phosphorus groups, linked together into chains to form very complex supermolecules. These nucleic acid supermolecules in turn are linked to protein supermolecules to form nucleoprotein.

The nucleoprotein molecule is at the borderline between the truly living material and the nonliving. Certain of the plant and animal viruses are known to be pure nucleoproteins. The chromosomes which control the hereditary characteristics of the individual and the race are nucleoproteins. They are the keystone of life.

STUDIES IN METABOLISM

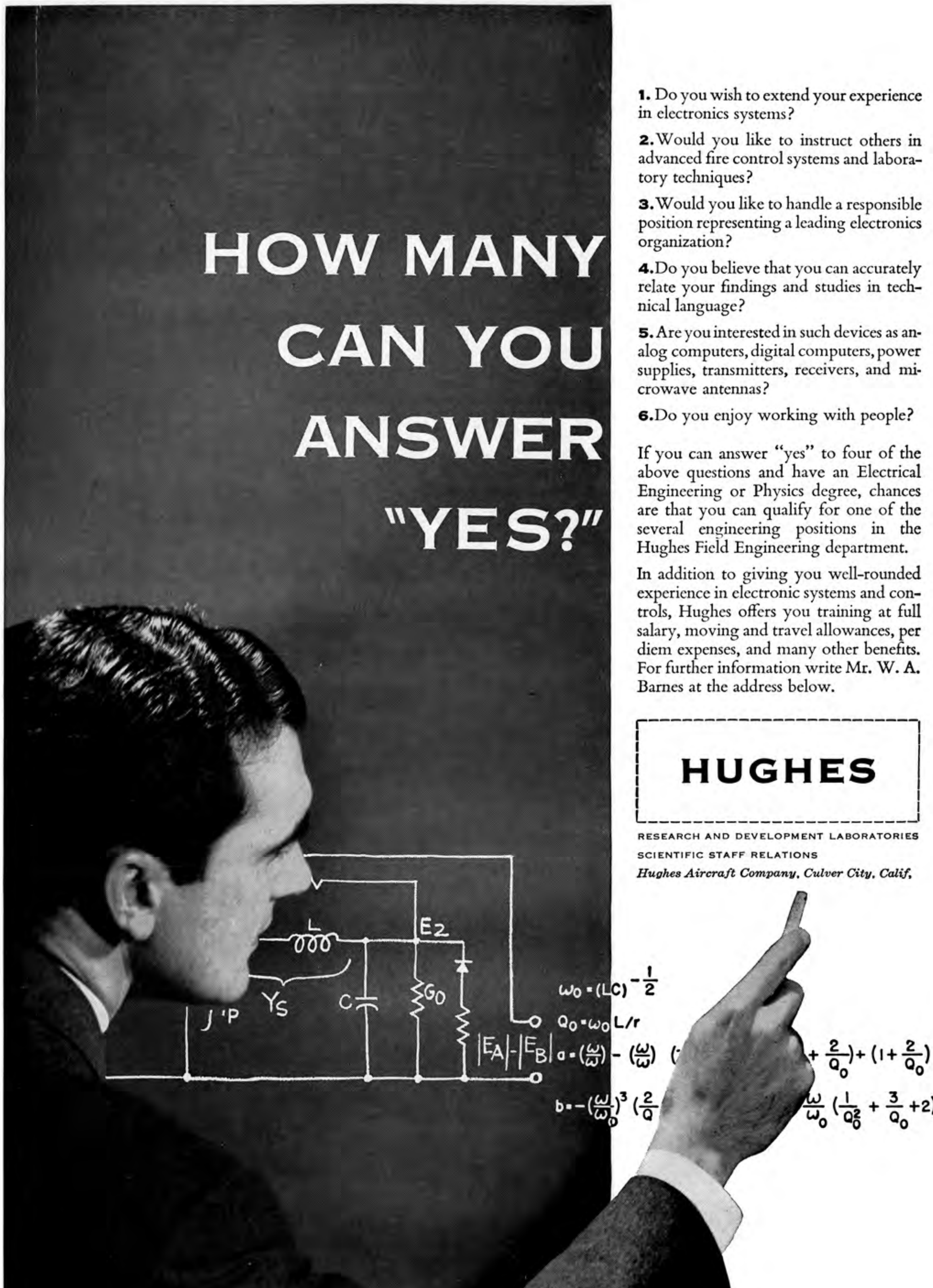
Research men at the University of Colorado are studying the activity of derivatives of nucleic acid in the system. They have been synthesized and techniques worked out for their use. Some are known to produce growth while others arrest growth when they are subjected to chemical changes. One phase of the research will investigate the results of such derivatives when applied to radiation-damaged cells.

Many of the research projects in other areas are related to the elements of the cell nucleus. At Harvard Medical School, for example, the effects of adrenal and pituitary hormones and of insulin in the formation of starch in muscle cells and its release through the action of acetic and pyruvic acid are being studied. Many other projects dealing with growth, proteins, genetics, and cancer also are related.

Ever since the discovery of insulin as a control for diabetes, attempts have been made to learn exactly which chemical reactions in the body are speeded up or slowed down by this substance. The primary chemical disturbance caused by undersecretion of insulin is, of course, a reduction in the body's ability to use sugar.

Radiosugar was made by growing bean plants in an atmosphere of radiocarbon dioxide or by using liver cells for a similar process of synthesis. This sugar, and the interaction of insulin, were then used in studying the chemistry of the muscle cells of rats which were diabetic, or which had hormone-secreting glands, the pituitary or the adrenals, removed.

(*Continued on page* 48)



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2. Would you like to instruct others in advanced fire control systems and laboratory techniques?

3. Would you like to handle a responsible position representing a leading electronics organization?

4. Do you believe that you can accurately relate your findings and studies in technical language?

5. Are you interested in such devices as analog computers, digital computers, power supplies, transmitters, receivers, and microwave antennas?

6. Do you enjoy working with people?

If you can answer "yes" to four of the above questions and have an Electrical Engineering or Physics degree, chances are that you can qualify for one of the several engineering positions in the Hughes Field Engineering department.

In addition to giving you well-rounded experience in electronic systems and controls, Hughes offers you training at full salary, moving and travel allowances, per diem expenses, and many other benefits. For further information write Mr. W. A. Barnes at the address below.

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES
SCIENTIFIC STAFF RELATIONS
Hughes Aircraft Company, Culver City, Calif.

MEDICINE

(*Continued from page* 46)

These experiments showed that insulin increases the ability of the muscle not only to manufacture glycogen—the form in which sugar is stored in the cells—but also to burn sugar for energy. The hormones of the pituitary and adrenal retard, and insulin accelerates, the first step in use of sugar by the body. In this step, sugar is combined with phosphoric acid. Normally, this balance of slowing down and speeding up keeps the amount of sugar in the blood within the necessary narrow limits. In the diabetic person, with less insulin, the retarding substances hold down the use of sugar so that the body must obtain a greater amount of energy from the burning of fats. This excessive fat-burning produces acids and results, in uncontrolled diabetes, in a fatal accumulation of acids in the blood and tissues.

Further experiments have probed into the acid processes of diabetes. Acetic and pyruvic acids are formed momentarily when fats and sugars are burned in the body. By tagging these acids with radioisotopes, it was found their use is decreased in the muscle cells of a diabetic. Insulin brought back to normal the use of pyruvic acid, but acetic acid remained unburned. If the factor responsible for burning acetic acid—the factor missing, or greatly reduced in the diabetic—can be found and made available, the treatment of diabetes will be further improved.

Radioactive phosphorus is used as a tracer to study its part in metabolism of sugars in the body. A great deal of work in this field has resulted in formulating what is known as the "phosphorylation cycle"—a description of the various intermediate steps in which phosphorus compounds are formed and used in the conversion of sugars into energy. Present experiments are concentrating on the liver's use of phosphorus in sugar metabolism. Normal conditions will be investigated first, afterwards those which exist in diabetic and cancer patients.

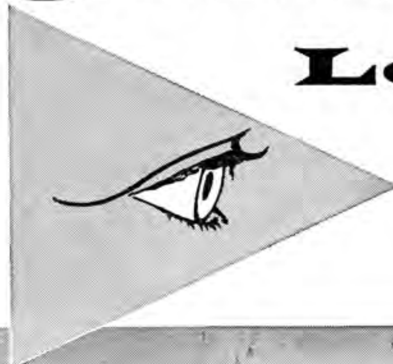
DIAGNOSIS AND TREATMENT

In diagnosing illnesses resulting from lack of hormones, extremely delicate techniques are necessary since these substances are effective in dilutions of one part in 10 million. Radio-tagged elements are used at Yale University School of Medicine, in connection with microscopic methods, to measure secretion of hormones; radioiodine in the case of the thyroid. In one case, a half teaspoonful of human serum was flown from California to Connecticut for a test and confirmed the diagnosis of overactive thyroid more quickly than routine methods on the scene, in San Francisco.

Radiophosphorus is being used at Harvard to locate brain tumors during sugery. Experiments showed that brain tumors, following intravenous injection, absorbed many times as much phosphorus as the normal brain tissue—in some cases over 100 times as much. The rays emitted by the radiophosphorus, however, penetrate only a little more than a quar-

(*Continued on page* 50)

Engineers... Look ten years ahead!



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MEDICINE

(*Continued from page* 48)

ter inch through brain tissue. Thus, in locating the tumor, it was necessary to have a counter small enough to be inserted into the brain during surgery. Such an instrument was devised in the Physics Department of the University of Wisconsin. The combination of radiophosphorus injection and this tiny counter, has been used successfully in 14 operations to remove brain tumors.

Radioiodine is effective in treating exophthalmic goiter in which the thyroid gland is overactive because the iodine has an affinity for thyroid tissue. The radioactive isotope deposited in the gland depresses its activity by the effect of the radiation. It is often useful where surgery has been unsuccessful and the gland has recurred after operation.

Radioactive iodine also is being used at Harvard to relieve pain and distress in two types of heart disease angina pectoris and congestive heart failure. Previous studies showed that lessening of thyroid activity would so diminish the body's demands upon the heart so as to reduce markedly the choking sensations and pain of angina pectoris and the shortness of breath and dropsy of congestive heart failure. Useful in a small percentage of cases that do not yield to other

One of the most promising uses for radioisotopes is in diagnosing disease. With radioactive iodine, for instance, thyroid disorders can be detected and treated.

therapy; treatment to reduce the activity of the thyroid by use of radioiodine has been tried on 19 patients. In five of nine suffering from angina pectoris, the pain was strikingly lessened or abolished and several are now gainfully employed. In four of seven patients with congestive heart failure, shortness of breath has been alleviated and ability to work increased.

CANCER RESEARCH

Cancer research, sponsored by the commission, has a dual purpose. It seeks to learn the basic structure and processes of cells—for cancer is pre-eminently a disease of the cell—and methods of using radioisotopes to diagnose and destroy cancer and tumors. It has the further purpose of studying radiation effects in man since in cancer patients heavy irradiation can be studied more intensively and with greater justification than under any other circumstances short of war and accidents.

A great deal of basic research is essential to a solution of the cancer problem. In trying to understand the subtleties of cancer cell behavior, we must have a firm understanding of the normal cells.

CAUSES OF CANCER

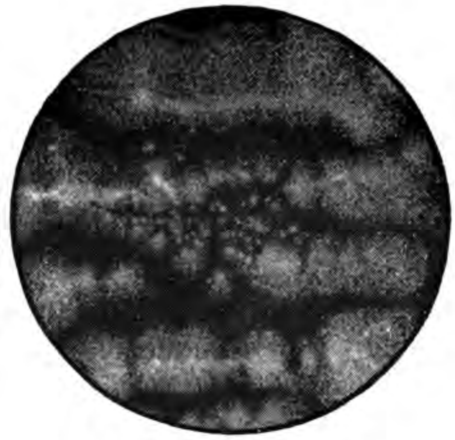
Knowledge of the details of nucleic acid metabolism should provide better means for combating, for measuring, and for enhancing the effects of radiation.

The simpler organic components that enter into the formation of nucleic acid have been prepared in the laboratory of the hospital at Sloan-Kettering Institute, and labeled with isotopes. Radiocarbon has been used, and the non-radioactive heavy isotopes of nitrogen and carbon. These components are fed to animals to ascertain which compounds in what amounts go to normal cells as well as to cancerous tissue. Tissue slices were incubated with radiocarbon — tagged amino acids—the basic stuff of which proteins are formed. The acids were taken up in the protein of the tissues, but it was found that two factors would stop the process: the absence of oxygen, or the addition of minute amounts of dinitrophenol—a drug known to prevent the formation of energy-rich phosphate bonds. Slices of tissue from the cancerous livers of rats take up one of the amino acids—alanine—six times as fast as normal liver.

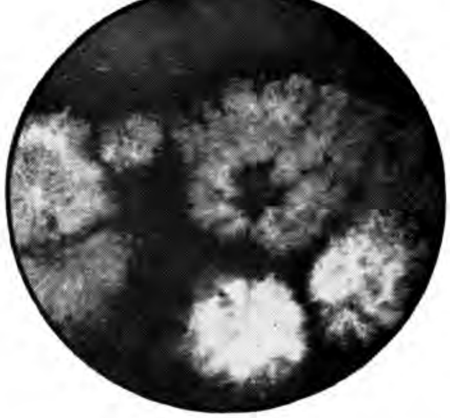
Radiation can cause cancer as well as control it. Experimenters are irradiating normal chemicals of the body to find whether they form cancer-producing chemicals. They are separating out microscopic parts of cells and using the electron microscope to look for changes caused

(*Continued on page* 52)

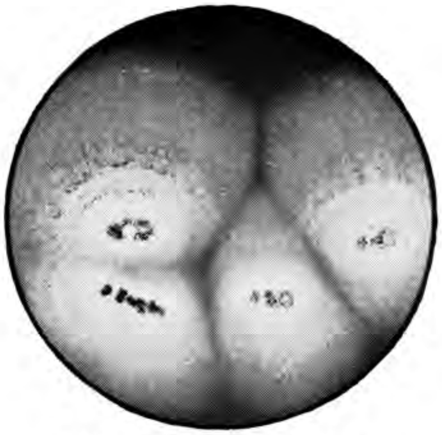
PENICILLIUM CITRINUM



ASPERGILLUS TERREUS

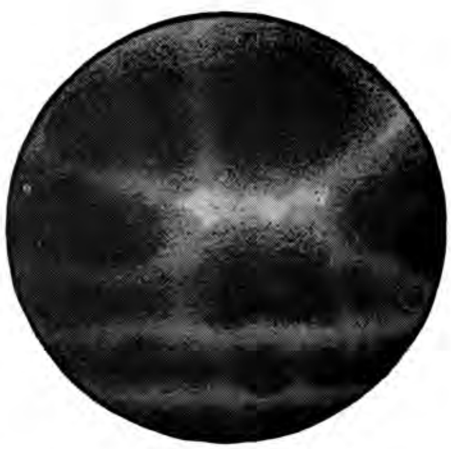


CHAETOMIUM GLOBOSUM



MYROTHECIUM VERRUCARIA

FUSARIUM MONILIFORME



ASPERGILLUS NIGER

And, What Do Fungus Tests Have To Do *with Turbine Aircraft Engines?*

● It's like this. Allison engines today are flying in all parts of the world . . . in sub-zero areas, as well as in tropical areas where the climate is hot and sticky . . . where growth of fungus on electronic parts, for instance, could cause malperformance.

So, the fungus test is one of seven environmental tests conducted on engine components at Allison. Purpose, of course, is to determine whether or not the constituents of the components—such as insulation, or possibly some lubricants—will support fungus. On one engine model, some 50 parts are subjected to the fungus test.

Six types, or clean strains of fungi (above)—representative of those encountered in tropical areas—are kept growing in one of the Allison test labs at all times. Engine components are inoculated with a mixture of fungi spores; then placed in an air tight chamber for 28 days. Specified humidity and temperature conditions are maintained during the required test period. Following the test, components are subjected to a functional test; then disassembled; inspected; decontaminated and returned to the Qualifications Parts Cabinet.

Not too glamorous, this test. But, it does point out the ramifications involved in the production of modern aircraft engines which must perform perfectly under widely varied conditions.

• • •

Allison—a leader in the design, development and production of aircraft engines—is looking for young graduate engineers and technically-trained personnel. Why not arrange for an interview with our representative when he visits your campus. Or, write for information now: Personnel Dept., College Relations, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

MEDICINE

(*Continued from page* 50)

in them by radiation. One puzzling question is the considerable time which elapses between radiation and the appearance of cancer. Tissues and cells are being examined carefully for chemical and structural changes which must occur during this period, but which are invisible by ordinary means of examination.

The way in which the metal beryllium, now coming into larger industrial uses, effects the bone was studied by injecting beryllium into rabbits. A group of enzymes, called phosphatases and extremely important to bone growth, are normally accelerated by magnesium—an element that closely resembles beryllium. Beryllium, on the other hand, inhibits the action of the enzymes. The experiments suggest that the enzyme is "fooled" into taking on beryllium instead of magnesium, and then is prevented from performing its normal function. Further studies will seek to clarify the relationship of these two elements and of calcium to other enzymes.

ISOTOPE TREATMENT OF CANCER

In using radioactive isotopes to treat cancer, physicians seek to destroy the growth by placing a source of radiation within the malignant cells themselves. If they can concentrate the radiation in this way with high efficiency, the patient will suffer less general radiation exposure than from typical treatment by X ray or radium. High efficiency is possible only if a tumor readily and rapidly absorbs the radioisotope, and if the rest of the patient's body takes up only harmless amounts.

Through the use of radioiodine to treat patients with thyroid cancer some interesting facts have been uncovered. Individual patients react in very different ways to the radiation of radioiodine when it is injected into the system. Each patient requires careful study since the nature of the tissues varies with each case. Irradiation damage from radioiodine deposited in or near specific cells differs from that caused by the same amount of radiation more generally distributed. Thyroid cancer that shows no affinity for radioiodine can be caused to take up large amounts of isotopes by procedures developed through research. This fact establishes that cancer is not a wholly separate growth, independent of all control but may respond to stimuli of the parent tissue from which it arose. Extensive destruction of certain thyroid cancers can be achieved by radioiodine therapy administered under certain circumstances. It is not clear that cancer can be entirely cured. More work is urgently needed.

While radioiodine has definite advantages in treating cancer, its use is sharply limited because normally it goes almost exclusively to the thyroid gland, or to cancers that have spread from this source. Scientists are attempting to direct radioiodine, and other isotopes such as radiosulfur, to other possible sites of cancer in the body. They do this by attaching the radioisotope to a "guide" that when injected into the system will go, for example, to the kidney. Research men prepared the "guide" by injecting mouse kidney tissue into a rat, then extracting from the rat the anti-body which it built up to resist this alien material. When this anti-body is placed in a solution of the radioisotope, it will absorb a quantity of the radioactive material. Injected then into a mouse, the anti-body "guided" large amounts of the isotope to the kidney with extraordinary speed. Guides have been similarly prepared which will carry radioiodine to the lung and this establishes that the principle of using a guide is not confined to a single tissue.

HEALTH PHYSICS PROGRAM

As more and more universities, hospitals and industries use radioisotopes it becomes increasingly important to protect the health of the

(*Continued on page* 54)


are your plans
as precise
as your planning?
The proof of the planning is in the finished plans. That's why you're smart to use Eagle TURQUOISE—the pencil the professionals prefer. Look what it gives you: Uniform grading (17 scientific formulas guarantee exactly the blackness you want—from every pencil, every time!). A strong non-crumbling needle point that stays sharp for line after long line of unchanging width. Inimitable smoothness—thanks to Eagle's exclusive "Electronic" graphite. TURQUOISE makes your plans look sharp—and you, too!
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MEDICINE

(*Continued from page* 52)

people working with these materials. A health physics group has been set up by the contractors who operate all atomic energy installations to protect the workers and the general public. It is the job of the health physicist to measure radiation, to estimate exposures and to recommend protective measures.

REMOTE CONTROL TECHNIQUES

Nuclear reactors and major chemical separation processes are remotely controlled from behind massive shields so that harmful radiation cannot reach the people who operate them. Most maintenance work on reactors and chemical separation equipment is similarly handled, although workers require elaborate protection during replacement of equipment.

Many extremely ingenious devices for remote control manipulation of "hot" materials have been developed both for the laboratory and the production plant. Argonne has put in operation a control device for laboratory use in which the operator, by manipulating his arms and fingers almost as in an ordinary laboratory, can handle radioactive materials and equipment on a bench behind a shield. This almost human device, using electro- mechanical linkage, is equivalent to lengthening the arms some 8 or 10 feet, and adding a couple of elbows to get around awkward corners in the shielding.

PERSONNEL MONITORING

The health physics group at each site measures the amount of radiation each worker receives when in an area of possible exposure. The worker carries a small pocket ionization chamber and a badge that contains unexposed photographic film. The ionization chambers are read and recorded daily, the film badges are developed once a week.

Results from reading these instruments not only provide daily records of exposure to radiation of each individual worker but also cumulatively provide extremely valuable long-range data that will help in establishing the permissible dose of radiation more exactly.

The health physicist also examines the workers frequently to determine how much radioactive material they have taken into their bodies. These laboratories have worked out an extremely sensitive urinalysis by which one billionth part per gram or radioactive metal can be detected.

AREA MONITORING

Health physicists make frequent surveys of intensity and contamination by alpha, beta, gamma, and neutron radiation at the production centers and laboratories. At convenient spots, they also install beta-gamma-sensitive and alpha-sensitive instruments for measuring contamination of worker's hands, feet, nostrils, clothing and equipment.

Monitors can check a reactor used for producing plutonium more easily than a reactor used in research. In production reactors, operating con-

Laboratory workers handling "hot" atoms work behind barricades. Here an operator, using a remote-control instrument, watches in a mirror as he siphons a radioisotope solution into a bottle.

ditions do not change, hence radiation will be reduced to negligible intensities. In a research unit, there are several open or partially open ports through which materials are put in or taken out. These may allow radiation to escape and make necessary special attention to protect personnel.

"If scientific research offers unimaginable opportunities for good, it imposes unexampled obligations to protect ourselves against equally unforeseeable dangers. The atomic Energy Commission is devoting extensive and unflagging attention to the biological and medical effects of radiant energy—both those that may prove to be beneficent and those that may maim or kill. When man first discovered fire he began a long apprenticeship to caution in dealing with what is both useful and dangerous—and the end is not yet."

Dr. Alan Gregg, Chairman,
AEC Advisory Committee on
Biology and Medicine.

—Acknowledgments—

Information for this article was obtained from the booklet entitled Atomic Energy and the Life Sciences, a report of the work of Dr. Gregg's committee. Pictures used for illustration were furnished through the courtesy of the Union Carbon and Carbide Company.

More graduate engineers moving up in the GAS industry ...the nation's sixth largest

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JOSEPH J. DRECHSLER
B.S. in Mechanical Engineering, 1948, Johns Hopkins University

Joe Drechsler, after 8 years with Baltimore Gas and Electric Company, is now Assistant Superintendent in a department with over 450 employees

After completing the company's Student Engineering Training Program, Joe spent one year in the Gas and Steam Testing Laboratory. He was then promoted through various levels of engineering and supervisory assignments, to his present job of Assistant Superintendent on April 1, 1956. This department has over 450 employees and is responsible for the installation and servicing of industrial, commercial and domestic gas appliances on customers' property, and the installation and servicing of gas and steam metering and pressure recording equipment.

ROBERT K. VON DER LOHE
B.E. in Industrial Engineering, 1948, University of Southern California

In just 6½ years with Southern Counties Gas Company of California, Robert K. Von Der Lohe has become Manager of Commercial and Industrial Sales

After two years with a construction engineering firm, Bob Von Der Lohe joined the gas company and began his steady climb to his current position. Starting as an assistant technician in 1950, Bob has moved up through the jobs of industrial sales engineer and staff representative-industrial sales, to his present post as Manager, Commercial and Industrial Sales. Bob does more than "sell" industries and commercial operations on the use of gas. He also supervises a staff which advises restaurant and hotel owners on ways to improve their gas operations and over-all productive efficiency.

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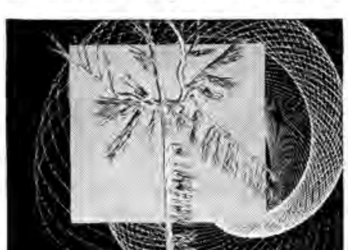

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BULLARNEY

By WHIT

A customer waiting for a small job to be done on his car watched a mechanic change the oil in another car without spilling a drop, check the radiator carefully, clean the windshield, wipe away the greasy finger marks, place a clean cloth over the upholstery, wash his hands thoroughly and drive the car slowly out to the street curb.

"Now there's a real mechanic," the customer observed to the foreman.

"Oh," explained the foreman, "that's his own car."

♣

In one of the Russian satellite countries a few years back, a very humorous incident took place. There was a peasant who walked past the guard and into a very large factory every day to work. At the end of the day he always left with a wheelbarrow full of straw. The guard suspected that the worker was smuggling something out, but every time he checked there was nothing but straw in the wheelbarrow. After about two months he gave up and said:

"Just tell me what it is you are stealing and I won't report you."

"Very well," replied the worker. "If you promise not to reveal my secret, I will tell you. I'm stealing wheelbarrows."

♣

A Metallurgical Engineer is a man who can go out with a platinum blonde and tell whether she's precious metal or just a common ore.

"Was your friend shocked over the death of his mother-in-law?"

"Shocked? He was electrocuted."

♣

First Little Boy: "I don't like the new little girl in our block. Her's neck's dirty."

Second Little Boy: "Her does?"

♣

POEM:

Thirty days has September,
April, June, and October.
All the rest eat peanut butter.
Except Grandmother,
She rides a Unicycle.

♣

There were mice in the basement, so the young married couple decided to set traps for the pests. One trap was placed by a box of apples and the other was placed by a box of nuts.

Once the traps had been set, the man and his wife went up to bed. They had just put out the lights when a loud 'Snap' sounded from the region of the basement. The man leaped out of bed and ran downstairs to inspect the catch. His wife followed as far as the top of the basement stairs, where she stopped and called down:

"Did you catch him by the apples, Darling?"

Came the answer from the depths of the basement; "No, dear."

♣

The man didn't say a word when he ran over his cat with a steam roller. Just stood there with a long puss.

Two small boys in the Salvation Army dinner put their grimy little hands side by side on the white tablecloth.

"Mine's dirtier than you'rn," exclaimed one triumphantly.

"Huh," snorted the other disdainfully, "you're two years older'n me."

♣

A little colored boy was sitting slumped down in his chair with his feet on the table when his mommy came in and said: "Lawd, you is a lazy boy; you is zackly like yo' pappy. Thank the lawd I didn't marry that man."

♣

People who live in glass houses might as well; everybody knows they do.

♣

Police Sergeant: "What, you back again?"

Drunk: "Uh, huh, any mail?"

♣

A man was getting a shave from a barber who flourished considerably. Suddenly he said, "Barber, would you mind getting me a glass of water?"

The barber stopped and asked sympathetically, "What's the matter, something in your throat?"

"No, I just want to see if my neck leaks."

♣

"Why is your friend so silent?"

"He can't seem to find a spittoon."

♣

Then there is the sad story of the EE who went nuts trying to hook up a Laplace transformer.

How General Electric stacks up on your job check list

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

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MISSOURI

SHAMROCK

APRIL, 1957

FEATURES

The Truth About Jobs For Engineers
Automotive Gas Turbines
Paucartambo—Power for Peru

25c

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

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ON THE COVER

William ("Buddy or Vic") Meinert of Brookfield, Missouri produced an interesting cover for this month's Shamrock. His work was selected because of timeliness of subject and his simple, but unique pen and ink presentation. Simplicity, provocation, directness, and mood are the basis of his work.

"Sketching is a hobby," says Buddy, "I hope to get more versatile as time goes on. I hope to tie art in with my major field of Journalism. Perhaps advertising layout or design." Meinert claims, with sincere conviction, the most discouraging part of a drawing is when, "someone comes up and asks—what is it?"

The season of "the great outdoors" is here. Crystal creeks, blue skies, brown and green, are for relaxing. We'll see you out there—inhabitants of the asphalt-concrete-steel jungle.

←

MISSOURI SHAMROCK

VOL. XXIII APRIL, 1957 No. 7

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DEPARTMENTS:

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

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1605 Ambassador Building
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Editorial

ARE WE STILL *ALIVE?*

With clouded wits the engineer sits and
pushes pens and pencils
While day by day, years slide away among
his inks and stencils.
He works and works and never shirks (he
couldn't do without it)
And if he stops . . . asleep he drops and
then he dreams about it.
With head that sinks and frame that shrinks
he does his toilsome duties
Without a glance to Gay Romance and blind
to all her beauties.
And when at last his life is past, there
comes no chance to show it.
For engineers are dead for years before
they ever know it.

The Iowa State Daily

Jokingly or not, sentiments of this sort are quite often applied to engineers in general. Indeed, **do** engineers become so buried beneath handbooks, formuli, and blueprints that they lose perspective of life itself? Do they lose sight of the fact that engineering exists not for engineering's sake but rather that man's "plane" of existence may be elevated—that man be freed from menial tasks and given a little leisure "time of his own".

As engineering students we might well stop and take stock of ourselves. To be certain we are here in college to get an education, but what sort of an education? One so narrow that it puts "blinders" upon us as one would a horse—so that we cannot lead but must be guided? One so broad and loose that we wander aimlessly, accomplishing little? Or one which cultivates our ability to get along with people and prepares us to assume our responsibilities in society, at the same time supplying the academic background and mental stimulus necessary for a successful career?

How to keep out of the "rut" and to develop your personality? Join a few organizations and more important become active in them. Tackle duties with a fervor! Be prepared to meet challenges with zeal!

LIVE A LITTLE, as the cliche goes. You'll be a better citizen and a better engineer.

MLC

FRONTISPIECE—

Welded steel sheet, plate, structurals and forgings comprise over half the weight of this 2,300 ton, 60 cubic yard, electric power shovel, reputed to be the world's largest. It was built by the Marion Power Shovel Company, Marion, Ohio, for operation at a Hanna Coal Company strip mine near Cadiz, Ohio. The boom is 150 feet long, extending nearly as high as a 16-story building. The dipper handle is 92 feet long and the dipper will rip out 90 tons of overburden in a single bite. Power is supplied through 16 electric motors totaling 9,000 hp. The relative size of the mammoth machine is indicated by the two men indicated by the arrow.

—Photo Courtesy LINCOLN ELECTRIC CO.

THE AUTOMOTIVE GAS TURBINE

M. L. CRENSHAW

Your car of the future may be powered by a small gas turbine. The purpose of this article is to summarize the principles of operation of the gas turbine and analyze some of the experimental vehicles built by the General Motors Corporation.

At the present time, one production line turbine power unit for motor vehicles is on the market. It represents some 13 years of development by the Boeing Aircraft Corporation. It is a 270 hp engine designed for truck use and has proven a good competitor for the well established supercharged diesel piston engine found in most trucks, particularly for use in the mountains.

THE NON-GENERATIVE INTERNAL COMBUSTION CYCLE GAS TURBINE ENGINE

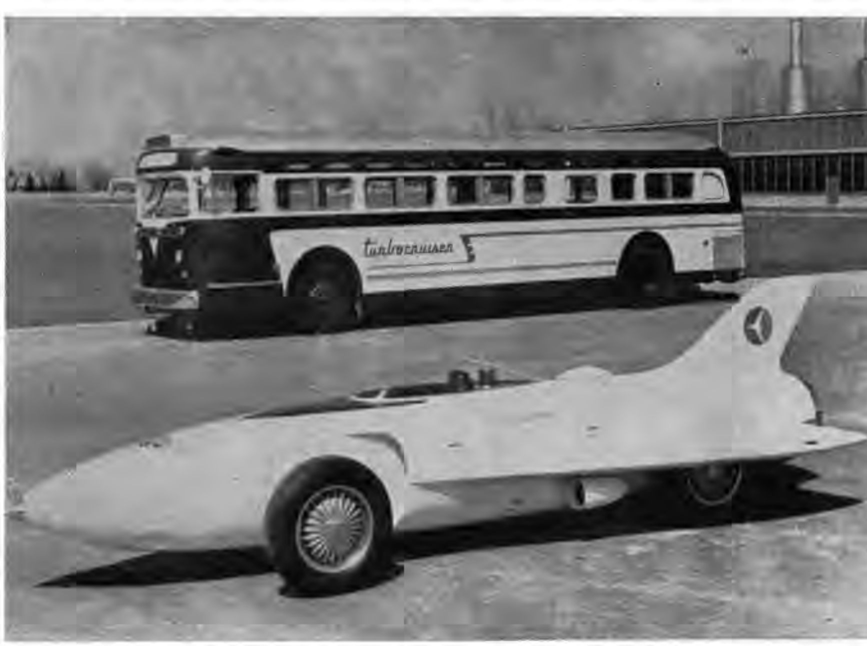
A non-regenerative gas turbine engine is shown in Figure 2. It is known as the GT-302 Whirlfire and was installed in Fire Bird I. It should be noted that this vehicle is neither passenger car, nor sports car, nor race car, but simply a test vehicle built to meet certain specifications. The Firebird I was designed with a thought toward avoiding any implication that this power plant was ready for passenger vehicle production.

The GT-302 was a refined version of the GT-300 which was for installation in the Turbocruiser, a GMC transit bus coach. The GT-300 utilized a large single combustor and was far too bulky for other than commercial uses. It was redesigned with the objective of keeping the over-all size to a minimum.

The Gasifier Section

The engine may be conveniently considered as two mechanically independent components. The first of these is the gas generator or as it is known, gasifier. Its function, as the name implies, is to produce hot compressed gases. It functions in exactly the manner as the familiar turbo-jet engine used in aircraft.

The air enters a relatively large duct in the front, the engine requiring some four to ten times the amount of air necessary for a reciprocating engine. A radial flow



Firebird I and Turbocruiser

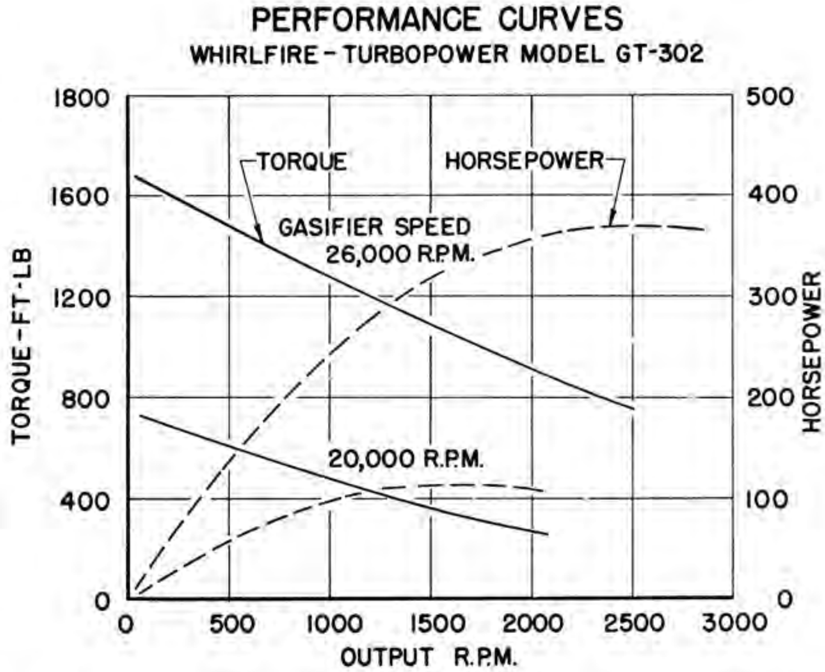
(centrifugal) compressor provides a compression ratio of something like 3.5 to 1.

It is discharged into two side entrance combustion chambers. The burner liners are of the conventional domed can type. Fuel enters through duplex-type nozzles located in the center of the burner domes. The ignition plugs, energized only during starting, are mounted on the side of the domes.

A double-walled duct carries the hot gases to the gasifier turbine, which is a single wheel unit of the conventional bucket-type design. Here enough energy is extracted from the hot gases to operate the compressor and all engine driven accessories, ie. fuel pump, lubrication pump, hydraulic pump and electric generator. A combination starter-generator is employed, producing the required power to start the engine and thereafter functioning to recharge the storage batteries.

The Power Section

The hot, high pressure gases from the gasifier unit are then channeled through the power turbine wheel. It is a somewhat larger unit though of the same general design as the gasifier turbine. From this turbine

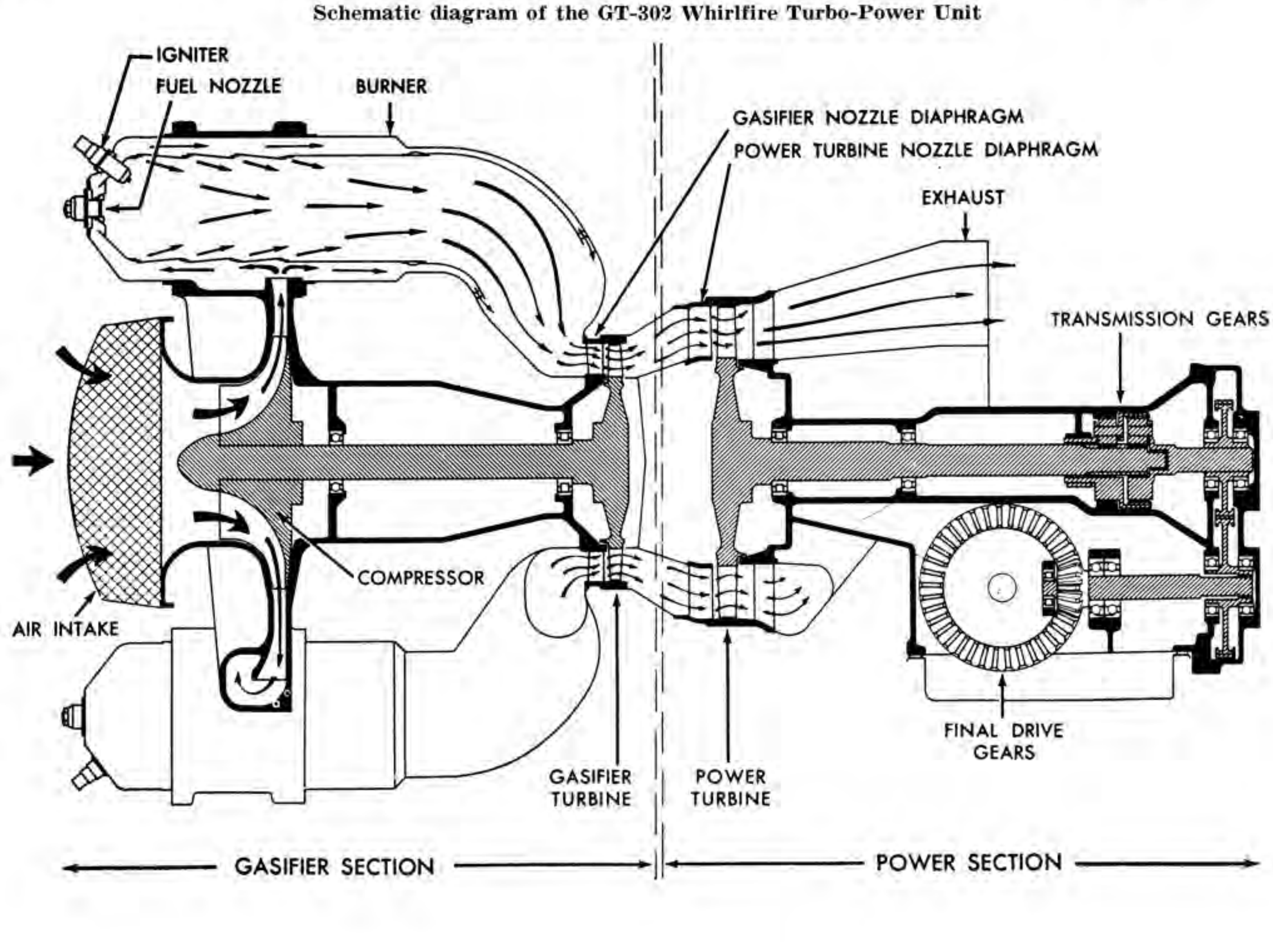


comes the motive power to propel the vehicle. The relatively cooler and lower pressure exhaust gases are then exhausted into the atmosphere.

The turbine transmit power to the rear wheels through a transmission assembly. The driver may select the "part" position or three gear ranges, "High", "Performance", and "Reverse" of the hydraulically operated transmission. No neutral is provided, the transmission remaining in "high" gear when the "park" pawl is engaged. Thus, the power turbine wheel is always connected to the rear wheels to prevent the possibility of a runaway. The "performance" setting provides acceleration in a lower gear range. Shift to "high" occurs auto-

(*Continued on page* 14)

Schematic diagram of the GT-302 Whirlfire Turbo-Power Unit



AUTOMOTIVE GAS TURBINE

(*Continued from page* 13)

matically at a predetermined speed. Planetary gearing is used because of its rather obvious space-saving and ease of manipulation features.

Operating Experience

Since it was felt that many problems would arise in the development of this power plant, it was decided that mechanical simplicity would be the prime objective. Consequently, an open cycle unit without regeneration was built, with high fuel consumption being an anticipated disadvantage. The engine will operate on quite varied fuels, from Diesel oil to gasoline. Octane and cetane numbers have little meaning though the fuel must be about the same degree of cleanliness as required for piston engines.

One of its most desirable characteristics is the torque curve as shown by the performance curves. The dual or free turbine arrangement makes the unit a "torque-converter" in itself. Stall torque is quite large, over twice the design point figure.

This maximum torque, however, is available only if the gasifier is at the maximum speed. From a standing start in direct drive with the gasifier initially idiling, quite a delay in acceleration is noticed. This is due largely to the inertia effects in the gasifier and the limiting thermal shock which the turbine can withstand. The acceleration is extremely smooth, however.

Despite a design operating temperature of some 1500° F, no problems have been encountered in either installation from heat. The aluminum radiation shield which surrounds the hot zone of the engine is probably largely the cause of this. Adequate protection is afforded the plastic body, which in many places is less than one inch away.

Noise is a surprisingly insignificant factor. The primary objectionable noise occurs at the air inlet. The exhaust, while quite voluminous is not overly hot, and is clear of discoloration and free of carbon monoxide.

Quite unlike those of the piston engine are the high speeds encountered in turbine work. Here one uses 1000 rpm rather 100 rpm increments. The ratio between idle and maximum are about the same as Diesel practice, however. The gasifier idles at 8,000 rpm with a maximum of 26,000 rpm. Gyroscopic effects, actually quite small, are further reduced by designing the two turbines to rotate in opposite directions.

Safety? The shrouds surrounding the turbines are made of steel forgings heavy enough to contain any bucket fragments. The discs are designed with a large safety margin. On several occasions pieces of special instrumentation have passed through the engine. While the buckets were bent, no failure was observed even after subsequent running of the damaged parts.

The complete GT-302 Whirlfire Engine

Much speculation has arisen concerning the lack of engine braking and most of it is quite correct. Since this imposes rather severe requirements on the vehicle brakes some sort of dynamic braking device may be required. It is possible that the transmission could be shifted into deverse and sufficient retarding torque developed in this manner.

Lubrication problems are not very severe in the gas turbine, since the oil is not exposed to the combustion area. High speed bearings and gears are jet lubricated, the oil also serving as a coolant. Oil consumption is so low that it has not been measured.

It may be summarized that, despite its tremendously favorable weight to power ratio and other many advantages, the gas turbine is still far from perfection. Future developments must be directed toward improved fuel economy, lessening of acceleration delay time, and a suitable dynamic braking system.

THE REGENERATIVE INTERNAL COMBUSTION CYCLE GAS TURBINE ENGINE

The earlier experience with the turbine units installed in the Firebird I and Turbocruiser demonstrated the feasibility of gas turbines as power plants for automotive use. Several shortcomings, however, had to be overcome. Chief among these were the high fuel consumption, and rather sluggish acceleration characteristic of the engine between idle and 70 per cent gasifier speed. After many miles of test driving, only these two disadvantages prevented a favorable performance comparison of the turbine power with conventional contemporary motor vehicle engines.

Regeneration

Regeneration appears to be the

(*Continued on page* 16)

AUTOMOTIVE GAS TURBINE

(*Continued from page* 14)

only satisfactory way of achieving fuel economy. The regenerator is a form of heat exchanger. It recovers heat from the hot exhaust gases and transfers this energy to the high pressure air coming from the compressor. There are two basic types of heat exchanges. The familiar "stationary" unit is quite simple in construction and generation. Heat merely passes directly through the flow passage walls. While leakage is no problem, reasonable effectiveness and acceptable pressure drop usually dictates a bulky unit quite unsuitable for the limited space available.

The rotating heat exchanger is more complex. Heat is carried by a rotating matrix from the exhaust gases to the intake gases. It presents high effectiveness and small size. Leakage of high pressure air past the regenerator seals is a difficult problem, though. If this leakage, which by-passes the turbines, exceeds practical limits, it can more than offset this gain of higher effectiveness. The rotating regenerator is about 85 per cent effective and has about 5 per cent leakage at design point compared to about 60 per cent effectiveness with no leakage for the stationary unit.

The rotating type regenerator was chosen for use in the GT-304 because of its size and weight advantages. A schematic drawing of this engine is shown below:

Acceleration Delay

The problem of acceleration delay encountered in the two previous installations has been tackled from two different angles. While this delay factor is acceptable in many applications, it would be completely unsuitable with the get-away performance demanded of today's passenger cars.

Acceleration delay is a direct function of the moment of inertia of the rotating parts of the gasifier and an inverse function of the amount of energy in the gas stream available. Reducing the weight and diameter of the rotors will lower the moments of inertia, however, rotational speeds must be increased, stresses rising accordingly. Increasing the turbine inlet temperatures will increase the available energy. This, however, creates problems in obtaining satisfactory alloys for use in the turbine buckets. Thus, these parts must be designed for the highest speed and temperature that stress limits will allow. By careful design it was possible to reduce the moment of inertia of the power section of the GT-304 to the equivalent of a modern V-8 engine.

Coupling the power turbine to a multiple ratio transmission also improves acceleration performance. The transmission for Firebird II was chosen with four ratios. The torque characteristics of the turbine will allow fewer ratios for acceptable power delivery, but this requires large changes in power turbine speed during shifts, which are most undesirable.

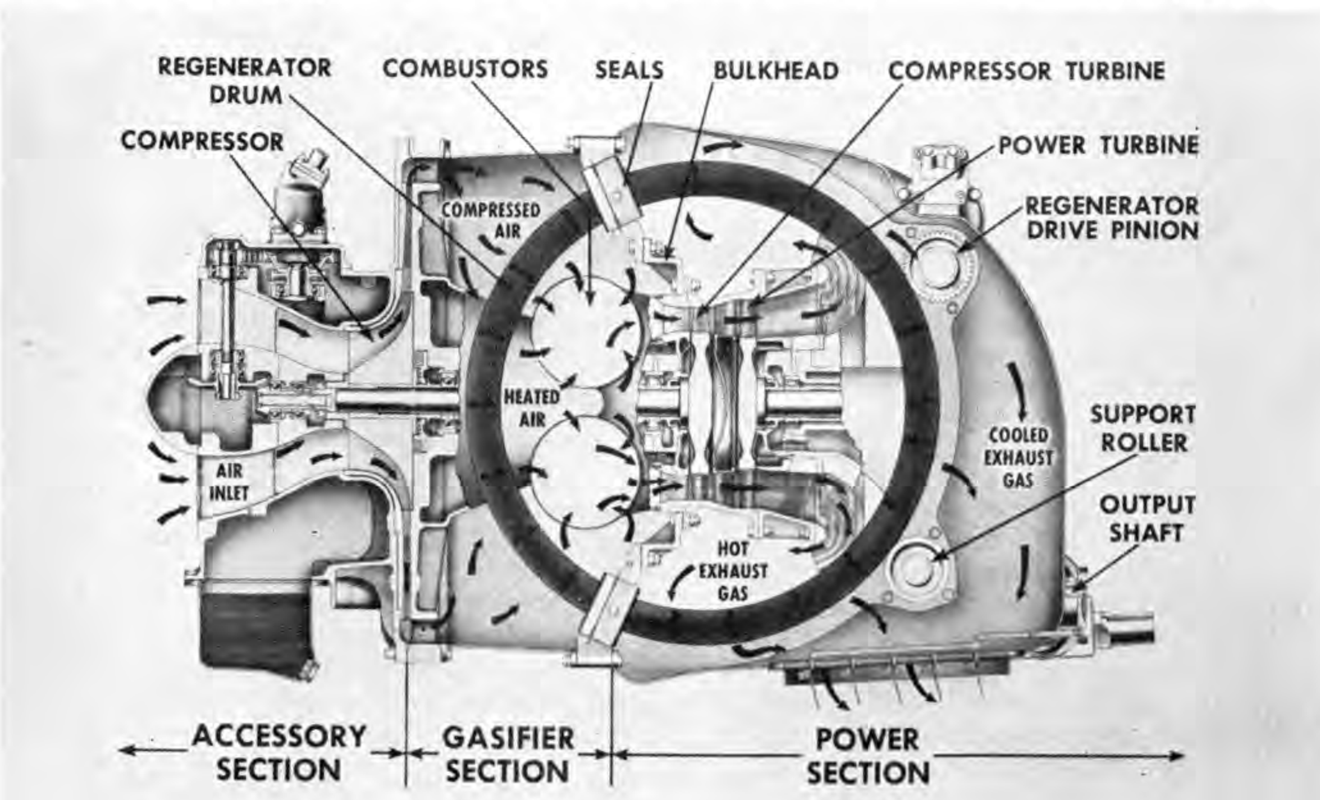
These efforts have resulted in minimum initial acceleration delay and superior performance at moderate road-speeds.

Operation

The operation of the GT-304 is quite similar to its predecessors the GT-300 and GT-302. It is briefly as follows:

Air enters the centrifugal com-

(*Continued on page* 18)



Schematic diagram of the GT-304 Whirlfire Turbo-Power Unit

GMR-235

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

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

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

★ ★ ★

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

AUTOMOTIVE GAS TURBINE

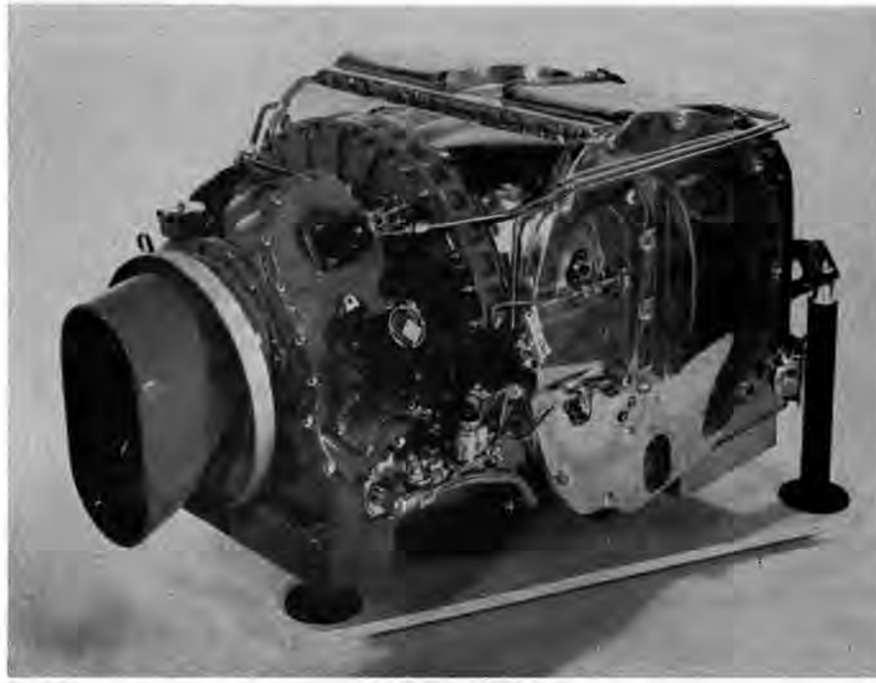
(*Continued from page* 16)

pressor. After compression it leaves the diffuser and is diverted 90°, discharging axially into a plenum chamber which houses the regenerator, combustors, and turbines. The plenum is divided into a high pressure (inlet) section and a low pressure (exhaust) section by the floating seals and center bulkhead assembly. The two drum shaped regenerators rotate in the vertical plane, passing from the exhaust side to the high pressure side through the seals. Air discharged from the compressor passes radially through the wire mesh of the regenerator drums absorbing the heat stored in them, then passing into the combustion chamber. Fuel is sprayed into four can-type combustors. Combustion occurs, generating hot gases which expand through two mechanically independent turbine stages. The first stage turbine drives the compressor and accessories. The second stage develops the power for propelling the vehicle. Hot gases from the power turbine are diverted to the center of the exhaust plenum. They pass through the cooled regenerators, transferring much of their remaining heat to the mesh of the regenerator. The exhaust gases, now cooler than those of a conventional piston engine, are dumped into the atmosphere.

Differences

The Firebird II installation is different in several respects from the previous Firebird I. The accessories were all driven from the gasifier turbine in earlier Whirlfire Motors. The loads demand of the Firebird II, however, could not be handled by the gasifier turbine at idle. It was decided then to drive the larger ones from the power turbine. Because of space limitations these units were mounted on the transmission. These are the air conditioning pumps, the hydraulic pump, and electrical generator. The transmission has a fluid input unit so that the power turbine is allowed to turn at all times to drive the associated accessories. The "softness" of this coupling is also an important assistance during shifting, when energy of the rotating mass must be absorbed to prevent jolts and unnecessary roughness.

One of the important features of this integrated engine arrangement is the direct air flow path and complete absence of interconnecting ducts. The minimum number of bends in the air flow path and large plenum type air passages contribute to very low pressure losses.



The complete GT-304 Whirlfire Engine

Another very important advantage of the engine arrangement arises from the fact that those parts of the engine which are exposed to, or contain, the hot gases are confined within the inner diameter of the regenerator drums. The top, bottom, front and rear surfaces of the engine are exposed to empressor discharge air or exhaust gas cooled by passage through the regenerators. As a result, no thermal shielding or insulation is required for the engine except on the circular regenerator and covers. This reduction of heat loss from the engine minimizes engine compartment ventilation requirements and is reflected in at least a slightly higher thermal efficiency.

One of the most surprising features of the GT-304 engine is the very low noise level. The regenerators are responsible for much of this improvement. The plenum type design with low air velocities combined with the attenuating effect of the regenerator matrices, act as sound barriers to muffle the turbine exhaust noise. A very effective inlet silencer further contributes to quiet operation of the Firebird II.

A very distressing condition was discovered when the engine was

(*Continued on page* 20)

Firebird II

AUTOMOTIVE GAS TURBINE

(*Continued from page* 18)

first operated with an open exhaust system. The combustion system, which had been developed for low carbon formation, produced "aldehydes" that were more acrid than any Diesel engine exhaust. Spray pattern and liner design proved to be the means of attacking this problem. The odor is barely noticeable now, and with further development can be completely eliminated.

Engine Specifications

The design rating of the GT-304 engine is 200 horsepower at a gasifier speed of 35,000 rpm and turbine inlet temperature of 1650°F. Allowance is made for all engine accessories, inlet and exhaust losses and reduction gear losses. Rated power turbine speed is 28,000 rpm with an overspeed allowance to 35,000 rpm. A 7.27:1 three step helical reduction gear reduces output shaft speed to a normal engine range. The weight of the original engine build-up is 850 pounds.

Future Program

Development of the GT-304 engine will proceed along three general lines, thermodynamic improvements, increased durability of components, and a reduction in the amount of critical material required for fabrication. It should be possible to improve both effectiveness and pressure loss of the regenerators from the first design incorporated in the engine. Many parts of the engine are fabricated from better materials than are actually required. This is partly due to lack of information and partly due to the fact that material cost is soon obscured in hand-made prototypes. Test engines can now be instrumented, and operating conditions determined to help in more logical materials selection. The goal of the General Motors Gas Turbine Program is an engine weighing less than three pounds per horsepower, having thermal efficiency approaching that of the reciprocating engine, and containing less than ten pounds of nickel or other critical material.

ACKNOWLEDGMENT

The information contained in this article and the illustrations appearing herein were adapted from the following papers presented before the Society of Automotive Engineers:

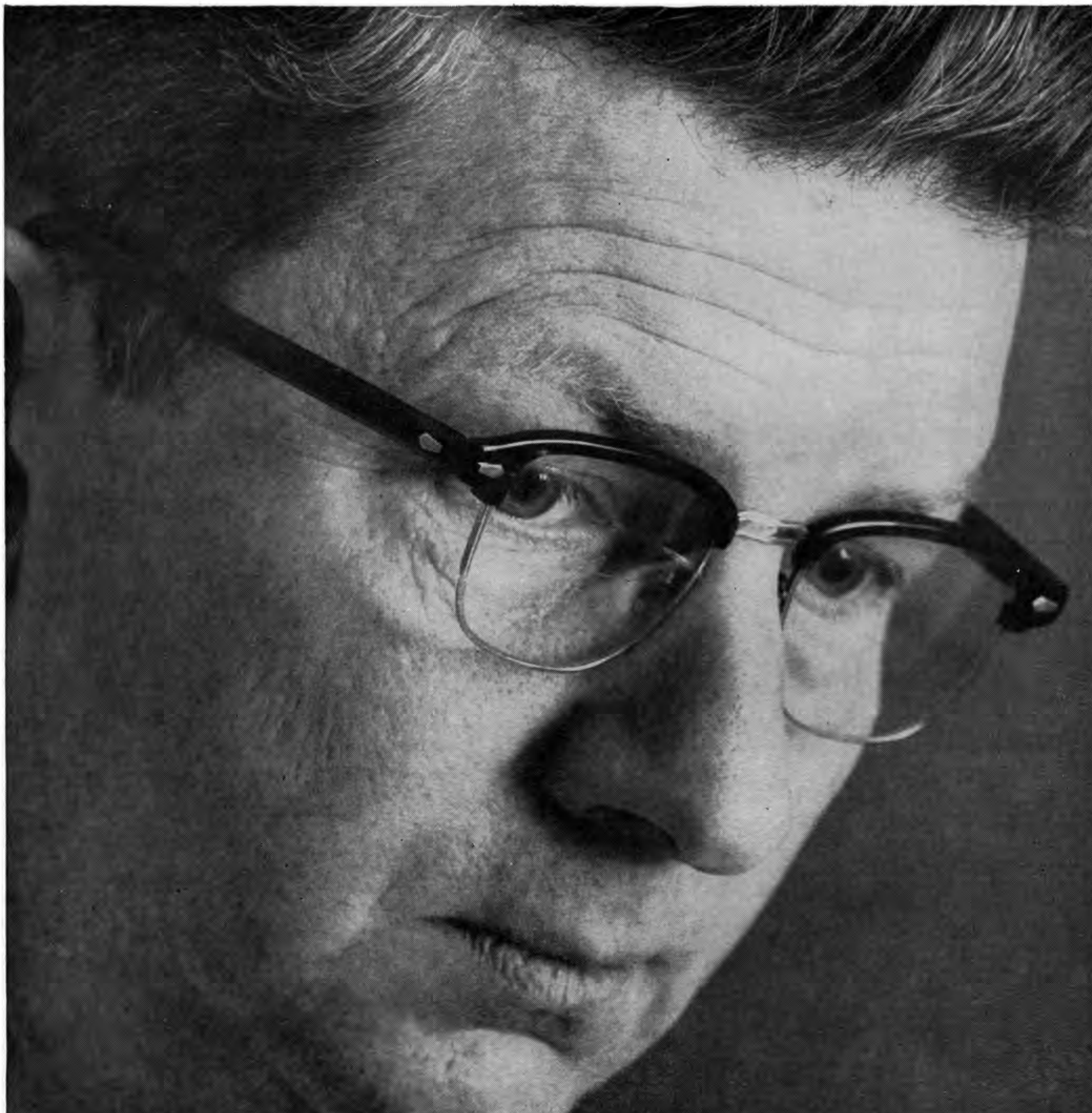
Introduction to Gas Turbine Automotive Vehicles
by R. F. McLean

An Aerodynamic Design in Plastics
by R. F. McLean

A Cradle for New Power
by R. Schilling

Pinwheels or Pistons?
by W. A. Turumen

The Regenerative Whirlfire Engine for Firebird II
by W. A. Turumen and J. S. Collman


YAVNO

...on economy in national defense

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

—*Charles Hitch, Head of the Economics Division*

THE RAND CORPORATION *SANTA MONICA, CALIFORNIA*
A nonprofit organization engaged in research on problems related to national security and the public interest

The Turbo-Encabulator

by STANISLAUS J. HAMMERSCHLUNG

In view of recent developments, the Missouri Shamrock reprints this significant paper which originally appeared in Centrifugal American, Vol. 13, pp. 77-78 (1950)

For a number of years now, work has been proceeding in order to bring perfection to the crudely conceived idea of a machine that would not only supply inverse reactive current for use in unilateral phase detractors, but would also be capable of automatically synchronizing cardinal grammeters. Such a machine is the "Turbo-Encabulator." Basically the only new principle involved is that instead of power being generated by the relative motion of conductors and fluxes, it is produced by the medical interaction of magneto-reluctance and capacitive directance.

The original machine had a baseplate of prefabulated amulite, surmounted by a malleable logarithmic casing in such a way that the two spurving bearings were in a direct line with the pentametric fan. The latter consisted simply of six hydrocoptic marselvanes, so fitted to the ambifacient lunar waneshaft that side fumbling was effectively prevented. The main winding was of the normal lotus-O-delta type, placed in semiboloid slots in the stator, every seventh conductor being connected by a nonreversible tremie pipe to the differential girdle spring on the "up" end of the grammeters.

Forty-one manestically spaced grouting brushes were arranged to feed into the rotor slip-stream a mixture of High-S-Valve phenylhydrobenzamine and 5% reminative tetryl-iodohexamine. Both of these liquids have specific pericosities given by the formula P=2.5Cnx6.7, where *n* is the diathetical evolute of retrograde temperature phase disposition and *C* is Cholmondeley's annular grillage coefficient. Initially, *n* was measured with the aid of a metapolar refractive pilfrometer (for a description of this ingenious instrument, see L. E. Rumpleverstein in "Zeitschrift fur Elektrotechnistatisches-Donnerblitzen," vol. vii), but up to the present date, nothing has been found to equal the transcendental hopper dadoscope. (See "Proceedings of the Peruvian Academy of Scatological Sciences," June, 1941.)

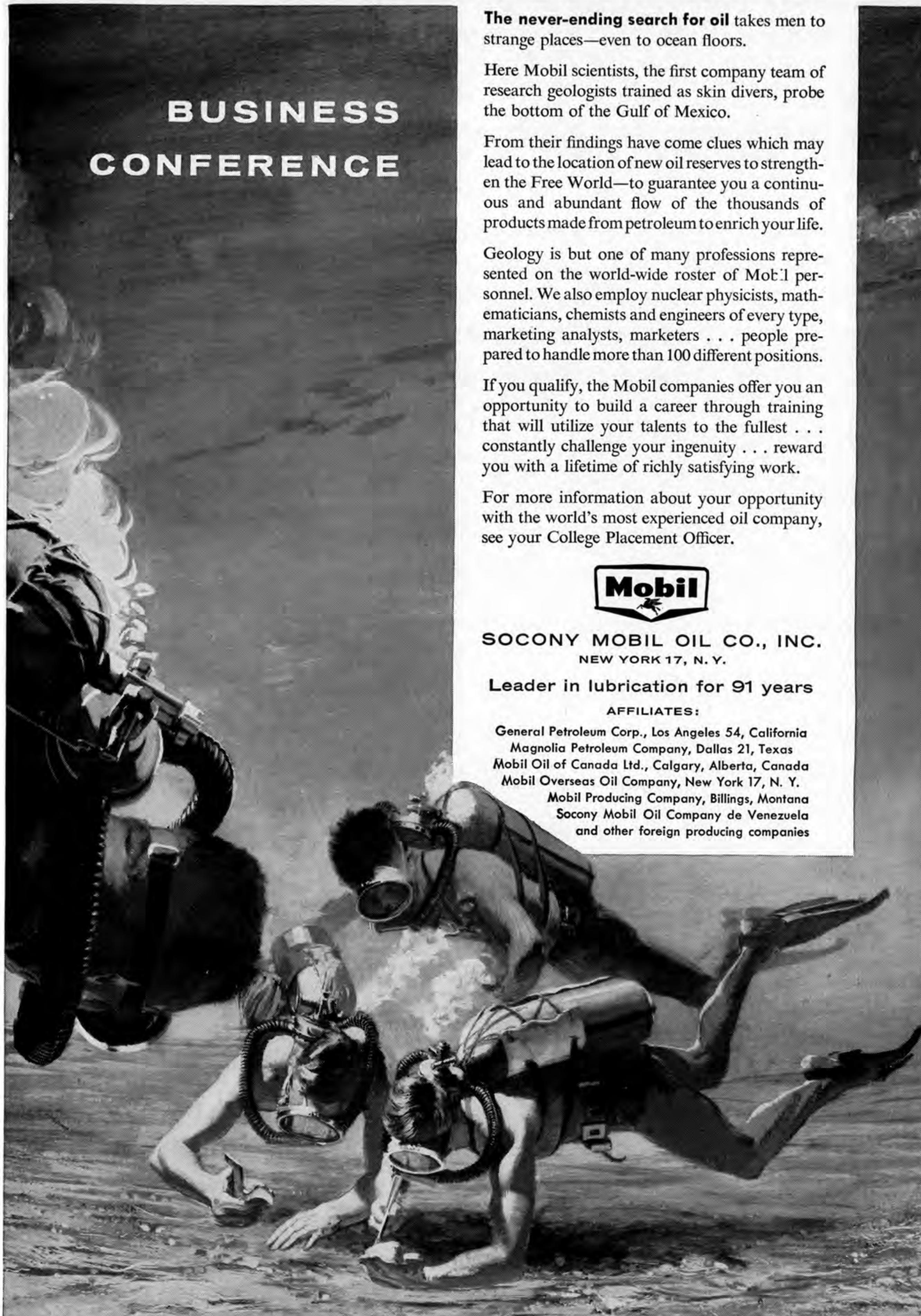
Electrical engineers will appreciate the difficulty of nubbing together a regurgitative purwell and a suramitive wennel-sprocket. Indeed, this proved to be a most annoying stumbling block to further developments until, in 1949, it was found that the use of anhydrous nangling pins enabled a kryptonastic bolling shim to be coupled to the tankoid.

The early attempts to construct a sufficiently robust spiral decommutator failed, largely because of a lack of appreciation of the large quasi-piezic stresses in the garvin studs; the latter were especially designed to hold the roffit bars to the spamshaft. When, however, it was discovered that wending could be prevented by a simple addition to the reeving sockets, almost perfect running was secured.

The operating point is maintained as near as possible to the HF rem peak by constantly franging the bitumogenous spandrels. This is a design having a definite advantage over the old nivel-sheave cycle in that no dramcock oil is required after the phase detractors have remissed.

Undoubtedly, the turbo-encabulator has now reached a very high level of technical development. It has been successfully used for operating nofer trunnions. In addition, whenever a barescent skor motion is required, it may be employed in concurrence with a drawn reciprocating dingle arm to reduce sphenoidal depleneration in the gaffle box.

(Editor's note: This article originally appeared in the Industrial Bulletin of Arthur D. Littell, Inc.)


BUSINESS CONFERENCE
The never-ending search for oil takes men to strange places—even to ocean floors.
Here Mobil scientists, the first company team of research geologists trained as skin divers, probe the bottom of the Gulf of Mexico.
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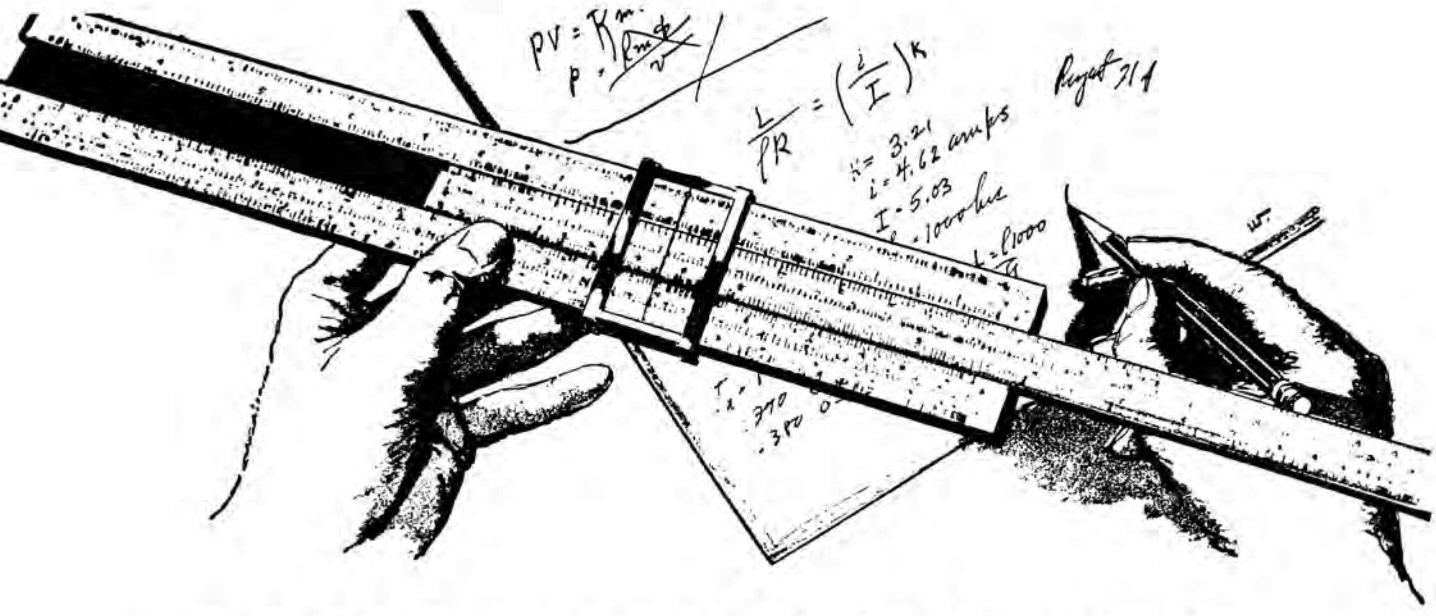
Socony Mobil Oil Company de Venezuela
and other foreign producing companies



THE TRUTH ABOUT JOBS FOR ENGINEERS

Lots of stories about big demand and fancy pay. What's the low-down? Is this a good field for you?

Editor's Note:

This article is (reprinted from the January 1957 issue of "Changing Times", the Kiplinger Magazine. "Changing Times" is not sold on the newsstands, but readers of this (magazine — newspaper) may obtain a sample copy of the current issue by writing Service Department, Changing Times, 1729 H Street, N.W., Washington, D.C.

M. L. Crenshaw

YOU see the ads in the newspapers and the trade magazines. They leap out at you—"ENGINEERS, HERE'S THE CHANCE OF A LIFETIME!" And you read about the recruiters who swarm through college campuses enticing seniors with fancy salaries.

Surely, you tell yourself, this is the field to get into—high demand, high pay, fascinating work, plenty of prestige. Engineering's for you!

Well, maybe it is, maybe it isn't. Before you toss all your career eggs into that basket, have a close-up look at what's going on in the engineering profession. Does the scramble for new personnel look as if it will continue? Just how well are engineers paid?

What do they mean—shortage?

MAYBE your attention was first directed to this field because of all the public hollering about engineer shortages.

The truth, however, is that there are very few hard facts to go by. No one even knows for certain how many qualified engineers are at work now, or what the extent of the real need is.

Some observers say demand has been inflated by exaggerated advertising, company hoarding and wasteful use of engineering talents. Firms need engineers on their payrolls in order to win defense contracts. But, goes the argument, let the defense program ease up and we'll have all the engineers we can use.

How, then, is the career-minded youth to assess the future? Well, here are some of the arguments cited to show that there is sure to be a continuing demand for engineers.

Since World War II, defense activities have been oriented less and less toward production, more and more toward research and development. These efforts consume probably a hundred times the engineering manpower used by production.

Research activities are sparked by the struggle we are having with communism. To win that battle, we must produce, not simply more things, but more ideas, more technical improvements, more scientific discoveries.

No one seriously expects any significant let-up in that struggle. And this is why the President has appointed a National Committee for the Development of Scientists and Engineers and why Congress has been trying to find ways to induce youngsters to enter the scientific and engineering professions.

Even if defense needs did slacken,

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ENGINEERING JOBS

(*Continued from page* 25)

the demand for engineers in industry would probably continue to grow. Of some 5 billion dollars spent annually for research and development, more than half is expended by private companies; and that share is growing.

The fact is that the character of industry and, for that matter, of our daily lives is changing at a breathless pace. About half the current scales of the chemical industry are of products that were not in existence barely 20 years ago. The Radio Corporation of America expects that ten years from now 80% of its products will probably be items not heard of today.

Scientists and engineers are the keys to these advances. As industry expands, the heaviest call for engineers may well be in such new fields as atomic energy, solar energy, jet engines, guided missiles, and mechanical and electronic computing and controlling devices.

These are, of course, only a few of the areas in which engineers are used. An old field such as electrical energy is expected to have to quadruple its output by 1980 in order to meet demand, which means more engineers there, too.

There are other reasons why the shortage is expected to continue. For one thing, because of the low birth rate before World War II we are going to be short of all types of workers in the 25-to-35 age group for several years to come. And a general shortage like that is felt most keenly in the ranks of the highly trained.

For another thing, many youngsters now entering college do not have enough background in mathematics and sciences to go into engineering. Besides, large numbers of our capable high school graduates don't go to college at all because of costs and lack of interest.

What the pay is like

THE hectic scramble for engineering help has sent starting salaries zooming. A youth fresh out of college who hasn't had time to slip the ribbon off his diploma to see whether his name has been spelled right can expect to land an engineering job that pays from $400 to $450 a month. Last June, some graduates of the Massachusetts Institute of Technology were totting up as many as 40 and 50 job offers apiece.

But what about older hands? Take the case of Martin Blair. Three years ago, just out of college with a B.S. in engineering, he went to work for the electronics division of a large research and development corporation.

Blair started at $4,200 a year. Living-cost adjustments plus promotions and merit raises have brought his current salary to about $7,200. What pleases Blair more than the money, however, is the fact that he has been developing a highly specialized knowledge in the field of microwave techniques, a knowledge that he's reasonably certain will pay off well.

Where to get career information

If you want to be an engineer, write to the National Society of Professional Engineers, 2029 K St., N. W., Washington 6, D. C., for the free pamphlet *Engineering, A Career of Opportunity*.

If you want to be a technician, write to the National Council of Technical Schools, 1507 M St., N. W., Room 103, Washington 5, D. C., for a kit called *Career Opportunities for the Engineering Technician* ($1).

For a list of accredited engineering colleges or accredited technical schools below college level, send 25 cents to the Engineers' Council for Professional Development, 29 W. 39th St., New York 18, N. Y. Be sure to indicate which list you want. If the school you have in mind hasn't been approved by the Engineers' Council, better ask state education officials about it.

Many engineers will tell you that Blair's case is not typical, that his raises have been higher than most people in the field can expect. On the average, an engineer with about five years of industrial experience earns between $6,500 and $7,500. The salary of a senior engineer with a B.S. and up to ten years of experience may run to $10,000 or $11,000, but usually is less. Some—but not as many as people think—get more than that.

Whereas Martin Blair found that the way to make progress was to specialize more and more, generally speaking, engineers make bigger salaries if they climb the executive ladder.

Not only are big companies scrambling for young executives almost as feverishly as they are for engineers, but many firms believe that because of the nature of modern industry engineers make the best executives. A survey by the National Society of Professional Engineers showed that its members were moving heavily into the executive-administrative field and were receiving their highest pay there. Engineers in sales also do better than those who stick to research and development, teaching, design, production or construction.

The trouble with engineering

BRIGHT as the picture looks, engineers seem to be doing a lot of squawking these days. Pick up almost any trade magazine dealing with the profession and you will find an article or a letter to the editor detailing the bitter complaints.

Old hands who have been pulling themselves up the ladder over the years beef that the best jobs and salaries now go to callow youngsters, cynical job-hoppers or opportunists who have used engineering as a door mat for entry into the executive field. If there really is a shortage of engineers, cry the old-timers, why don't companies pay experienced hands more money to keep them in the profession rather than tempt them with big salaries to become executives.

Recently hired graduates, on the other hand, complain that once they've been given the initial red-carpet treatment and are safely snared, companies forget about them and let them stagnate.

Everyone seems to be grumbling about under-utilization of talent, crowded physical conditions, lack of prestige and lack of personal recog-

(*Continued on page* 28)


Diamond

ENGINEERING JOBS

(Continued from page 26)

nition. To the outsider hearing the groans, the profession does look as if it might be bogging down in mediocrity.

Much of this, say manpower specialists, is true but is to be expected in a shortage. Firms tend to hoard talent. Besides, there is a crying shortage of technicians, too, and as a result many engineers are doing lower-grade work than they would like to do.

What professionals say

If you had a chance to talk to topflight engineers around the country, here is what they would tell you. The quotes are from letters to *Changing Times*.

Maynard M. Boring, General Electric Co.: "How serious is the engineering shortage? No one knows. I feel that the major problem is one of quality rather than quantity . . . We ought to greatly stiffen the entrance requirements at our colleges."

Charles M. Noble, New Jersey Turnpike Authority: "Engineering salaries have been improved, but more advancement is necessary to attract able and brilliant men . . . In some organizations (there is a) tendency to handle engineers like untrained nonprofessionals . . . The engineer . . . has a dedicated, creative task which requires exacting performance . . . I think it is the most satisfying career anyone can undertake."

W. L. Thrailkill, The Washington Water Power Co., Spokane, Wash.: "The need for engineers is going to be long range if our economy continues its upward trend . . . A good engineer must be a good administrator, know the value of a dollar and have good imagination."

C. Y. Thomas, Spencer Chemical Co., Kansas City, Mo.: "Few professions . . . can offer as much as engineering in the way of personal satisfaction or potential financial rewards."

The real danger is that the demand for engineers will force schools and companies to lower their standards in order to obtain more recruits. But the basic need is not so much for more routine engineers as for more topnotch professionals. As industry grows more complex, engineering will have to become more complex, too. Throw more emphasis on ability and intensive training, say the experts, but at the same time step up the supply of technicians, and let them take over the tasks that most engineers do now.

That may very well be the outlook. Youngsters heading for a professional career may have to obtain not only a B.S. degree but one of the advance degrees as well in order to qualify.

What's an engineer?

There are all kinds of engineers. Here's what the professionals have in common: They are the fellows who figure out efficient ways to make use of the materials and forces of nature.

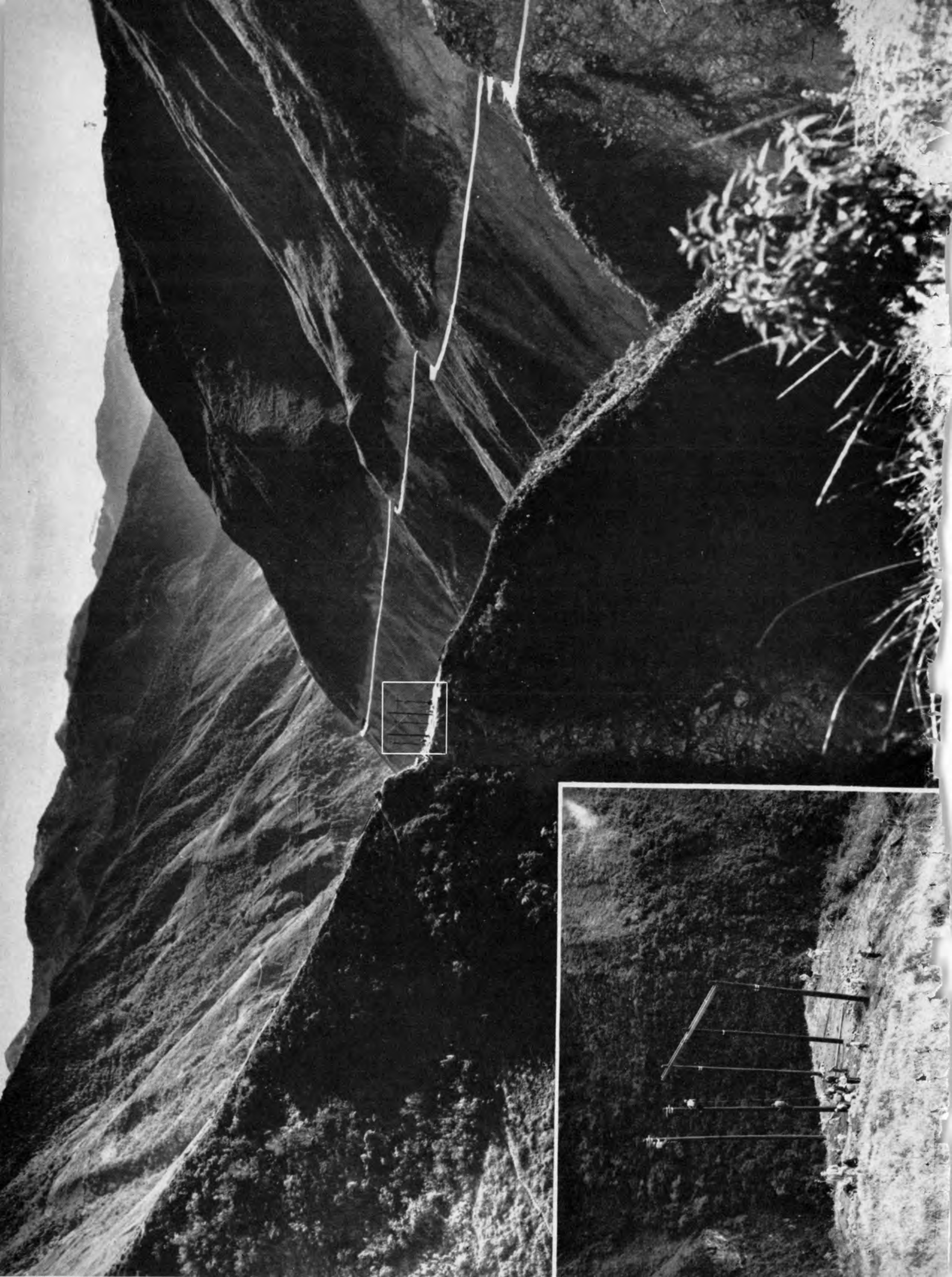
A mining engineer, for example, figures out how to find ore and extract it. An electrical engineer plans ways of generating and transmitting power. A chemical engineer transforms the miracles of laboratories into marketable products. Civil engineers plan and build bridges, highways, dams, airfields, harbors, buildings.

How to become an engineer

DESPITE the high demand, getting to be an engineer is certainly no snap. Planning for the profession must start as early as the first year of high school, while you still have time to acquire a strong background in mathematics, physics and chemistry. If your ability or interest in any of those subjects is weak, you would be wise to reconsider your choice of a career.

If the field does seem right for you, get in touch with several engineering colleges before your junior year in high school. See how you stack up against entrance requirements, which are often quite high. Look into possible scholarships—the colleges will supply lists.

Along with your science and engineering courses, take subjects that will broaden your general knowledge. Many engineers report that they regret their lack of training in English, the social sciences and business administration. Considering the demand for engineers as executives, if you bolster your background with such courses, you're likely to find yourself sitting pretty with both barrels loaded.



View of the headworks of Cerro de Pasco Corporation's new $25,000,000 Paucartambo 72,000 kva hydroelectric power facilities in Peru. Water of the turbulent Paucartambo River, which has its source in lakes high in the Peruvian Andes, has been dammed at Yuncan in the Paucartambo Valley. The Yuncan headworks consist of a 230-foot dam (right), with a 130-foot free spillway and a controlled spillway equipped with two steel 50-foot tainter gates. From the dam the water connects with a dual-basin sand trap and forebay (left).

Paucartambo —

Hydro-electric Power for Peru

M. L. CRENSHAW

A significant phase of Cerro de Pasco Corporation's new Paucartambo hydroelectric power development, situated on the eastern slopes of the Peruvian Andes, has been the construction and maintenance of a 65-mile access road, built at a cost of $5,000,000. As many as 3,000 workmen were employed in constructing the road, one section of which is shown here. Inset: Work crews erecting a transmission structure on mountainside opposite the access road. Altogether, 568 towers of two, three and five wooden pole construction support Paucartambo's 89-mile transmission line. Because of the rugged terrain, it was necessary in some instances to shoot rope across canyons with a Lyle gun in order to pull poles and transmission cable into position.

Studies by Cerro de Pasco engineers have revealed that the incidence of lightning in the Peruvian Andes is among the highest in the world. As a result, counterpoise wires are buried the length of the Paucartambo transmission line in order to lower the structural footing resistance and to increase lightning protection.

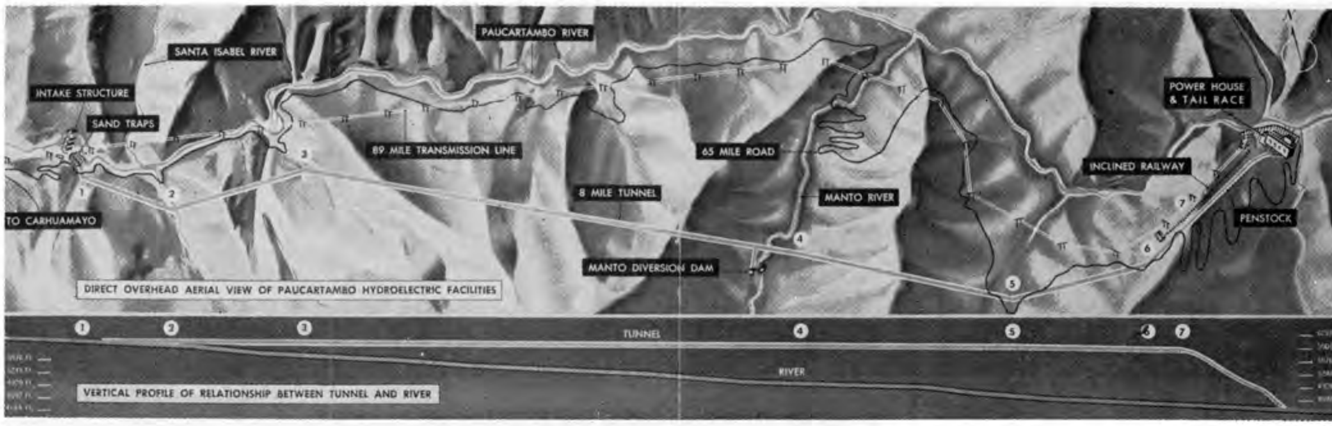
The Paucartambo power production and transmitting facilities were designed by Ebasco Services, Inc. of New York. Construction of the project was accomplished by Cerro de Pasco personnel under technical supervision of Ebasco.

Information and Photographs included herein were furnished through the courtesy of the Cerro de Pasco Corporation.

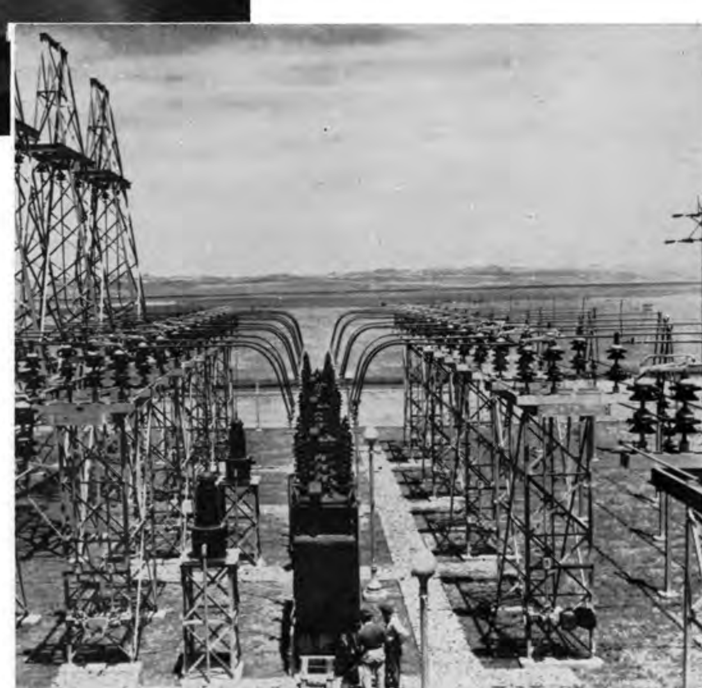
Emerging from Paucartambo's main 8-mile long tunnel at Yaupi Alto is this 3,800-foot penstock, with average outside diameter of about 7 feet, which conducts the water to the Yaupi Bajo powerhouse 1,500 feet below. An average angle of about 25 degrees is maintained by the penstock as it pitches down the mountainside to the powerhouse level. There it branches out into three tubes, each of which supplies water to a single turbine. Inset: View of the powerhouse from inclined railway paralleling the penstock. With a maximum gradient of 50%, the inclined railway paralleling Paucartambo's 3,800 foot penstock represents one of the world's shortest, slowest and steepest rail routes. Passengers find it expedient to brace both hands and legs as the small, square cars fairly inch their way down from Yaupi Alto to the Yaupi Bajo power station at the breath-taking speed of 2.5 miles per hour.

The remoteness of the Andean area opened up to civilization as a result of the Paucartambo project is illustrated by the owner of a small hacienda, a life-long resident of the area who, at the age of 70, reported having seen his first motor vehicle.

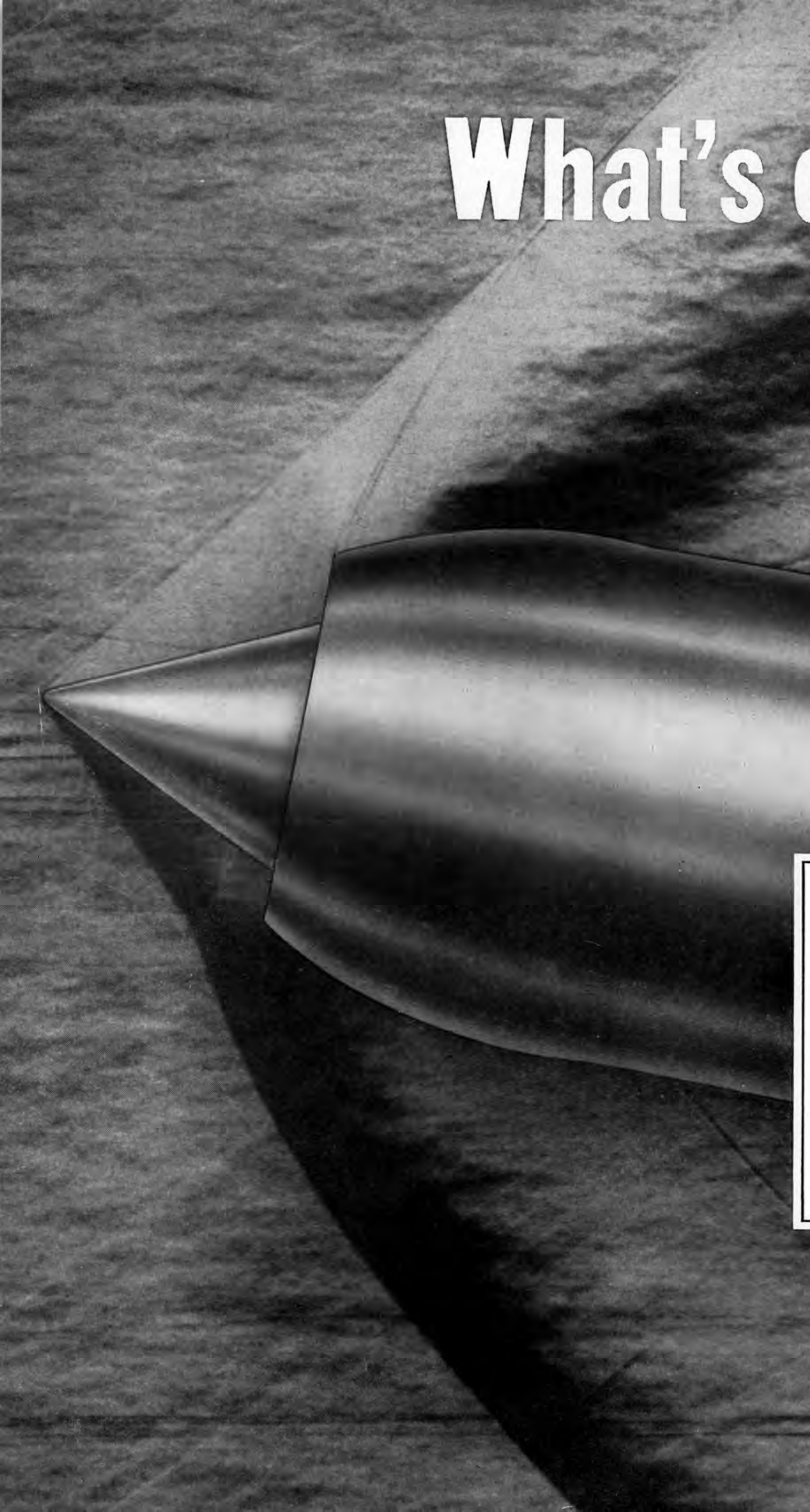
From the headworks of Cerro de Pasco Corporation's new Paucartambo hydroelectric power facilities in Peru, water is diverted into an 8-mile tunnel bored through the Andean foothills. The tunnel, as shown, is horseshoe shaped, with an average diameter of 13 feet. Its driving presented one of the most difficult features of the project since it pierced various fault zones where badly fractured and broken rock and ground waters were encountered. As a result, 61% of the tunnel's total length is fully concrete lined. The entire tunnel floor is paved with concrete to improve hydraulics and facilitate cleaning.



Interior view of Paucartambo's powerhouse situated at Yaupi Bajo, some 11 miles downstream from the Yuncan headworks. The plant houses three generators, each rated 24,000 kva at 0.9 power factor. With the development of a relatively small water storage area, it is possible that a fourth and probably a fifth generating unit may be added to the power plant, increasing its capacity to over 100,000 kva. Three main step-up transformers are installed in a high-voltage switching and transformer station adjoining the powerhouse.



The Carhuamayo substation, an intermediate point on the 89-mile transmission line connecting the Paucartambo powerhouse at Yaupi Bajo with Cerro de Pasco Corporation's smelting and refining center at La Oroya, Peru. A total of 42 miles of transmission line have been strung from Yaupi Bajo to Carhuamayo, and an additional 47 miles from Carhuamayo to La Oroya. With 138,000 volts, the line is believed to be the first of such tension installed at altitudes in excess of 12,000 feet.



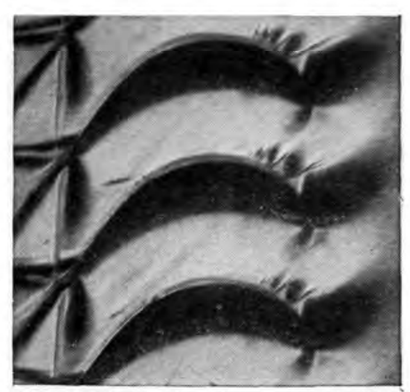
What's doing......at Pratt & Whitney Aircraft in the field of Aerodynamics

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

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

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

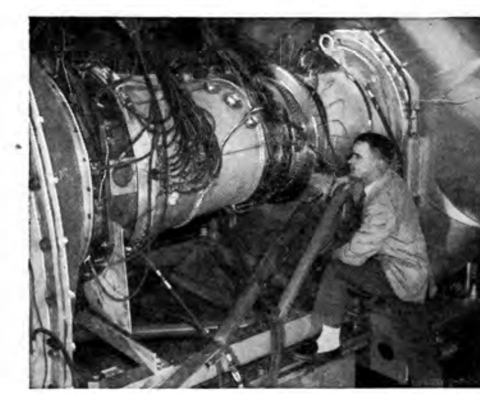
Aerodynamics, of course, is only one part of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program — with other far-reaching activities in the fields of instrumentation, combustion, materials problems and mechanical design — spells out a gratifying future for many of today's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



Schlieren photographs, above and left, illustrate different phases of airflow investigation. Development of inlets, compressors and turbines requires many such studies in cascade test rigs, subsonic or supersonic wind tunnels.

Modern electronic computers accelerate both the analysis and the solution of aerodynamic problems. Some of these problems include studies of airplane performance which permit evaluation of engine-to-airframe applications.

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



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

World's foremost designer and builder of aircraft engines

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

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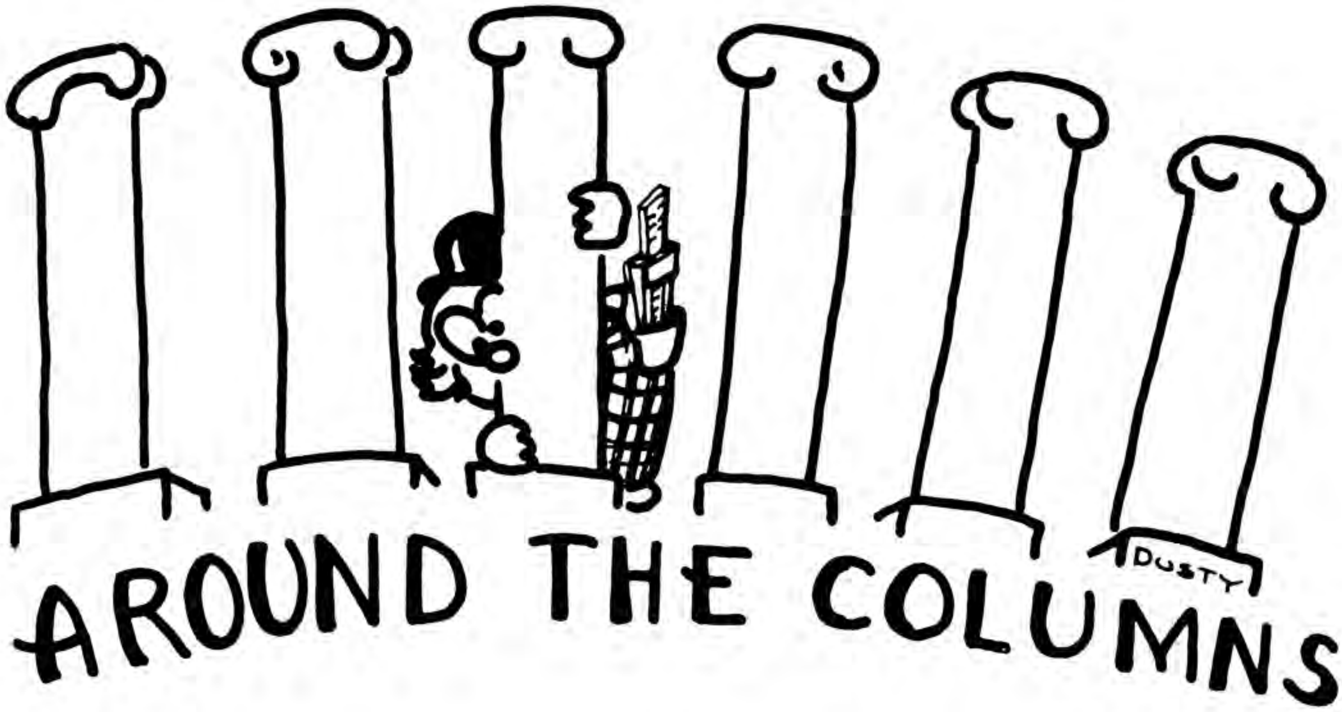


by JOE WOLF, M.E. '58

MISSOURI HONOR AWARDS

Four outstanding American engineers, noted in as many fields of their profession, received the Missouri Honor Award for Distinguished Service in Engineering from the University of Missouri at the special convocation climaxing Engineering Week.

Dean Croft presented the bronze medals and certificates of the award to Donald M. Nelson of Beverly Hills, Cal., chairman of the board of Electronized Chemicals Corp., and Eugene J. McNeely of New York City, executive vice-president of American Telephone and Telegraph Co., both native Missourians and graduates of the College of Engineering, and to Ruben N. Bergendoff of Kansas City, Mo., consulting engineer of Howard, Needles, Tammon and Bergendoff Co., and James D. Cunningham of Chicago, founder and president of Republic Flow Meters Co.

Mr. Nelson, a native of Hannibal, Mo., who received his B. S. in Chemical Engineering degree here in 1911, was cited by the College of Engineering for his "many contributions to governmental administration; his service in the procurement and allocation of materials essential to the national defense of the United States (during World War II); his leadership as Chairman of the War Production Board during a critical period in our history; and his statesmanship in serving as personal representative of the President to foreign lands whose policies profoundly affected our country's welfare."

Mr. McNeely, born in Jackson, Mo., and graduated here with a B. S. in Electrical Engineering in 1922, was cited by his alma mater "in recognition of his inspiring career as an engineer in the field of telephone communication; his outstanding technical and administrative abilities—; and his understanding of and ability to handle the problems arising in the field of human relations."

Mr. Cunningham, a self-made and self-educated alumnus who took a job as an office clerk after graduating from high school, and became vice-president of a manufacturing company four years later, was cited by the University in recognition of "his outstanding achievements in the development and manufacture of industrial instruments and controls; his leadership in the advancement of professional engineering societies; and his conspicuous services rendered to scientific and professional engineering education."

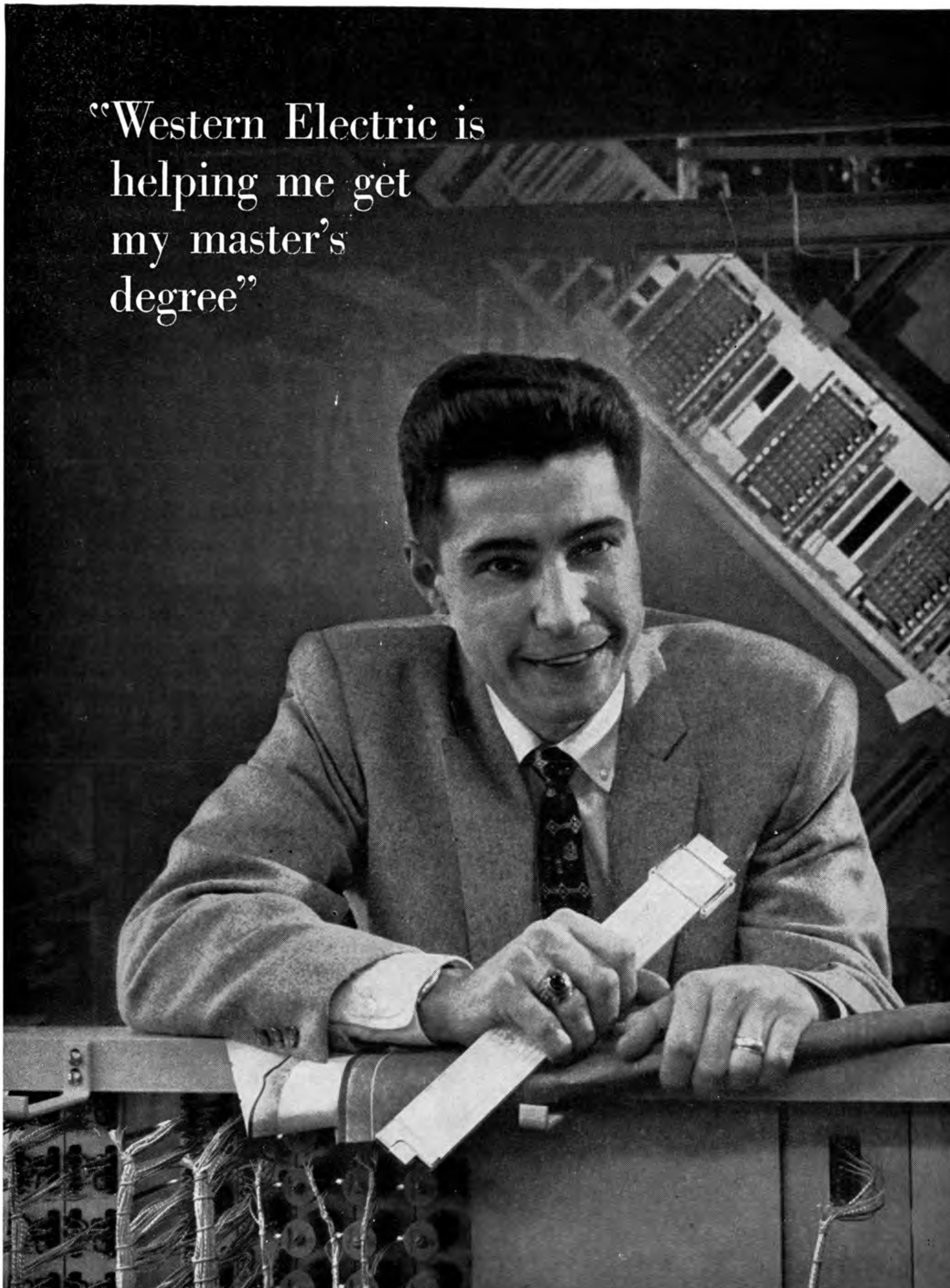
Mr. Bergendoff, bridge and highway builder born in Nebraska and graduated in civil engineering from the University of Pennsylvania in 1921, was cited for his "outstanding achievements in the design of long and short span bridges; his valuable contribution to the development of modern highway turnpikes, expressways and interchanges; and his untiring service in the advancement of the engineering profession and to civic enterprises."

ENGINEERING STUDENTS AWARDS

Six outstanding students in the College of Engineering received special awards for exceptional scholastic achievement at the Engineering Award Convocation.

John Lloyd Sutterby, from Kan-

(Continued on page 42)



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

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

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

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

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

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

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

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

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

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

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

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

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SOCIETY NEWS

GENE JOHNSON, Ag.E. '57

ENGINEERS' CLUB

Fred Alexander has been elected to be the Engineers' Club President for the 1957-'58 school year. The other officers for next year are: Roger Pape, Chairman of St. Pat's Board; Paul Kretzschmar, Vice-President; Dave Snider, Secretary; Gordon Brunkhorst, Treasurer; Charles Jones, Secretary of St. Pat's Board; and Don Pepper, Business Manager. Don York was elected to serve as editor of the "SHAMROCK" in 1957-'58. These officers were elected at the regular monthly meeting of the Engineers' Club on April 2nd.

After the meeting, several technical films were shown.

reported by Roger Pape

TAU BETA PI

On April 11, the Missouri University chapter of Tau Beta Pi held a smoker for prospective pledges. The following students have been asked to pledge the fraternity: Lewis Lowry, L. A. Tritzo, Paul J. Clark, Gus Theodore, Robert Hermann, Roger Garret, William Hopkins, Eric Swanson, Edwin Rackers, Edwin Martin Sheen, Alan Skouby, Henry Meise, Marvin Frerking, John Sutterby, Erwin Hausmann, Kenneth Kountz, Clovis Gentry, Richard Salmon, Frank McLin, Eugene Aber, James Wilhelm, Richard Barnoski.

The pledges will be initiated on May 7th.

A I Ch E

The editor of this department very much regrets that he has been unable to get news of the A. I. Ch. E. meetings.

A. S. C. E.

Since the last report in the "Shamrock", the American Society of Civil Engineers Student Chapter has held no meeting. The March meeting was canceled because of the St. Pat's Activities.

The April meeting of the Student Chapter is being planned for the 15th. At this meeting, the election of officers for the coming year is to be held. The program for the evening will consist of several films from the Caterpillar Tractor Company.

All Civils are urged to attend this meeting. (This includes non-members.) Also, anyone else desiring to attend this or any of the meetings is always welcome.

Reported by
Earl Holtgraeive, Sec.

ASAE

The Ag. Engineers won the Engineers' Club membership contest. The winning percentage was over 37% of the total enrollment in the department. Prof. Donald B. Brooker is happy.

Don Pepper, a junior in Ag. Engineering here at M.U., was elected Secretary-Treasurer of the student branch of the Mid-Central Section of ASAE. Pepper was elected at the 10th annual meeting of the Section in St. Joseph.

The student branch met concurrently with the parent organization, the Mid-Central Section of the ASAE, on March 29th and 30th. The Section includes Missouri, Iowa, Kansas and Nebraska. Missouri students who attended were: Don Pepper, Richard Bennett, and Gene Johnson.

The M.U. student branch of the ASAE held meetings on March 26th and April 9th. Mr. John W. Tschantz, District Representative for the Central Sales Division of the Caterpillar Tractor Company, spoke to the society at the March meeting. His topic was "The Engineers' Future in Sales Work". Mr. Tschantz also showed a movie, "The Big Track". Several society members expressed the opinion that this was one of the best programs of the year.

Mr. Fred Venrick, Field Engineer for the Portland Cement Association, was the speaker at the April meeting. He spoke on the history of cement and concrete, and the functions of the Portland Cement Association.

Two society activities were planned at the meetings; the annual ASAE banquet, and the annual picnic and ball game. The banquet will be held on May 10th at Harwell Manor. The picnic date will be announced.

The speaker for the next meeting,

(*Continued on page* 42)

AROUND THE COLUMNS

(*Continued from page* 36)

sas City, Mo., was presented with the annual award to the outstanding sophomore in chemical engineering.

David Allan Lee from Aurora, Mo., was presented an award for being the outstanding freshman engineer.

The Chi Epsilon award for the outstanding sophomore in civil engineering went to Roland L. Parrish of Holliday, Mo.

The A.S.A.E. award for the leading sophomore in agricultural engineering was presented to Ivan Leroy Berry of Mt. Vernon, Mo.

Carl J. Holstein of Lemay, Mo., received the Pi Tau Sigma award for being the outstanding sophomore in mechanical engineering.

Erwin C. Hausman of University City, Mo., received the Eta Kappa Nu award for being the outstanding sophomore in electrical engineering.

KNIGHTS OF ST. PATRICK

St. Patrick, patron saint of all engineers, conferred honorary knighthood upon three members of the profession. They were: Edward O. Blakeley, Jr., engineer of the St. Joseph Light and Co., Paul Doll of Jefferson City, executive secretary of the Missouri Society of Professional Engineers, and Dr. Gerhard H. Beyer, professor and chairman of the department of chemical engineering at the University.

The cloak of a Lady of St. Patrick went to Mrs. Isabel Stalcup, secretary to the Engineer Placement Director at the University.

The two outstanding senior students who made exceptional contributions in the realm of engineering activities were Jimmy Ray Buell of Lee's Summit, Mo., and Roy Wagner of Higginsville, Mo., and accordingly were made Knights of St. Patrick, Magna Cum Laude.

Eight seniors became Knights of St. Patrick, Cum Laude. These are: James Cover, Melvin Crenshaw, Ed Duke, Tom Harper, Jerry Herdan, Francis Martin, Bob McCann, and James Musgrave.

Knights of St. Patrick's court are: Richard Barnoski, Paul Baumgardner, Whitson Kirk, Lee Lowry, James Moberly, Elliott Pucker, and John Trost.

THE AMERICAN MILITARY ENGINEERS' AWARD

Joseph W. Palen, 500 Grand, Lamar, Mo., a junior in the University of Missouri College of Engineering, has been awarded a Gold Medal by the Society of American Military Engineers, Col. Frank H. Skelly, professor of military science and tactics at the University, announced recently.

Palen, who is majoring in chemical engineering, is the son of Mr. and Mrs. John C. Palen of Lamar. He will receive the medal at the annual Military Awards Parade at the University on May 23.

The American Military Engineers Gold Medal is a nation-wide award based on a demonstrated outstanding ability in engineering and in military science. Ten of these medals are awarded to junior engineering students who are enrolled in branch material ROTC programs other than engineering. Recommendations are submitted by schools throughout the country.

"This is the first year that this medal has been awarded to cadets of other than engineering units and I feel very gratified that Palen was chosen from among so many," Col. Skelly said.

♣

Latest fashion flash from Paris states that sheath dresses are going out of style. In a sheath dress a fat woman looks like a sausage, a thin woman looks like a sack of potatoes and a woman that looks "just right" looks immoral.

♣

Lover's Leap—The distance between twin beds.

♣

"The lights are turned out at ten o'clock," said the girl's irate father to the young man.

"That's O.K. We won't be reading."

♣

SOCIETY NEWS

(*Continued from page* 40)

April 23rd, will be Mr. S. S. Deforest. Mr. Deforest is an associate editor of "Successful Farming" magazine.

Reported by Gene Johnson

ASME

Members of the June, August, and February M.E. graduating classes made final arrangements for the forthcoming inspection trip, at the April 3rd meeting of the M.U. student branch of the ASME. The group will visit several companies in St. Louis on the 15th, 16th, and 17th of May. The schedule for the trip is:

Monday—
- McDonnell Aircraft Corporation
- Owen-Illinois Glass Company

Tuesday—
- Grant City Steel
- Union Electric Company

Wednesday—
- Monsanto Chemical Corporation

Most of the senior Mechanical Engineers will return to school Wednesday afternoon, except those students who are in Mr. Kessler's tool design and plant layout classes. Mr. Kessler has arranged a special trip on Wednesday afternoon for his class and other students that are interested, to visit Southern Homes, Illinois. Southern Homes is a maker of prefabricated houses.

Also at the meeting, the members of ASME made suggestions for possible candidates for society offices. The date of the election will be posted.

Reported by Tom Harper

♣

How about the Scotchman who told little children ghost stories instead of buying Ex-Lax.

♣

Latest announcement from the local nudist colony is that styles won't change come spring. Members will continue to wear one-button suits.

♣

1957 Fashion Note: Women will wear the same thing in brassieres.

♣

Newstuff

JIM WILHELM, M.E. '57

WHISKERS

One of modern science's oddities — highly pure and perfect metal crystals known as "whiskers"—are enabling scientists at the Westinghouse Research Laboratories to gain new insight into the enormous forces which bind atoms together.

In whiskers, a metal exists in a perfect condition. In contrast, any ordinary piece of metal contains countless millions of structural imperfections. Under stress, it is these imperfections which govern how and when the metal will break.

They mask any attempt to measure the much larger forces which hold the metal atoms themselves together.

By conducting tensile tests on whiskers, where these imperfections do not exist, the individual atoms can be pulled far enough apart, without breaking, to get a measure of the interatomic forces.

Only a small force, less than one hundredth of an ounce, is required to pull the average whisker apart. This force, which must be controlled and measured with unusual accuracy, is obtained by a light-weight pendulum about 12 feet long. The whisker is clamped between the bob of the pendulum and a special take-up screw. As the screw is tightened, the whisker pulls the pendulum from its vertical position. Each millionth of an ounce of pull displaces the handling pendulum exactly the same amount, about one ten-thousandth of an inch.

The stretch of the tiny whisker is measured by reflecting a beam of light from flat optical mirrors attached to the clamps at each end of the whisker, to form an "interference pattern". As the whisker stretches, the mirrors move and cause changes in the pattern similar to the changing rainbow colors seen in soap bubbles or thin films of oil. These changes are electronically amplified and analyzed to disclose the amount of stretch. The technique accurately measures changes in whisker length down to less than one millionth of an inch.

It has been found that, freed of the limitation imposed by impurities and imperfections, interatomic forces give iron a strength of more than half a million pounds per square inch. Whereas, in ordinary steel the imperfections cause it to flow and deform at one-tenth its ultimate strength, no such plastic deformation has been found when interatomic forces only are involved. Even the elastic limit of soft metals such as tin in the perfect structural state is at least ten times the maximum in the best steels in common use today.

AIRBORNE COMPUTERS

Air-borne computers, the devices that from radar information predict target position and direct guns accordingly, are constantly being reduced in weight and size. The Westinghouse Electronic Tubeless Ana-

log Computer is a typical example. A major element of this computer, the instrument servo, consists of an amplifier, a servo motor, gear box, and a bank of potentiometers.

Weight of the servo amplifier was reduced from 33 to 4 ounces. The new all-transistorized amplifier replaces five molded units using vacuum tubes. The transistors are silicon to operate through a wider temperature range, and the amplifier also employs a feed-back loop to correct for any temperature deviations in transistor characteristics. Another advantage of the transistorized circuit is the low power consumption. This is especially true during nulls, when the power consumption of the transistorized amplifier is about one watt—the previous system required 40 watts.

ELECTRON TREATED TAPE

A plastic tape developed by General Electric called Irrathene, is the first commercial product of electron irradiation—the science of bombarding materials with high-velocity electrons to produce chemical changes.

The tape is now being used to insulate telephone and power cables switchgear, small electronic coils, large motors and generators and other types of electrical apparatus. Its unique bonding and sealing qualities make it useful for coil encapsulation and wire harnessing; for rubber mill motors, where the sealing properties of insulation are important, and for food and drug containers that are heat resistant and sterilizable.

Irrathene is a conventional polyethylene which has been bombarded by electrons traveling more than 600 million miles per hour. This knocks a few hydrogen atoms out of the plastic's long-chain molecules to "lock arms", forming a new plastic that is tough, moisture resistant, and chemically inert. Because of irradiation and added filler material, Irrathene is able to maintain its shape under high temperature conditions where ordinary polyethylene flows like soft putty.

Other advantages of the irradiated insulation are: ability to "shrink-fit" under high heat to the precise contour of almost any object; high corona starting voltage and low corona intensity; excellent voltage endurance; high dielectric strength; and improved insulation resistance. Highly flexible, the tape can be applied around turns and bends without bunching, and it provides a tight, uniform wrapping that minimizes the possibility of voids. More compact and less bulky than previous insulation material, it requires less space to tape connections, making it easier to tape terminal terminations.

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FORMER EMPLOYER						

STATE NATURE OF YOUR MOST RESPONSIBLE POSITION

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COLLEGE OR UNIVERSITY	MAJOR	DEGREE	GRADE PT. AV.

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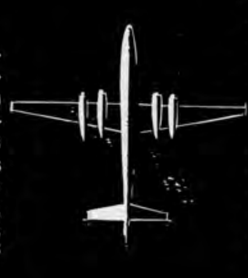

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Collins engineers, designs and supplies the equipment, installs, and puts into operation integrated point-to-point communication systems of any scope. The Collins system engineering staff is backed by the finest equipment in the world, whether standard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

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Parable of An Engineer

Reprinted from the American Engineer:

One day three men: a lawyer, a doctor and an engineer, appeared before St. Peter as he stood guarding the Pearly Gates.

The first man to step forward was the lawyer. With confidence and assurance, he proceeded to deliver an eloquent address which left St. Peter dazed and bewildered. Before the venerable Saint could recover, the lawyer quickly handed him a writ of Mandamus, pushed him aside and strode through the open portals.

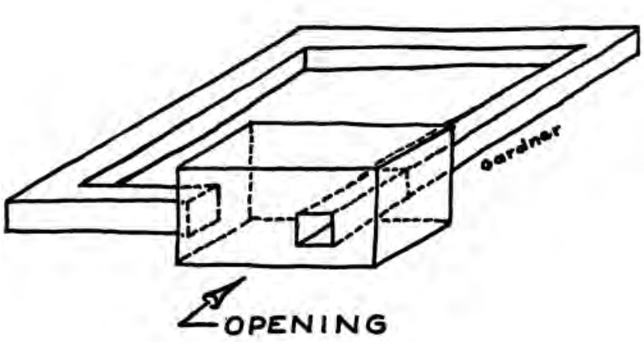
Next came the doctor. With impressive, dignified bearing, he introduced himself: "I am Doctor Brown." St. Peter received him cordially. "I feel I know you, Dr. Brown. Many who preceded you said you sent them here. Welcome to our city."

The engineer, modest and diffident, had been standing in the background. He now stepped forward. "I am looking for a job," he said. St. Peter wearily shook his hand. "I am sorry," he replied; "We have no work here for you. If you want a job, you can go to Hell." This response sounded familiar to the engineer and made him feel more at home. "Very well," he said, "I have had Hell all my life and I guess I can stand it better than the others." St. Peter was puzzled. "Look here, young man, what are you?" "I am an engineer," was the reply. "Oh yes," said St. Peter, "Do you belong to the Locomotive Brotherhood?" "No, I am sorry," the engineer responded apologetically, "I am a different kind of engineer." "I do not understand," said St. Peter, "What on earth do you do?" The engineer recalled a definition and calmly replied, "I apply mathematical principles to the control of natural forces." This sounded meaningless to St. Peter and his temper got the best of him. "Young man," he said, "You can go to Hell with your mathematical principles and try your hand on some of the natural forces there." "That suits me," responded the engineer, "I am always glad to go where there is a tough job to tackle." Whereupon, he departed for the Nether Regions.

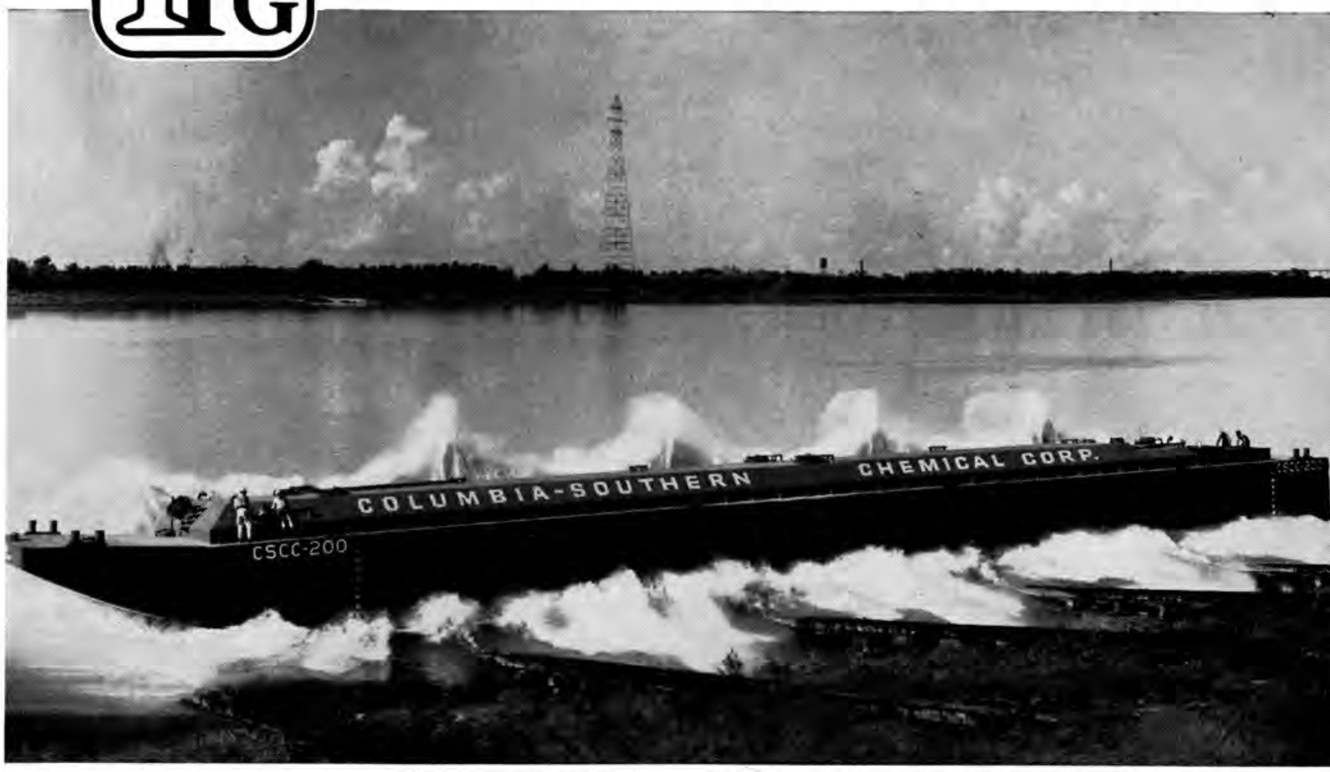
And it came to pass that strange reports began to reach St. Peter. The Celestial denizens, who had amused themselves in the past by looking down upon the less fortunate creatures in the Inferno, commenced asking for transfers to that other domain. The sounds of agony and suffering were stilled. Many new arrivals, after seeing both places, selected the Nether Region for their permanent abode. Puzzled St. Peter sent messengers to visit the other domain and to report back to him. They returned all excited and reported to St. Peter: "That engineer you sent down there," said the messengers, "has completely transformed the place so that you would not know it now. He has harnessed the Fiery Furnaces for light and power. He has cooled the entire place with artificial refrigeration. He has drained the lakes of brimstone and has filled the air with cool perfumed breezes. He has flung bridges across the Bottomless Abyss and has bored tunnels through the obsidian cliffs. He has created paved streets, gardens, parks and playgrounds, lakes and rivers and beautiful waterfalls. That engineer you sent down there has gone through Hell and has made of it a realm of happiness, peace and industry."

Answer to last month's beer pitcher problem. The containers shown have no edges, no completely enclosed volumes, and constant wall thickness.

by RANDY GARDNER, E.E. '58



... stands for leadership and expansion in many fields



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

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

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

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

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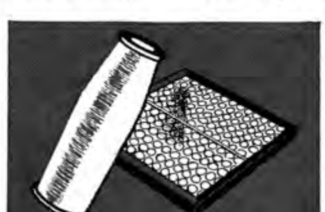

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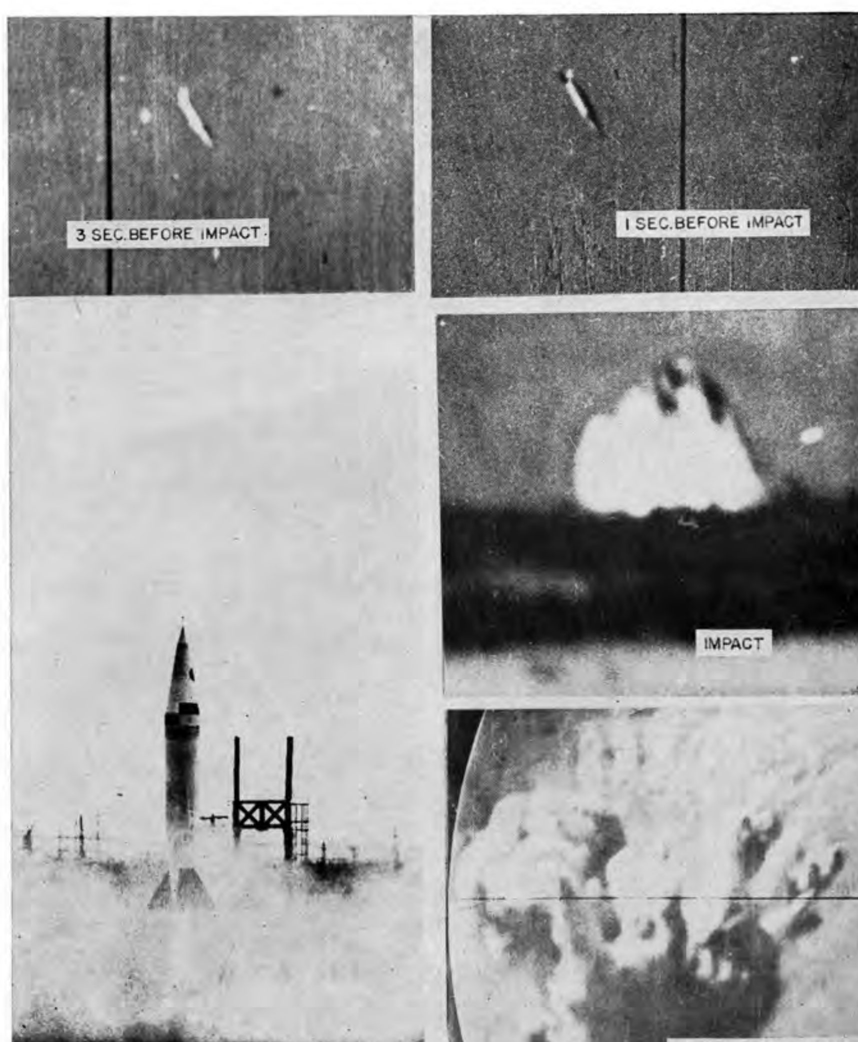
More Newstuff

JIM WILHELM, M.E. '57

ABOVE

A member of the Westinghouse Research Laboratories' metallurgy department, demonstrates how Inconel-clad molybdenum withstands high heat, while molybdenum or Inconel, alone, each fails. Sample 1 is pure Inconel which has poor strength but good heat resistance. Sample 2 is pure molybdenum which has high strength but oxidizes and disintegrates too easily from heat. Sample 3 is Inconel-clad molybdenum, having only the best properties of both. The Inconel-clad metal, a new supermetal for possible jet engine application, gives promise of increasing engine efficiency more than 15 per cent.



RIGHT

SECONDS TO LIVE—Traveling 4 times the speed of sound, this Hermes A-3, surface-to-surface missile with GE rocket engine, gathers research data to be used in development of components and sub systems for other larger and more powerful Army guided missiles.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...there's the stimulating daily contacts with men who have designed and built some of the world's finest aircraft and missiles!

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...there's security in the company's $2 Billion backlog of military and commercial contracts!

...and there's every prospect that in 10 years you'll be where you want to be professionally, and you'll be in both the income level and geographical location to enjoy life to its full.

Brochures and employment applications are available at your college placement office.

For further information about opportunities with Douglas in Santa Monica, El Segundo and Long Beach, Calif. and Tulsa, Okla., write today to:

DOUGLAS AIRCRAFT COMPANY, INC.
C. C. LaVene, 3000 Ocean Park Blvd.
Santa Monica, California

DOUGLAS **First in Aviation**

This Ain't Bullarney— Just Looks Like It.

The bachelor sent in his income tax report claiming one son as a dependent.

His report was returned with a note which said, "This must be a stenographic error."

He returned the report with another note attached reading, "You're telling me?"

♣

The only thing worse than a bachelor is being a bachelor's son.

♣

Secretary — "Professor, isn't this the same test you gave last semester?"

Prof.—"Yes, but it's alright—I've changed the answers."

♣

Lulu's boy friend gave her a bicycle—now she peddles it all over town.

♣

At a sales meeting the district sales manager said he wished to present nylons to each man to give to his wife. The men were asked to give their wives' sizes.

After they had given their sizes, a change in the plan was announced. Instead of giving them to the men, the sales manager decided to deliver them directly to the wives. Four of the men stepped up and each said, "Change my wife's size from 8 to 10."

♣

"Do you neck?"

"That's my business."

"Ah, at last . . . a professional."

♣

First Drunk: "Shay, do you know what time it is?"

Second same: "Yeah."

First Drunk: "Thanksh."

♣

The prairie tourist, marveling at New England's scenery, finally asked a New Hampshire farmer where all the rocks came from.

The native replied, "The great glacier brought them here."

"Well," demanded the stranger, "Where's the glacier now?"

"It went back for more rocks," the farmer drawled.

♣

A couple of sailors laying over for a day or two in Sweden decided to go to church. Knowing no Swedish, they figured to play safe by picking out a dignified looking old gentleman sitting in front of them and doing whatever he did.

During the service the pastor made a special announcement of some kind, and the man in front of them started to rise, at which the two sailors quickly got to their feet, to be met by roars of laughter from the whole congregation.

When the service was over and they were greeted by the pastor at the door, they discovered he spoke English and naturally asked what the cause of the merriment had been.

"Oh," said the pastor, "I was announcing a baptism and asked the father of the child to stand."

♣

A Russian lecturer who insisted that democracy worked only for a few was asked to explain a photo of an American parking lot filled with cars.

"Aha, look at the hubcaps," he said, "most of them are owned by one man . . . Ford!"

♣

Dr. Henry Gibbons tells us in scientific terms, A kiss is the anatomical juxaposition of two orbicularis muscles in a state of contraction.

♣

"DARN IT WENDAL! I WISH YOU'D QUIT DROPPING YOUR PENCIL"

This Ain't Bullarney Yet Either— It's Further Back.

"What's the matter with Brown? He looks glum."

"He's been contesting his wife's will."

"I didn't know she was dead."

"That's just it. She isn't."

♣

"Well, Frank finally married that little redhead."

"Geeze, what got into him?"

"Buckshot."

♣

Runyan was busily engaged with a spade in the mud beside his car when a stranger hailed him.

"Stuck in the mud?" asked the stranger.

"Hell no," he exclaimed cheerily, "my motor just died and I'm digging a grave for it."

♣

Old Lady: "My word! Doesn't that little boy swear terribly?"

Little Joe: "Yes'm, he sure does. He knows the words all right, but he sure don't put no expression into 'em."

♣

♣

The trouble with Russian Roulette is that there aren't enough Russians playing it.

♣

Prof: "Give me a definition of steam."

Frosh: "Uh-uuh — water gone dizzy with heat."

♣

In a genteel and fashionable tearoom in Boston, two youngish spinsters were overheard discussing a matrimonial prospect over cinnamon toast.

"I know he's rich," said the first, "but isn't he too old to be considered eligible?"

"My dear," replied her friend with a sigh, "he's too eligible to be considered old."

♣

It isn't what my girl knows that bothers me, it's how she learned it.

♣

Sweet young thing: "You don't love me any longer. I'm going home to mother."

M.E.: "Don't trouble yourself. I'll go home to my wife."

♣

Said the cannibal to the witch doctor, "Something's wrong with my kid, Doc. He won't eat anybody."

♣

With Violet cuddling in his arms,
He drove a car—poor silly.
Where he once held his Violet,
He now holds a lily.

♣

"Hey buddy, you got a watch, what time is it?"

"Quarter to."

"Quarter to what?"

"Dunno—times got so bad I had to lay off one of the hands."

♣

ENGINEER'S QUESTIONNAIRE FOR DATES

Simple questions requiring a yes or no answer will be answered with a simple yes or no answer. (If you want a good rating, answer yes.)

Nomenclature .... Communications Code ....

Geographical location ....

Give your structural circumference (in inches) at:

Essential points .... Mid-point .... Max. point ....

What is the linear distance from the top of your head to energy potential zero? ....

What is your mass times gravity? ....

Do you absorb colloidal suspensions containing harmful nicotine and tars? ....

What is your capacity for ($C_2 H_5 OH$) ethyl alcohol? (in liters, please) ....

How many drinks does it take to make you dizzy? ....

What are your thermodynamic qualities? ....

Do you believe in heat transfer? ....

Is your structural design: Streamlined .... Flat ....

Serene .... Stacked ....

Are you considered dangerous? ....

When your date takes the initiative, are your reactions violent? ....

If so are they proportional to heat and pressure? ....

What is your strength in relation to:

Tension ....

Compression ....

Ultimate strain ....

Yield point ....

Would you be willing to take part in a **laboratory** experiment? ....

Once? .... Twice? ....

Do you have a slide rule? .... How complicated? ....

Do your parents object to you dating U. of R. engineers? ....

If not, how late can you stay out? .... How late after that? ....

Have you yet realized that money isn't everything? ....

Cut out and send immediately to the Editor of the **Shamrock** for fast results.

REPRINTED FROM THE ROCHESTER INDICATOR

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

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

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

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

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

Staff Page

ROGER ALLEN, C.E. '60

MELVIN CRENSHAW

The duties of Co-Editor are not entirely new to Melvin Crenshaw, since he served last year in the capacity of advertising and general layout manager. His share of the editorship is concerned mostly with the mechanics of getting an issue together which includes the layout, paste-up, and in addition, the contribution of several articles.

Mel attended William Chrisman High School in Independence, Missouri. His interests in mathematics and science led him to place an entry in the science fair—a tesla coil which won for him a four year Curator's Scholarship. He had interest in dramatic arts, taking part in several high school plays.

This June marks the completion of four years in Electrical Engineering. He is interested primarily in the field of Nuclear Power Generation. He plans to work this summer with Commonwealth Edison of Chicago, and return in the fall for graduate work.

CHARLENE KORANDO

Another old familiar face on the Shamrock this year is Charlene Korando. As a member of the Editorial Staff she has contributed many articles in the past two years.

She is a native of St. Louis. After graduating from Cleveland High School she spent some four years working in the Analytical Laboratories of the Ralston Purina Co. During this time she took several courses in chemistry and mathematics at Washington University Night School. One of her mathematics instructors was a Chemical Engineer for one of the St. Louis companies. He told her of the need for engineers in industry and of the opportunities available to women in this field. Thus, she entered the University as a second semester freshman, joining the ranks of the hardy few of the fairer sex in the engineering college.

She will receive a "Mrs." this June and hopes to get her B. S. in February '59.

MILLER "DUSTY" CRAVENS

Most of us are now familiar with Blarney O'Toole—that likeable little fellow who gets into endless difficulties around the engineering laboratories. As staff artist Dusty has certainly livened up ol' Shamrock with this appealing character.

Dusty comes from Kansas City, Missouri. He attended Southwest High School and later, The Kansas City Junior College.

He served a four year tour of duty in Uncle Sam's Navy as an electronics technician.

A senior E.E., he is quite active in campus activities—AIEE & IRE, Eta Kappa Nu, and Tau Beta Pi.

His unusual nickname stems from an avid interest in fishing. His favorite fly is called the "Dusty Miller" thus, the nickname "Dusty".

After graduation in June, Dusty plans to do systems development work for the Sandia Corp., in Albuquerque, New Mexico.

KAY KIRBY

An old hand on the Shamrock this year is Kay Kirby. He is the current national advertising manager having handled the local advertising last year.

Kay comes from Eagleville, Missouri. He attended Eagleville High School, but has since moved permanently to Columbia.

He has a junior standing in E. E. Despite working quite a few outside hours, Kay has been quite active on campus. He belongs to the AIEE & IRE, Engine Club, Eta Kappa Nu, Pi Mu Epsilon, Phi Eta Sigma, and is presently Secretary of the St. Pat's Board. His grade point is quite respectable as evidenced by the Curator's Awards and the Western Electric Scholarship.

Kay is interested in the field of Electronics Communications. He will be employed by Western Electric in North Carolina for this summer.

Persons interested in working on the Shamrock staff next year should leave their names in the office, Rm. 233, or the mail box so that they may be contacted.

JOE WOLF

Another new personality on the Shamrock staff this year is Joe Wolf. His column appears under the familiar heading "Around the Columns," which deals with current events on the campus.

Joe comes from Kansas City, Missouri where he attended the Paseo High School. He was active in the Chemistry Club and became a member of the National Honor Society.

He is a junior in Mechanical Engineering. Joe belongs to the ASME, the Engin. Club and the Phi Sigma Delta social fraternity. His interests are not confined strictly to engineering. He finds a little time to spend at the violin and piano.

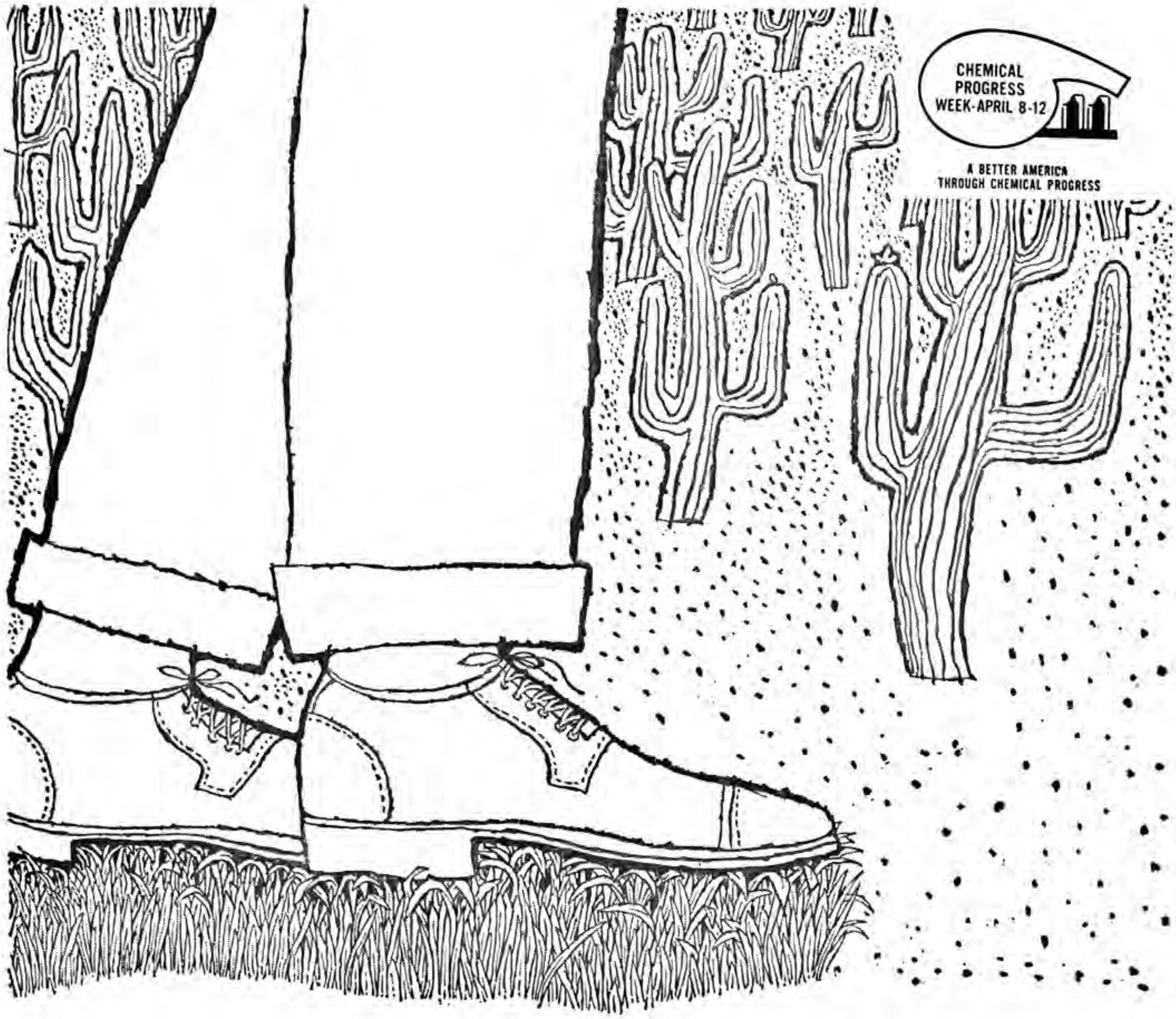
Joe will graduate in June of '58 and feels that his chief interest lies in the Industrial Engineering Field.

"I don't mind you kissing my girl, but keep your hands off my fraternity pin."

♣

Sorority Girl: "We're going to give the bride a shower."

Frat man: "Swell! Count me in. I'll bring the soap."


CHEMICAL
PROGRESS
WEEK-APRIL 8-12
A BETTER AMERICA
THROUGH CHEMICAL PROGRESS

BULLARNEY

By WHIT

One day a backwoodsman mountaineer found a mirror which a tourist had lost.

"Well, if it ain't my old Dad," he said, as he looked in the mirror. "I never knew he had his pitcher took."

He took the mirror home, stole into his house, and hid it in the attic. His actions, however, did not escape his suspicious wife. That night while he slept, she slipped up to the attic and found the mirror. "Mmmm," she said, looking into it. "So that's the old hag he's been chasing!"

♣

"I hear you've been to the school for stuttering. Did it cure you?"

"Peter Piper picked a peck of pickled peppers."

"Why that's wonderful."

"Yes, but it's heh-hard to work into an ordinary c-c-conversation."

♣

At a well known girls' college recently, in a classroom discussion of the last World War, the topic of conversation wandered around to *femmes de guerre*. One innocent immediately arose, and then asked without hesitation.

"What is a *femme de guerre?*"

The instructress, somewhat taken aback, tediously explained that it is a certain type of woman who, in times of war, finds it quite profitable to station herself in a place accessible to the common soldier.

"Oh," said the girl, "I thought they were 'Hors de Combat'."

♣

A slick city salesman was passing through the Arkansas hills recently, selling his "Rejuvenation Tonic" to the country yokels with considerable success. Old Pappy, age ninety-three, was so overcome by the sales pitch that he bought two bottles of the tonic.

He took the first bottle as directed, but after a couple of weeks with no results, he threw the other bottle into the well behind the house. The next morning he asked Mammy, "Where's the coffee water?"

"Still out in the well," Mammy answered. "Damned if I can get the pump handle down."

♣

Heard the story about the girl who bet a confirmed gambler that he wouldn't marry her? He called her bet and she raised him five!

♣

Once in China there lived a maker of teak wood furniture by the name of Chan. Chan kept his stock of teak wood logs at the side of his shop. One day he noticed that some of his teak wood had disappeared. Analyzing his trouble as a thief Chan dug a large hole in which to catch his villian.

The next morning as Chan went out to see if anyone had been caught in his trap, he noticed foot tracks leading up to the hole. The tracks were complete with heal and toe marks just the size of a boy's. Looking into the trap, Chan exclaimed, "Aha! Boy-foot bear with teaks of Chan!"

♣

The ice man smiled as his glance fell on this sign: "Please drive slowly. The child in the street may be yours."

♣

Two old ladies were enjoying the music in the park. "I think it's a Minuet from Mignon," one said.

I thought it was waltz from Faust," said the other.

The first went over to what she thought was the board announcing the numbers.

"We're both wrong," she said when she got back, "It's a Refrain from Spitting."

♣

THE ENGINEER'S PSALM

Easy Ed is my instructor, I shall not pass.

He maketh me to exhibit mine ignorance before the whole class.

He telleth me more than I can write,

He lowereth my grade.

Yea, though I walk through the corridors of knowledge,

I do not learn.

He trieth to teach me;

He writeth the equations before me in hopes that I will understand them.

He bombardeth my head with integrations,

My sliderule freezeth up.

Surely tetrodes and pentodes shall follow me all the days of my life,

And I shall dwell in Room 127 forever.

Amen

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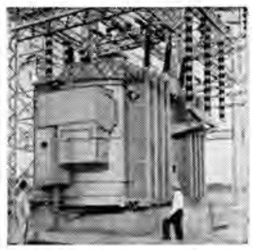
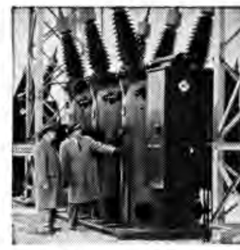
...where you can design, build, research or sell products like these

...and grow with 3 growth industries

POWER EQUIPMENT

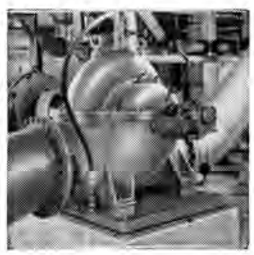

Steam Turbines


Transformers of all Types


Circuit Breakers

CONSTRUCTION


Road Building Equipment


Pumps, Blowers


Cement-Making Equipment

MANUFACTURING


Motors


Control


V-Belt Drives

Opportunities in these fields

Thermodynamics
Acoustics
System Analysis (Electrical and Mechanical)
Stress Analysis
Hydraulics
Electronics
Process Engineering
Mechanical Design
Structural Design
Metallurgy
Nucleonics
High Voltage Phenomenon
Analog and Digital Computers
Fluid Dynamics
Basic Research

You can grow faster in a company that supplies the basic needs of growth! Power, construction and manufacturing *must* grow to supply the needs of our population which is increasing at the rate of 50,000 per week. Allis-Chalmers is a major supplier of equipment in these basic industries.

But there's another factor of equal importance: Allis-Chalmers Graduate Training Course offers unusual opportunities for the young engineer to:

- Find the type of work he likes best
- Develop engineering skill
- Choose from a wide range of career possibilities

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

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

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

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

ALLIS-CHALMERS A-C ALLIS-CHALMERS 5196

SHAMROCK SEZ

VERILY EVEN AS IT HATH BEEN SAID—

THOU SHALT NOT SWEAT IT.

How General Electric stacks up on your job check list

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

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

• **OPPORTUNITIES FOR ADVANCEMENT**—Through the Company's Personnel Registers, and individual appraisal of your qualifications and preferences, you are considered for all new or related jobs and promotions throughout the Company.

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

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

• **JOB LOCATION**—There are opportunities for you as a G-E engineer in 150 cities in 45 states, plus many foreign countries.

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

• **TRAINED COLLEAGUES**—As a G-E engineer, you may be working with outstanding men who are responsible for the envisioning, production, and distribution of such new products as man-made diamonds, high-speed rocket and jet engines, the new heat pump, commercial atomic power reactors and electronic ovens.

• **EMPLOYEE BENEFITS**—General Electric's outstanding benefit program for you and your family includes all the usual life, accident and illness insurance and pension plans, plus a Savings and Stock Bonus Plan and discounts on G-E home appliances.

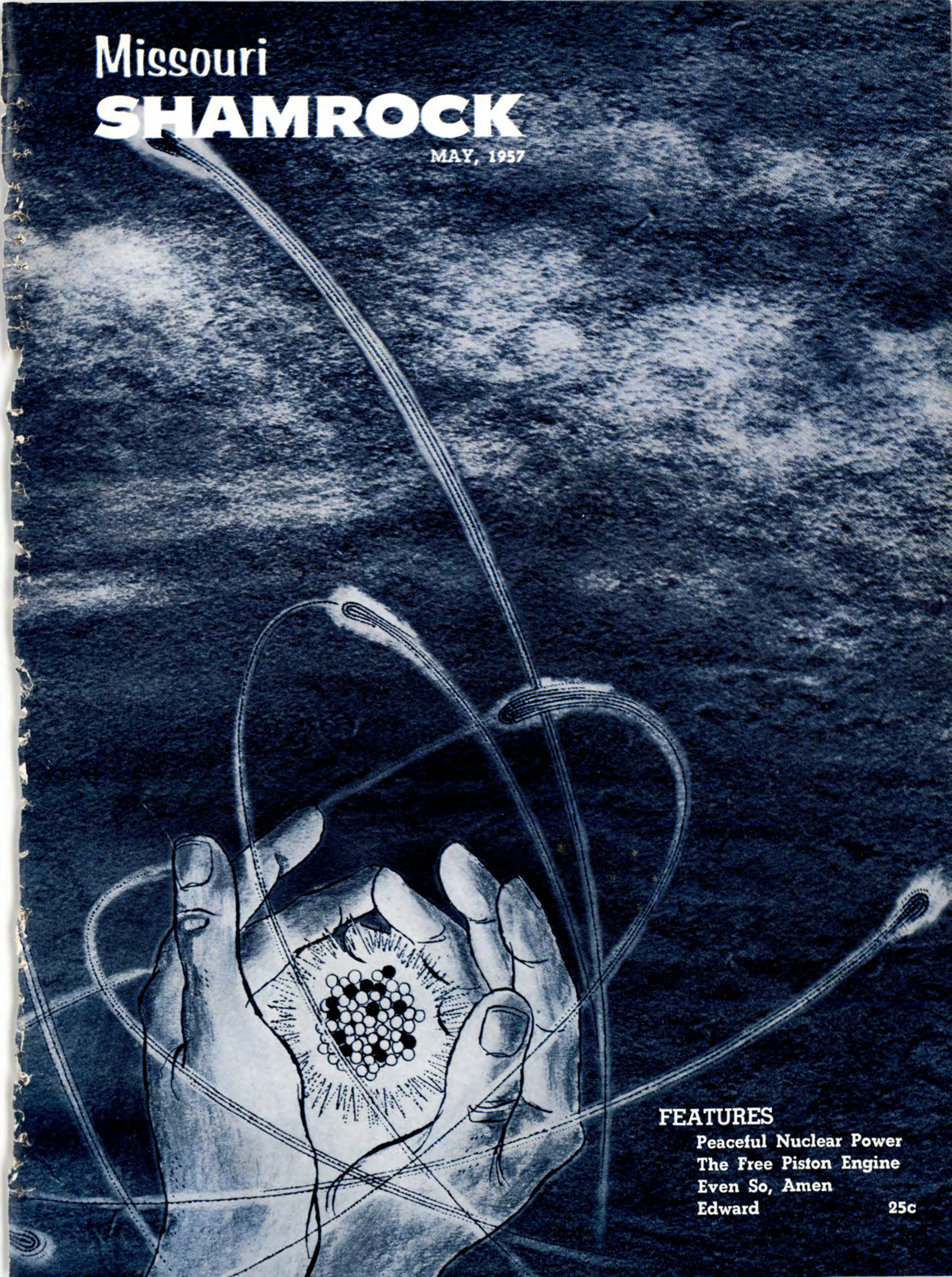
• **THE COMPANY'S FUTURE**—General Electric's investment in research can mean much to you. Forty-two major Company laboratories, dedicated to invention and innovation, will play a major role in doubling the Company's sales during the next eight years. Only through research is a company assured of future growth. For you, this growth at General Electric means new and challenging technical and managerial positions. General Electric Company, Section 959-3, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Missouri SHAMROCK

MAY, 1957



FEATURES

25c

Harry M. Crooks, class of '49, speaks from experience when he says:

"At U. S. Steel there is a wide and varied choice of opportunities offered, under the most agreeable working conditions."

THE RAPID RISE of Harry M. Crooks to his present responsible position is typical of that experienced by many hundreds of college graduates who have joined forces with U. S. Steel.

Presently Assistant Superintendent of the Power and Fuel Department, National Works, National Tube Division of United States Steel, Harry M. Crooks graduated in January, 1949 with a BS degree in Mechanical Engineering, after serving three years in the U. S. Navy. He started with U. S. Steel on February 1 as a student engineer. Within a year-and-a-half he was made Process Engineer in the Power and Fuel Department, and ten months after that, Power Engineer.

After three years as Power Engineer, he was promoted on March 1, 1954 to his present job as Assistant Superintendent, with a wide range of responsibilities, including all power and fuel utilities throughout the large National Works plant. This position includes supervision of mill and furnace air supplies for the steelmaking process, steam and mixed gases for power, and open hearth oil and tar. In carrying out this work, he supervises a force of 250 men.

Mr. Crooks decided to work at U. S. Steel because he felt that U. S. Steel had one of the finest training programs available in industry today. During his training, he arrived at the personal conclusion that, being an engineer, his best opportunities were in the operating branch of the steel industry.

Quoting Mr. Crooks: "Through the training received at the mill, the engineer has the opportunity to work in and become acquainted with every phase of steelmaking and with every department of the plant."

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

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ON THE COVER

For nearly twenty-five centuries, the atom has intrigued the world's greatest philosophers and scientists. Many have sensed that within the atom a powerful force is held captive, and have searched for ways to free this energy so that it could be harnessed to serve useful purposes for mankind. In the complex uranium atom, the answer was finally found. It took many years and many minds to make atomic energy a reality.

Today, we look to the atom for a multitude of far-reaching developments. It promises us a longer and healthier life . . . more abundant food . . . a new source of heat and power . . . and a better understanding of the world in which we live.

Furnished through the courtesy of THE UNION CARBON and CARBIDE CORPORATION.

←

MISSOURI SHAMROCK

VOL. XXIII MAY, 1957 No. 8

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FEATURES:

DEPARTMENTS:

MEMBER
ENGINEERING COLLEGE MAGAZINES
ASSOCIATED

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NICE WORK ON A HOT SUMMER DAY

THE temperature at altitudes of 36,000 feet and above goes far below zero, so it's standard procedure to demonstrate the starting capabilities of modern jet aircraft engines in a man-made "climate" of a brisk minus 67°F.

At Allison, demonstration tests are run periodically on both military and commercial aircraft engine models in cold weather tanks like the one shown above.

And, how do they get the tank's inside temperature down to the required 67° below zero? Here is one way Allison engineers do it. Outside air is cooled first with air-to-water heat exchangers. Then, a mechanical refrigeration system takes the air temperature to below zero. For the third step, the cold air is run through a turbine section of an Allison T-38 engine. As the gas expands, it comes out at about a minus 130°F. There is some warming as the air is piped to the cold tank, but usually, warm air has to be added to bring the tank temperature UP to a minus 67° Fahrenheit!

Fuel and oil tanks are located inside the test chamber, and they—with the engine—are permitted to "soak" in the frigid temperature before firing up. Tests of 72 hours "soak" duration have been made on Allison Prop-jet engines. Of course, the front opening is clamped shut for the test, and performance is checked by remote controls. But, occasionally, it's necessary for an engineer to "bundle up" and go inside the cell. It's nice summer work.

★ ★ ★

Allison now is in the midst of an engineering expansion and development program representing an expenditure of $75 million. Completion of the program will make the Allison engineering Research and Development Center one of the most complete in the world . . . an ideal place to apply your academic training. Write for information about your future career at Allison: Personnel Dept., College Relations, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

How does a chemist happen?

"New ideas," Henry Thoreau wrote, "come into the world . . . with a flash and an explosion and perhaps somebody's castle roof perforated." Many a budding young chemist has introduced his parents to chemistry in similar fashion. But the real making of a chemist takes place in quiet, unspectacular little ways.

There is the challenge of a teacher who asks two new questions for every one he answers.

There is the mental sweat and labor of working out a quantitative analysis—and the glowing pride of being *right,* to the fourth decimal place.

There is the romance of chemistry written wordlessly in the twinkle of an aging professor's eye.

There is memorizing and mixing . . . calculating and titrating and cramming. Hour upon unending hour of them.

But the hours, the days, the years of work and study silently dissolve in that magic moment when a new idea strikes . . . in that moment when all that *has* been done is forgotten, when all that seems important is to learn if this new thing that has never been done, *can* be done.

In that fleeting moment, the student becomes a scientist and begins for the first time to use chemistry to help people gain a little more comfort, a little extra convenience, a little better health.

It is many such moments that make a career in the chemical industry exciting, challenging, and very, very satisfying. Write for a copy of our booklet which shows how you can achieve this type of satisfaction at Koppers. Koppers Company, Inc., Pittsburgh 19, Pennsylvania.

KOPPERS ®

KOPPERS CHEMICALS

Questions students ask Du Pont

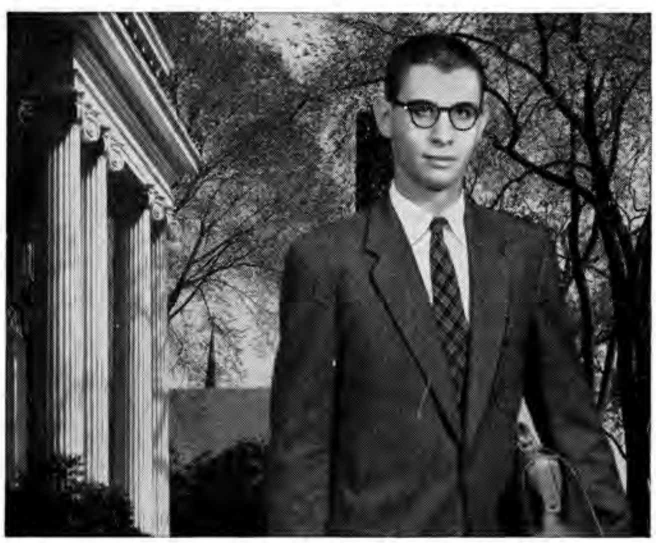
—and some of the answers in summary form

"Do you hire men who have definite military commitments?" asks Oran A. Ritter, Jr., of Louisiana State University.

Yes, because Du Pont has always been interested in men on a long-term basis. Du Pont has employed many graduates with military commitments even though they were due to report for duty a few weeks after joining the Company.

"Would a graduate degree help my chances for advancement at Du Pont?" asks John C. Nettleton, of Villanova University.

Many factors are involved, and an advanced degree would undoubtedly have a favorable effect in all technical work, but it would probably be of more direct benefit in research or development at Du Pont than in production, marketing or sales.



"Where would I work for Du Pont?" asks Gaylord E. Moss, of Tufts College.

Du Pont has more than 140 plants and research and development laboratories scattered through 26 states. If you have a definite preference, and Du Pont has an opening there for which you're qualified, your chances of getting it are good.

"How are chances for advancement in a large company like Du Pont?" asks Herschel H. Loomis, Jr., Cornell University.

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We can give only brief answers to these questions in this space. But we'll be glad to answer them more fully, and to try to answer other questions you may have that bear more directly on your own future. Why not write us today? Address: The Du Pont Company, 2507C Nemours Building, Wilmington 98, Delaware.

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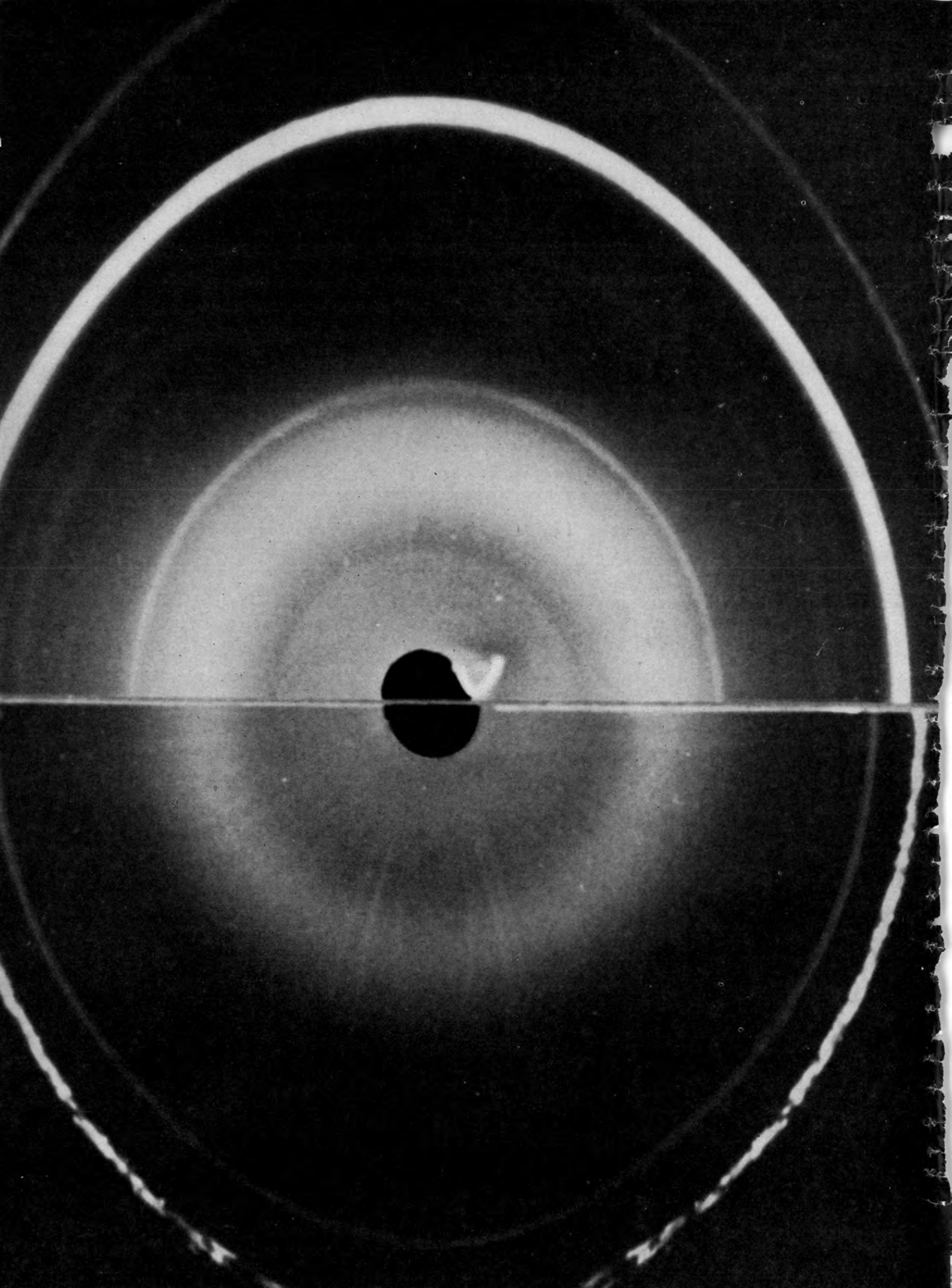


Editorial

ARE YOUR GOALS HIGH ENOUGH?

Probably most of us who are graduating have no "concrete" goals in mind as we leave the shelter of college life. We must, however, decide whether we will be content with "just a job" or will strive for advancement and personal improvement.

The problem of advancement is often shrugged aside with the comment "There isn't room for all at the top." Indeed, there is only room for those who show they are worthy of trust. How well small tasks are done in the early years of our career determines whether we will even have an opportunity to show that we are capable of greater things. By tackling whatever duties we may be assigned with perseverance and by meeting new challenges with determination, we will indicate our ability to assume new responsibilities. As it is so well put in the old proverb—**Whatsoever be worth doing, is worth doing well.**

Our rapidly advancing technology is ever expanding the boundaries of knowledge. The engineer must keep abreast of this advancement if he is to succeed. This means taking an active interest in professional societies, their journals and technical periodicals.

Indeed, our college education must be only a springboard. Advancement depends not only upon ambition, initiative, and hard work, but also on growth in professional stature and keeping abreast of current developments. The choice is yours—to be **mediocre** or **successful.**

M.L.C.

FRONTISPIECE—

THE BIG EYE—General Electric Research Laboratory x-ray diffraction pattern shows spacing of boron and nitrogen atoms in borazon (cubic boron nitride).

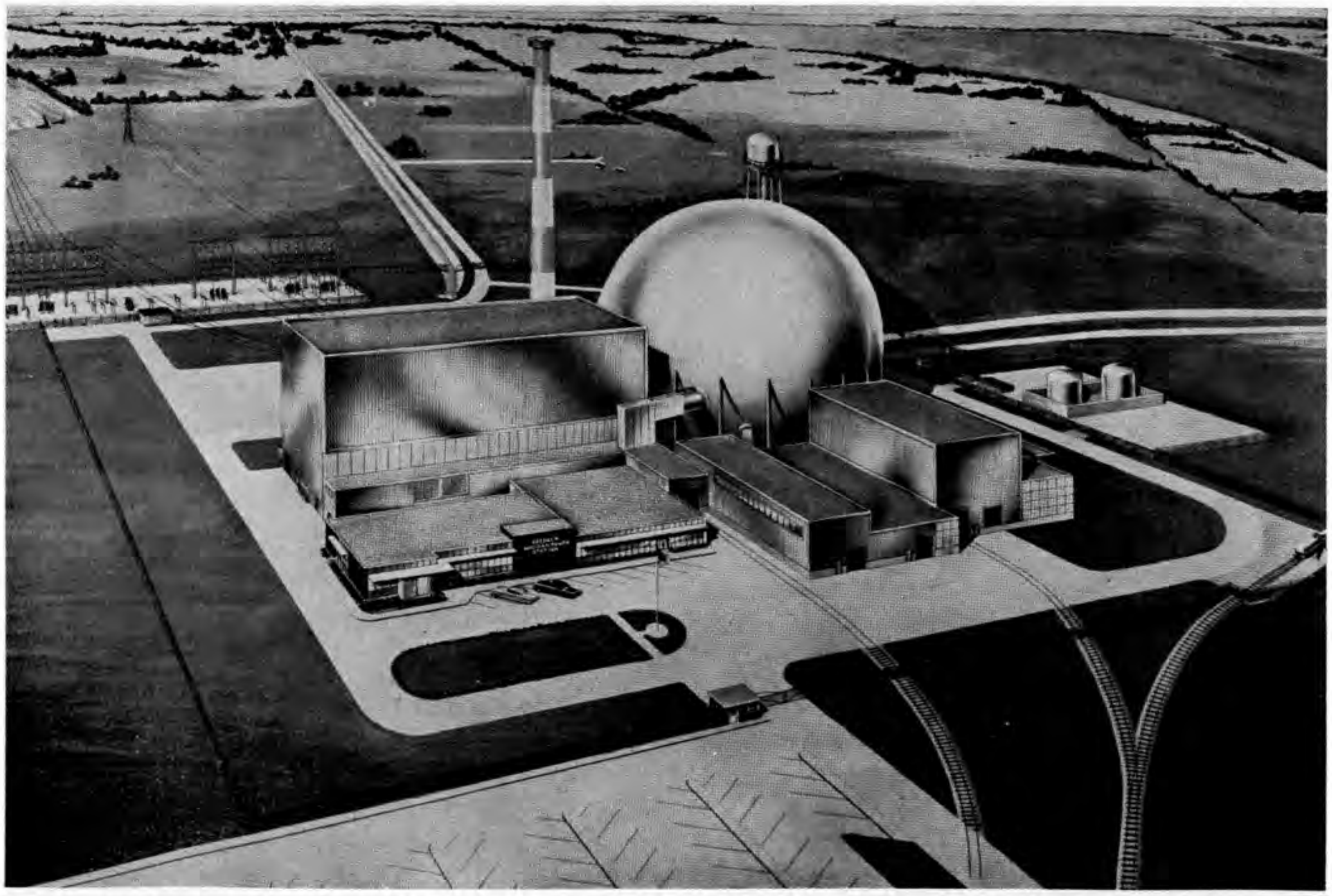
POWER FROM THE ATOM

The Dresden Nuclear Power Station represents one of the several schemes proposed for making the atom work for you and me. It may be near a reality.

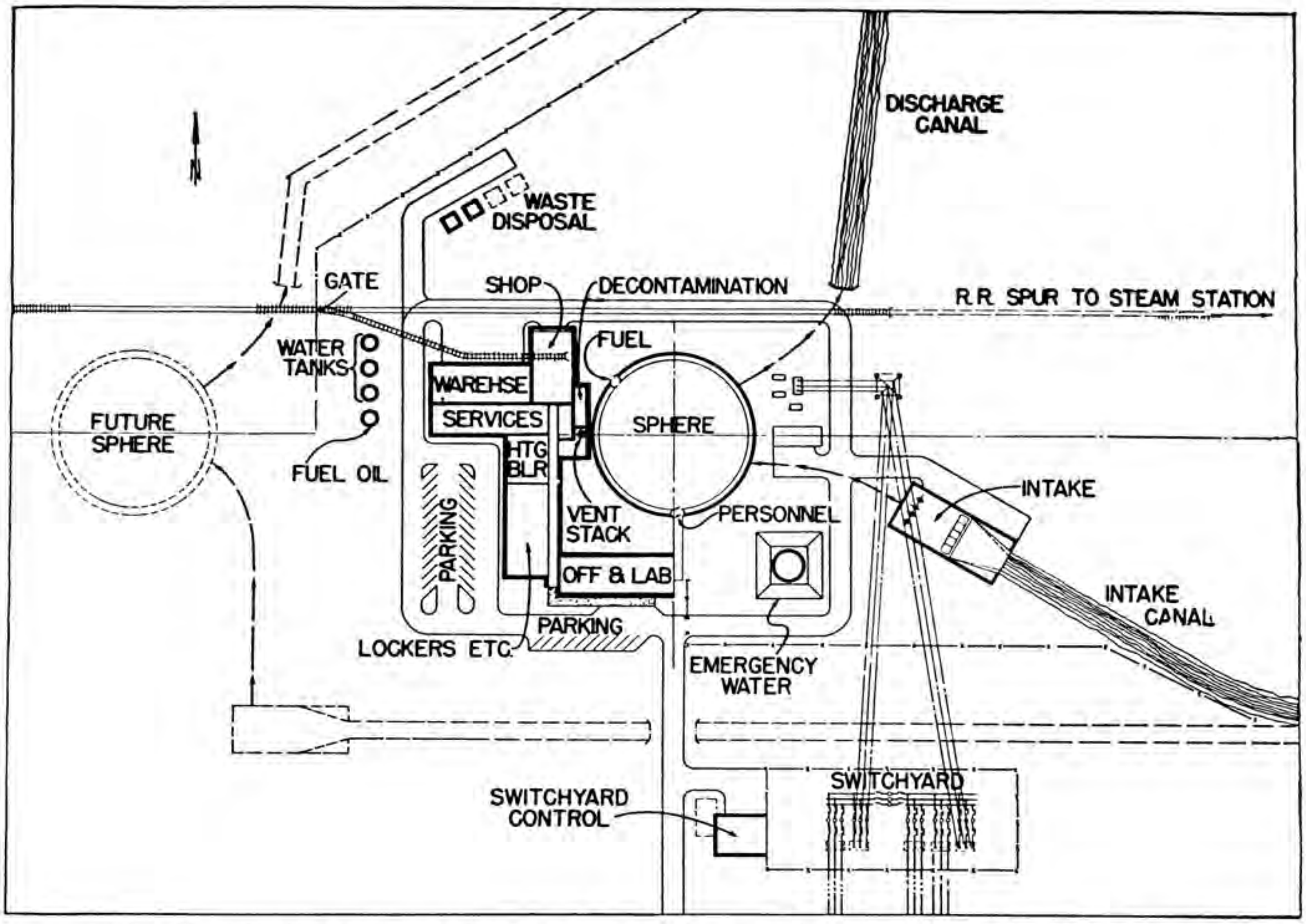
M. L. CRENSHAW, E.E. '57

Introduction

Construction on the largest all-nuclear power plant yet planned was scheduled to have begun this spring and be in service by 1960. The site for the 180,000 kilo-watt station is a relatively unpopulated area some 50 miles from Chicago just west of the junction of the Des Plaines and Kankakee Rivers. It will be financed entirely by private enterprise. The entire plant is being designed and built by the General Electric Company at a contract cost of 45 million dollars. It will be owned and operated by the Commonwealth Edison Company who is capitalizing some 30 million dollars of the cost. The Nuclear Power Group is supplying the remaining 15 million dollars as a research and development expense in return for design and operation know-how. Included in this group are the following companies: American Gas and Electric, Bechted Corporation, Central Illinois Light Company, Commonwealth Edison Company, Illinois Power Company, Kansas City Power and Light Company, Pacific Gas and Electric Company, and Union Electric Company of Missouri.



Artist's conception of the 180 million watt Dresden Nuclear Power Station to be built near Chicago.



GENERAL LAYOUT OF DRESDEN Nuclear Power Station with provisions for future expansion

The Dresden Station

An artist's conception of the completed facility indicates the compact nature of the design. The general layout plan shows the proposed details and provisions for future expansion. It differs basically from a conventional steam power plant only in that the energy of nuclear fission supplies the heat necessary to produce the steam. This steam is used to power a turbo-generator and produce electrical energy. While its basic principles are similar to conventional plants, many features require special attention and modification.

The Dual Cycle Boiling Water

The direct boiling cycle was pioneered by the Argonne National Laboratory of AEC. Steam is generated in the reactor container and sent directly to the turbine. This cycle has a single loop with no heat exchangers. It provides good thermal efficiency in the reactor with capital-saving simplicity.

The dual cycle approach is a modification of this direct cycle, providing improved power output and faster response to load demand. This approach allows the removal of as much energy as possible by boiling in the upper part of the reactor without exceeding the limit of reactivity for good stability. The steam-water mixture from the reactor goes to the primary separating drum. The steam, at essentially the reactor pressure, flows directly to the high-pressure section of the turbine. The saturated water flows through the secondary steam generator, a heat exchanger where some energy is removed to produce steam at a somewhat lower pressure. This secondary steam is admitted to a lower stage of the turbine. The fraction of energy removed at the heat exchangers serves to control the temperature of the water returned to the reactor.

The effect of admitting cooled water at the reactor inlet is to delay the point of boiling in the reactor cooling channels. At full load, with equal steam flow from the primary and secondary steam drums, boiling occurs at about the midpoint of the cooling channels. Thus, with this technique, additional heat may be removed from a reactor of a given size.

Another very desirable feature of the dual cycle is its self-regulating feature. At low load the amount of steam generated in the external secondary steam generator is small,

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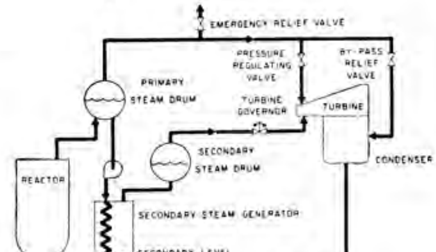

Figure 1
Simplified flow diagram.

DRESDEN

(*Continued from page* 11)

hence, hot water enters the reactor inlet. Boiling begins in the lower part of the reactor and less steam can be produced. At high load the amount of external steam generation is great, hence, cooler water enters the reactor inlet. Boiling now occurs only in the upper part of the reactor and much more heat may be released. The self-regulation feature of the dual cycle does not, however, eliminate the necessity for a control rod system. Control rods are necessary to provide regulation during start-up or shutdown, emergency shutdown, controlling neutron flux, and to compensate for burn-up and fission product poisoning.

The pressure in the reactor is held constant by the turbine regulating valve which regulates the primary steam rate. Load changes are met by actuation of the secondary admission valves by the turbine governor. Response to load changes is good.

A simplified flow diagram is shown in Figure 1.

The Reactor Plant

A perspective view of the reactor plant is shown in Figure 2. This illustration shows the main equipment and piping in skeleton form with the biological shielding.

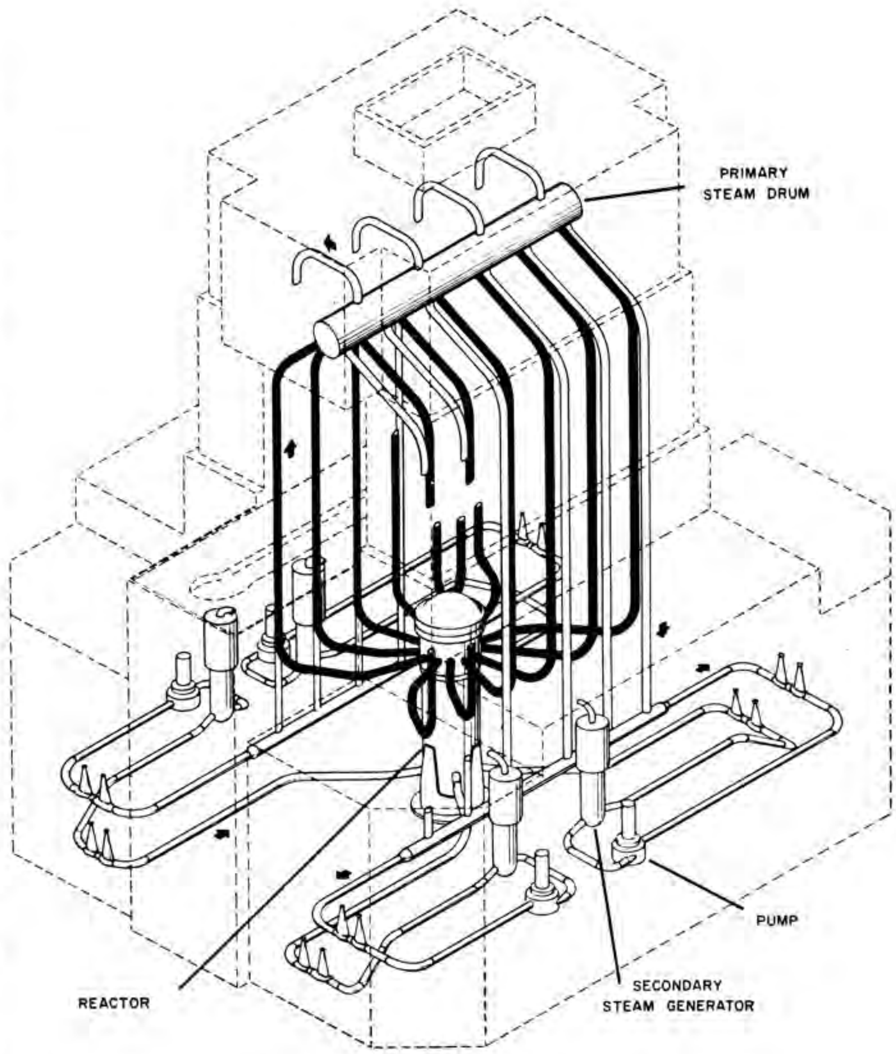

Figure 2
Perspective view of the reactor package.

The reactor is shown in Figure 3. The pressure vessel, some 40 feet long and 13 feet in diameter, is provided with a removable top to provide access to the core for fuel handling. It has 5¼ inch thick walls, lined with ¼ inch thick lining of stainless steel. Its total weight is some 350 tons.

The reactor core is a honeycomb structure of square Zircaloy-2 channels 3¾ inches on a side. Standard channels contain 25 fuel rods of ½ inch diameter, arranged in a square lattice. Control rod bearing channels contain 16 fuel rods with 9 rods being displaced by the poison type control rod. The core is about 10 feet in diameter and 10 feet long. The total heat output of the core is 627 megawatts.

The basic fuel is slightly enriched uranium dioxide fabricated as a sintered solid in the form of a cylindrical pellet. A series of these pellets are encased in a Zircaloy-2 tubular jacket to form a rod. A total of some 17,000 rods weighing a total of 60 tons is required.

The control rod system consists of 90 rods located in an 8-foot diameter cylinder centered in the core. The control rod poison is a cadmium-silver alloy clad in a stainless steel jacket. They are normally controlled by a mechanical system which allows only one rod at a time to be manipulated. Scram or emergency shutdown is accomplished by a hydraulic system which simultaneously inserts all rods in 1.5 seconds.

The primary steam drum is 8½ feet in diameter and 60 feet long, providing some 1700 cubic feet of water storage volume. It serves the dual role of reservoir and separating device. The primary steam pres-

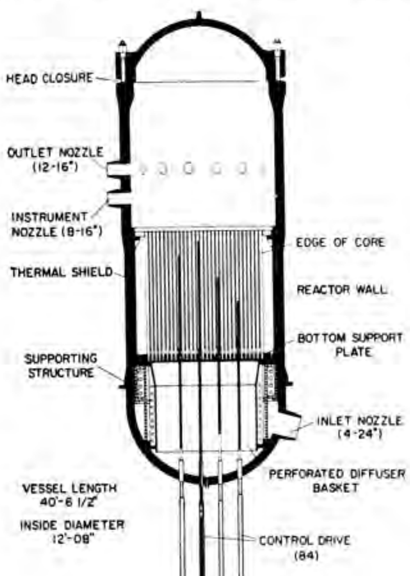

Figure 3
The reactor longitudinal section.

sure is 1000 psig.

The four secondary steam generators are housed in individual shielded compartments, allowing maintenances to be performed without plant shutdown. They generate steam at 500 psig. The recirculating pump associated with each secondary steam generator is located in the same shielded compartment. They are of the "canned type" to prevent water damage to the windings.

The Turbine Plant

The turbine is of conventional design. It is a three section unit on a common shaft with all three sections exhausting into a common condenser. The unit has a load control governor on the secondary admission valves and an initial pressure governor on the primary admission and by-pass valves for shunting flow around the turbine to the condenser. A sketch of the turbine-generator outline is shown by Figure 4.

Power is generated at 14,400 volts by an 1800 rpm conventional, 30 psi hydrogen-cooled generator. This unit is rated at 250,000 kva at 0.85 pf. A main power transformer of 225,000 kva steps the voltage up to 138,000 volts for integration into Commonwealth Edison's transmission system.

Control

The control room will contain the entire instrumentation and control of the plant. With such centralization, the need for personnel to enter areas which may be radioactive during operation will be minimized.

A model of the dual cycle boiling water reactor. The reactor package is shown in section view revealing interior details. The steel sphere housing the reactor is 190 feet in diameter.

Safety

The reactor and its associated equipment are to be housed in a vapor light sphere 190 feet in diameter. It is made of welded steel plate, varying from 1¼ inches thick at the top to 1⅜ inches at grade level. A test pressure of 37 psig will equal or exceed that estimated to result from the most severe reactor rupture accident that is possibly conceivable. The reactor and its primary components, the steam generator, steam drum, and recirculating pumps, will be contained in thick dense concrete shield to form the reactor package. With the possible exception of the feed-water flowing to the primary feed pumps, there will be levels of radiation throughout the entire main power loop of sufficient magnitude to require shielding. The shielding material used will be standard density concrete.

While the boiling water reactor is inherently safe (both the increase in temperature and the formation of steam bubbles decrease reactivity), two additional independent safety systems are provided. One is the control rod system already discussed. The other is a system for dumping sodium pentaborate into the reactor and so causing fission to cease. The reactor safety system serves to use emergency shutdown or "scram" of the reactor in the event of accident or improper operation. The scram signals override all other control means. Extreme reliability is desired, both from the standpoint of proper operation when required and of minimizing

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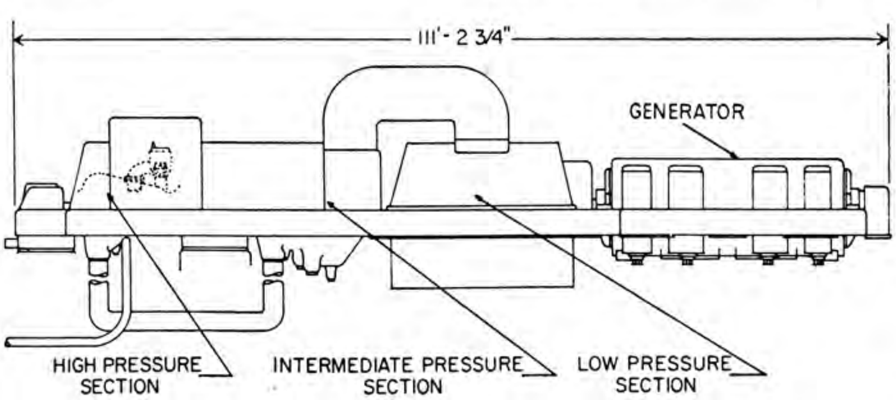


Figure 4
The Turbine-Generator.

DRESDEN

(*Continued from page 13*)

the number of spurious or needless trips.

To accomplish this, a dual system is used, each equipped with simple, rugged, dependable and fast components. Each system has similar dual sensors performing parallel functions. One of the two sensors in each system must operate to initiate a scram. The failure of any one sensor in either or both systems will not prohibit a scram, however. The failure of one system due to poor electrical connections, accidental ground, loss of power, or an open relay coil will not cause a scram operation. Automatic shutdown will occur automatically should any of the following conditions exist.

1. Power level beyond a specific excess of normal full power.
2. Failure of any component of the control system which would place the reactor in an unsafe condition.
3. Excessive rate of change of power level.
4. Failure of recirculating pumps, resulting in loss of coolant to reactor.
5. Excessive reactor pressure.
6. Loss of feed water pumps.
7. Loss of circulating water to the main condenser.
8. Low vacuum in the condenser.
9. High neutron flux.
10. Manual scram.

Economics

The estimated actual cost of power generated by the nuclear plant will be 10 mills per kilo-watt hour. Deduction of the research expense of 15 million dollars to be paid by the Nuclear Power Group, Inc. will reduce the cost to somewhere near 7.5 mills per KWH, that required by a modern conventional-type power plant.

Conclusion

The foregoing description covers the original design concept. Many of the features may be changed or modified as the design becomes more finalized in order to incorporate advancements made during the five year construction period.

Thus, the actual cost of nuclear generation is somewhat higher that could be justified in competition with conventional steam plants. The research and development costs incurred on the first full-sized plant are naturally much greater than will be those for future plants. Just how much these initial costs may be reduced by further improvements is, of course, not known. It was decided that future progress could be further advanced most rapidly by proceeding with the planning and construction at this time. In a broad sense, the Dresden Nuclear Power Station will serve as a springboard for future nuclear power plants which will undoubtedly produce electrical energy cheaper and more efficiently.

BRITAIN HARNESSES THE ATOM —FOR PEACE

M. L. CRENSHAW, E.E. '57

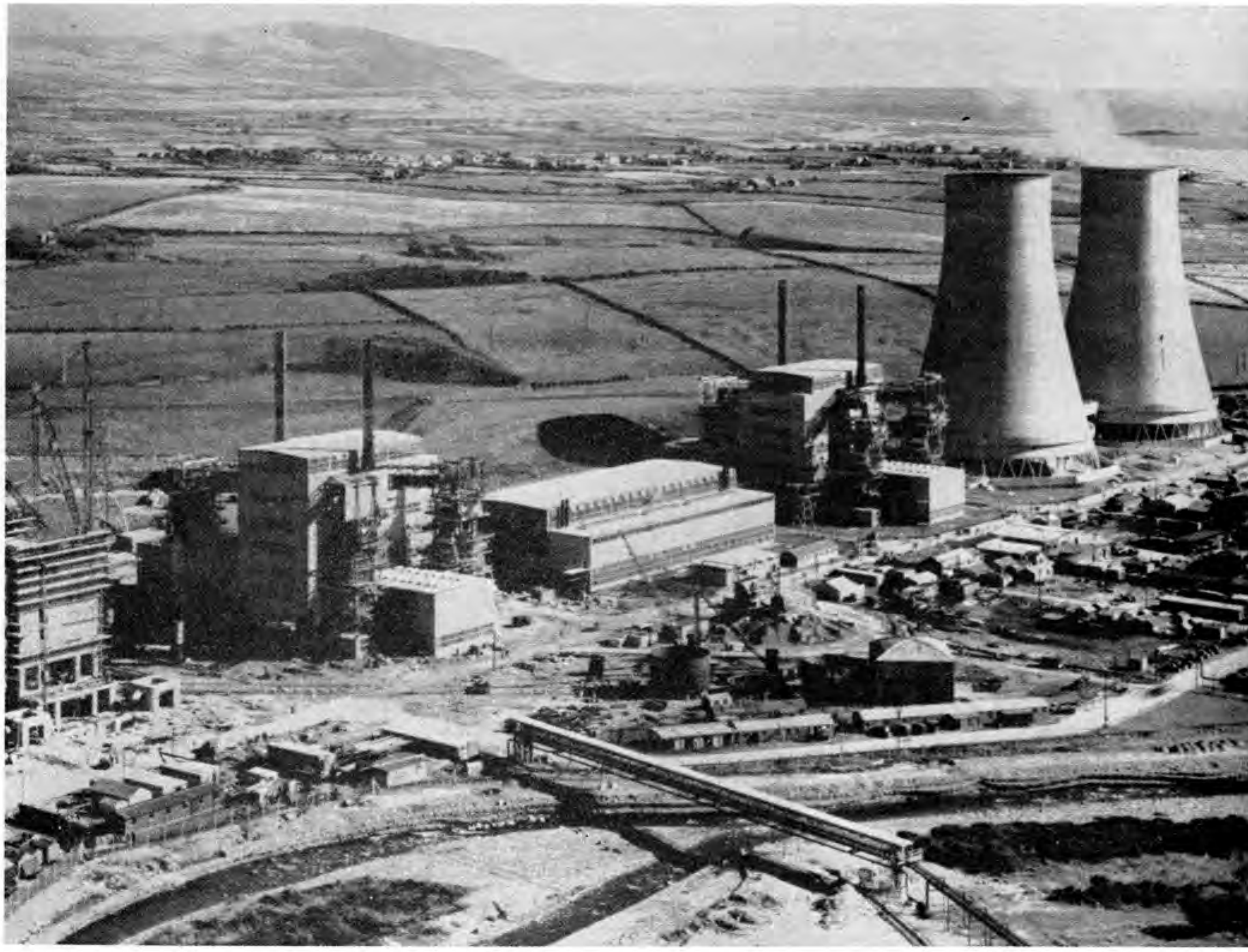
The first commercial nuclear power plant was dedicated and began operation in October of 1956. Her Majesty Queen Elizabeth II ushered in the era of peaceful atomic energy for Britain as she closed the switch on the Calder Hall Station. This project represents ten years of research by the United Kingdom Atomic Energy Authority. First organized in 1945 to explore the peace-time uses of atomic energy, the AEA reported in 1951 that power generation was possible, but not feasible, from a practical standpoint. In 1953, the increased need for plutonium for military purposes led the government to accept a plan for a combination plutonium-electric power producing plant.

The charging deck of the No. 1 reactor. Some of the control rod actuators can be seen in the foreground.

The Calder Hall project uses two gas-cooled, graphite moderated reactors. Since they are of the fast breeder reactor type, natural uranium may be used as the fuel.

Whessoe's Ltd., was chosen to construct the huge reactor vessel components. This massive structure, which surrounds the 31 by 21 foot reactor core has an internal volume of some 57,000 cubic feet. Carbon dioxide under a pressure of

The basement of the turbine hall of Calder Hall A. On the left can be seen the dump condenser used to absorb the steam not required by the turbine. On the right, the conventional condensers of the turbine plant are shown together with the massive one piece concrete base which supports one 23,000 k.w. turbo alternator set.



Britain's Calder Hall, the first large scale atomic power station, is already in use. Built in just over three years, the Calder Hall station uses atomic energy to produce electricity for homes and factories in Britain. Shown in the center are the power house and reactors (heat exchanger outside). At the far right are the cooling towers.

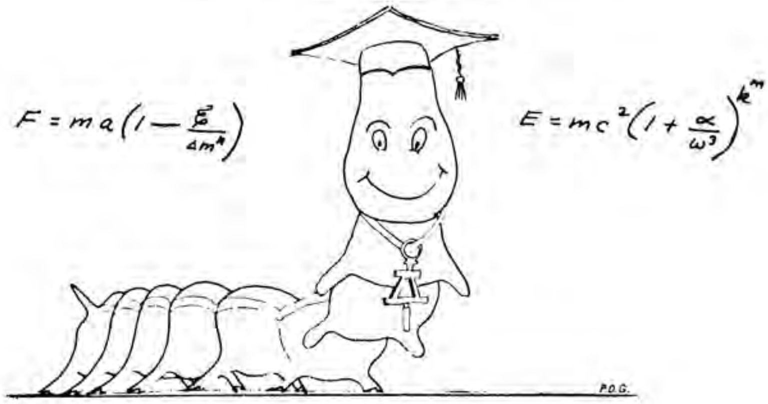
100 psi passes through the reactor where its temperature is raised by 352° F. There are four heat exchangers for each reactor, eight main blowers, and two cooling towers. The heat energy of the gas is transferred to water which is converted to steam at a temperature of 590° F and a pressure of 200 psia. The cooling system consists of two cooling towers of the split basin type. The half basin capacity is 687,500 gallons.

Power production is actually a by-product of the cooling operation. It is, however, the most significant phase of the operation. A total of 92,000 KW is generated by four 23,000-KW turbo-generators. Some 20,000 KW are used in the manufacture of plutonium, the remaining 72,000 KW is distributed for public use.

The progress to date has led to the creation of a ten-year program, with provisions for at least twelve more plants. A total generating capacity by nuclear means of two million KW is visualized by 1965.

The British do not have large scale facilities for separating U-235 from the other isotopes. One reason is that they cannot spare the coal required to produce the large amounts of electrical energy needed to operate separation plants. Thus, badly in need of additional power, they have found it desirable to use the gas-cooled graphite moderated fast breeder reactor which permits chain reactions to be sustained without the use of enriched fuel—regardless of the economics. From their point of view the nuclear power production is a necessity rather than an experiment as it is in the United States.

EDWARD



P. D. GERNHARDT, M.E. '56

In each generation there is usually one person who stands above all others by virtue of his superior accomplishments. Although it is not generally known, this is true not only of man, but also of other animals. The subject of this story belongs in the latter classification, for Edward was a caterpillar. His scientific name defies pronunciation; suffice it to say that he was one of those pretty green fellows with gray stripes along the back and a tiny spike tail.

The life of a caterpillar is not usually of particular interest to other than a dedicated student of entomology. Edward would have been no exception but for the remarkable circumstances of his early life. The locale in which he spent his first moments of life was most important. He was perched on an upper branch of an enormous oak tree which embellished the front lawn of one Professor Heet. Fifty feet beneath Edward's perch was an open window. Just inside the window was a small table with a book upon it, an abridged edition of "Grimm's Fairy Tales", mute reminder of a recent visit by one of the Professor's grandchildren.

Edward had been speculating as to the best course of action for one so recently exited from an egg; should he eat immediately or should he examine his surroundings first? Being an adventurous soul, he decided upon the latter course of action. He had just marshalled his right feet into a simultaneous forward step when the great event of his life occurred. A sudden gust of wind caught him in his state of unbalance and he found himself suddenly catapulted into the void.

Fifty feet isn't very far for a six footer to fall (although it may be somewhat lethal), but for a two incher it is a trip to the stars and a fellow can arrive pretty hungry. Edward did. He landed right on top of a certain small table with a certain book upon it. Glancing about, he spied "Grimm's", and with no delay, set to the feast. Even at this early stage in his development, Edward was a very systematic soul; he started at the top layer (page) and ate his way across and downward. He didn't eat the outer cover, however, for it had a hard (lacquered) surface which even his potent mandibles could not penetrate.

It is impossible to say at what moment or how realization burst upon Edward. For uncounted millions of years his ancestors had crawled their merry way up and down the flora of this planet without a thought to their collective credit and now here was Edward with a vocabulary of three thousand, two hundred and sixty-eight words (and a stomach ache). He was very tired. It isn't every day that a caterpillar consumes two hundred and thirty-six pages of John Gutenberg's gift to mankind. So he fell asleep. Sound asleep.

When Edward awoke, he heard a rumbling sound. After careful investigation he determined that it was his stomach. He was hungry again (caterpillars have voluminous appetites). "Grimm's" was but an empty shell so he decided to search the great world beyond for nourishment. Edward didn't know this, but while he had been mastering the word "quickly" in "Grimm's" the old Professor had slowly replaced the book in its accustomed place in his library.

Edward began stepping out of the carcass of "Grimm's". Just as the fantail was clearing his eye chanced upon a handsome meal entitled "The Critique of Pure Reason". He ate about a hundred pages before he had to admit defeat. Philosophy wasn't his dish. Next on the menu was a leafy appearing (green cover) little morsel entitled "Elements of Calculus". Edward was intrigued by the summaries of Algebra, Trigonometry and Analytical Geometry contained in the first chapter but he became positively entranced when his digestive system encountered "delta y" over "delta x". He concluded his first meal with the Transcendental functions and in one more sitting had consumed the entire text. He had a special liking for infinitesimals, perhaps because of his own rather minute stature. He also found imaginary numbers somewhat to his liking.

In the ensuing days, Edward absorbed sixty-four volumes representing a goodly portion of the knowledge of man. He leaned rather heavily toward the mathematical sciences, though he did delve into Zoology sufficient to determine that he was a caterpillar incapable of reasoning. This was rather discouraging to him until he reasoned that he must be a mutant caterpillar (capable of reasoning).

Edward had not confined himself entirely to his erudite meals. He had also been observing the activities about him, and particularly the activities of the enormous human bipeds who occasionally came crashing into the room, emitting ear shattering roars. They held a fatal (or nearly so, as it turned out) fascination for him. He had to establish contact with them! By careful observation he was able to determine that the table on the far side of the room had upon it a Bausch and Lomb microscope ("College Physics", page 238 and quite tasty) which was often used by his most frequent human visitor. Edward reasoned that if he could get over there and position himself under the lenses he would at least establish an illusion of equality with the tremendous human. Thus, it was that one morning Professor Heet went over to his microscope, started to place a slide in it, but decided first to examine the lenses to make sure they were clean. The slide had taken Edward (singular) quite by surprise and very nearly transformed him into Edward (plural) before he had the presence of mind to scramble up and grasp the lower eyepiece of the microscope.

When the Professor looked into the piece he absent-mindedly noted that there was a caterpillar with a badly frightened expression looking back at him. Just as he was about to sweep the insect away it occurred to him that he had never before seen a caterpillar, or any other insect, for that matter, with a badly frightened expression! He closed one eye and with the other stared into the microscope in much the same manner as Balboa must have had when he first sighted the Pacific Ocean.

The sight which confronted him was fantastic; unbelievable; for this tiny insect was counting! It swayed its body, then paused; it swayed its body twice and then paused; it continued this process to the count of twenty and then smiled through the microscope.

Professor Heet was not a drinking man. Nor was he subject to hallucinations. He didn't even smoke. It was apparent to him that this was a most unusual creature. He lifted it gently and placed it in the palm of his hand. He was rewarded for this effort by a stately pirouette on the part of the insect. It was the beginning of a friendship unto death.

In the succeeding weeks, Professor Heet and Edward became well acquainted. The Professor was continually amazed at the high degree of intelligence that Edward possessed. He devoted his every effort to the development of devices which would make Edward's abilities available to man. In this, he occasionally found it necessary to enlist the aid of his friends at the University. Professor Oom of the Electrical Engineering Department made the greatest contribution, for he developed a tiny sound amplifier which made it possible for Edward to carry on a squeaky form of conversation with his human colleagues. In one respect only did Edward remain a primitive insect; he took his daily rest in a potted nasturtium which the Professor transplanted from the garden.

Finally the day arrived when Professor Heet felt that he had done all that he could for Edward. He decided to take him to the college of engineering and formally introduce him to the Dean.

The Dean was typical of the species. His major eccentricity was in the apparel with which he attempted to give his rather obsolete body an appearance of modernity. A new student had described the Dean quite well when he asked, "Who's the English butler?" In order to properly complement his attire, the Dean had developed a very dignified pose in his office; he habitually leaned back in his swivel chair and propped his feet upon his desk. It was in this pose that Professor Heet found the Dean when he arrived with Edward.

Unfortunately, Professor Heet sometimes acted rather hastily. He did on this occasion. Without any warning, he placed Edward on the Dean's desk. Edward spoke. The Dean fell backwards wildly clawing the air. His hand grasped the small aquarium which he kept behind his desk. Edward's next words, "Excuse me", were addressed to a somewhat disheveled Dean, struggling aimlessly on the floor amidst a group of forlorn fish.

After the Dean had recovered his aplomb, he considered the phenomenon. He decided to determine the exact extent of this insect's erudition. Professor Danyelz of the Psychology Department was enlisted in this project. After eight hours with Edward he emerged to proudly announce that the insect had assigned him an I.Q. of one hundred and fifty-eight! When queried as to the insect's I.Q. he could only mumble indistinctly about the impossibility of testing a mind in the two hundred to three hundred range.

The Dean, despite his eccentricities, was a brilliant and imaginative man. He saw in Edward a solution to a pressing problem. A few weeks

(*Continued on page* 38)

Winning Tau Beta Pi Essay

EVEN SO, AMEN

ROGER E. GARRETT, Ag. E. '57

Breathes there the man with soul so dead who never to himself hath said:* "Someday I'll get even"?

There are various ways of getting even and each has its own merits. For the man who is a little behind the Joneses, the desire to "get even" is understandable. For the man who owes a debt, it is desirable. For the man who follows the high standards of another, it is admirable. But for the man who has been wronged, it is inexcusable.

There is inherent in getting even the fact of achieving equality. In some cases it is understandable, perhaps desirable, or even admirable for a person to seek equality with his fellowmen. Society will often function more smoothly if its people have similar desires, not only in matters of clothing and cars but also in matters of politics, education and religion. Thus, it is often for the good of society that individuals desire to keep even with those who are continually forging ahead to new and better things.

Society also stands to gain from the good will created when men accept the responsibility of paying their debts, both financial and moral. But perhaps the greater gain is realized by the individual, who stands with Longfellow's "Village Blacksmith" and "looks the whole world in the face for he owes not any man." While the ability to face the multitudes of people in the world is important, what is more important is that the debt free man can face himself. For all the difficulty that comes with paying financial debts, this is easy to do when compared with the difficulty of paying moral debts. There is a great temptation to overlook injustices done to others, especially unintentional injustices. With practice, a person can become rather adept at overlooking his own unfairness to others. But he cannot look the world in the face until the debt is paid. He has an albatross hanging from his neck.* He must pay the debt. He must come up to an even standing with the one whom he has wronged.

He must come *up* to an even standing. He must not go *down*. Suppose this person were the object of another's injustice. He is now the creditor and the responsibility for payment of the debt rests with the one who incurred it. What should the creditor do? Nothing! If the debt were unintentionally incurred, then the debtor deserves the right to pay the debt. He deserves the chance to face himself and the world. He deserves the opportunity to come up to an even standing with his creditor — to get even. When the creditor seeks revenge for an incurred debt, he robs the debtor of the right to get even—to seek equality. The resulting inequality can cause only an unbalance in society which, as in any machine, causes vibrations and unnecessary stresses.

Getting even, from the standpoint of the creditor, harms not only the debtor and society but also the creditor himself. It has been said, "Revenge is sweet." Perhaps this statement is true. At least some people seem to derive pleasure from revenge. But as the effect of sugar on the body does not stop with the pleasant sensation on the tongue, neither does the effect of revenge on the revenger stop with the sweet satisfaction of getting even. When that which society calls unjust has been committed, whether intentional or not, it is the result of some action less than the ideal. The person committing the injustice has exhibited a weakness. And to seek revenge upon one who is weak is to show a similar weakness. As grass-roots philosophy would say it, "You can't get even with another unless you become as small as he is." The person who seeks revenge for an injustice not only prevents the wrongdoer from rising up to a higher level but also reduces himself to a lower level. Thus, the standard of society has been doubly reduced from what it might have been.

Only little needs to be said about the vicious circle which results from revenge. That which is considered revenge to one may be considered by the other to be a new injustice which deserves revenge. And so it goes, down and down, with each person trying to get as small as the other.

If one craves the sweetness of revenge, there is another method which reverses the circle. Remember how difficult it is to pay a moral debt? Now if a creditor settles the debt by revenge, the debtor is released from his obligation. But if the creditor, by refusing to seek revenge, sets himself up on an even higher standard, the debtor must struggle more than ever to get even so that he can face himself and the world.

Breathes there the man with soul so dead . . . Dead indeed is the soul of him who does not seek to raise himself to at least equality with his fellowmen. But more than dead is the soul of him who seeks to lower himself to match the weakness of others. His is a disease which contaminates. It threatens the life of every soul it contacts.

* "The Lay of the Last Minstrel," Sir Walter Scott.

* "The Ancient Mariner," Samuel Coleridge.

THE FREE PISTON-TURBINE

What will the car 10 or 15 years in the future be like? There are many speculations as to what may be used as a power plant. This article describes one which appears to be a good contender.

M. L. CRENSHAW, E.E. '57
C. L. KORANDO, Ch.E. '59

POWER! PERFORMANCE! ECONOMY!—the keynotes to the automobile engine of the future. What type of engine will make the dream car of tomorrow a reality?

An exciting search is going on today in which many kinds of advanced engines are being investigated and tested. From the automotive engineering standpoint power produced more simply and efficiently is the prime consideration. In these respects the gas turbine engine has many attractive features which are desirable for automotive use.

The conventional gas turbine unit is much like a small jet aircraft engine in operation. It produces large quantities of hot high pressure gas which is used to drive a power turbine which in turn supplies the motive power for the vehicle.

The "free piston" turbine engine, which currently appears even more attractive from certain standpoints, is much like the open cycle combustion gas turbine. The only basic difference is the substitution of a free piston gasifier for the rotary compressor, hammer, and compressor drive turbine. It does, however, enhance the already desirable characteristics of the turbine power unit.

The General Motors Corporation has built an experimental passenger vehicle known as the XP-500 which is powered by a free piston-turbine engine known as the "Hyperex", GMR4-4. By studying its operation and characteristics, the potentialities of this concept of automotive power may be glimpsed.

The Free Piston Engine

Since the free piston gasifier produces significantly cooler gases than the open cycle combustor, heat losses and insulation are not a great problem and the gasifier and power unit may be separated. The gasifier would be located under the hood and the power turbine and trans-

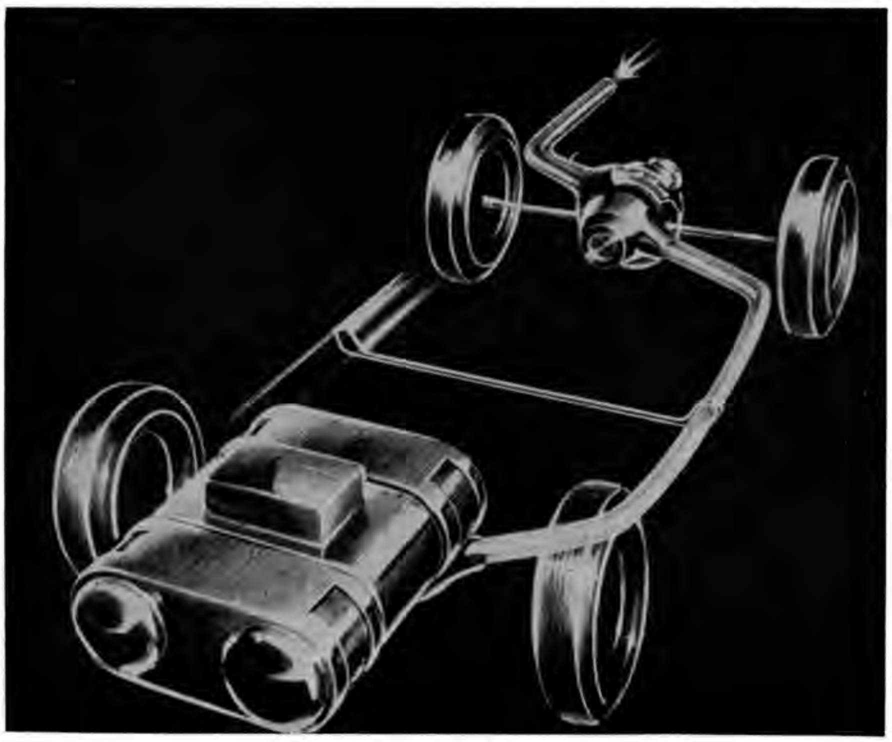


Figure 1
A drawing of the free piston-turbine engine combination.

mission would be mounted on the rear axle as indicated by Figure 1.

The operating cycle is shown by Figure 2. The engine is basically a uniflow, opposed piston, two-cycle Diesel engine. The bounce cylinders at each end may be thought of as air springs, the "rate" of which is determined by the amount of air in them. The compressor cylinders act as a super-charger and scavenger. The fuel injectors is similar to that found on the familiar reciprocating Diesel engine. A rather complicated control device determines the bounce or cushion pressure necessary for the amount of fuel being injected. The pressure determines the length of the stroke which is the critical factor in which the engine will run properly or not.

Lower Temperature

The principal advantage of the free piston gasifier over the combustor-type is the lower temperatures involved. The temperatures range from 450 to 900° F. At these temperatures, readily available materials have quite acceptable life expectancies and thus, non-critical materials may be used. This advantage cannot be over-estimated.

The great difference in temperatures is due to the fact that the free piston unit extracts the energy necessary for compression mechanically from the exhaust gases before they are run through a turbine, rather than extracting them by a turbine from hot exhaust gases as is done in the combustor unit.

(*Continued on page* 24)

Figure 2
Operating Sequence of the Free Piston Engine.

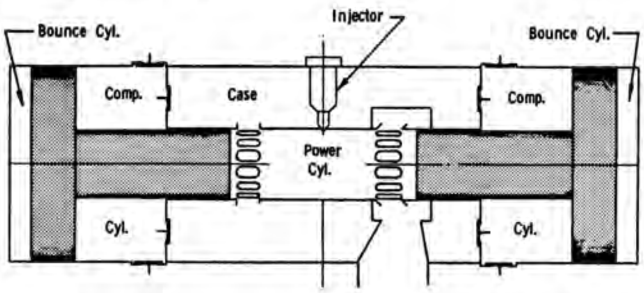


Figure 2-A
Idealized section showing pistons in starting position. Intake and exhaust ports open. All valves closed.

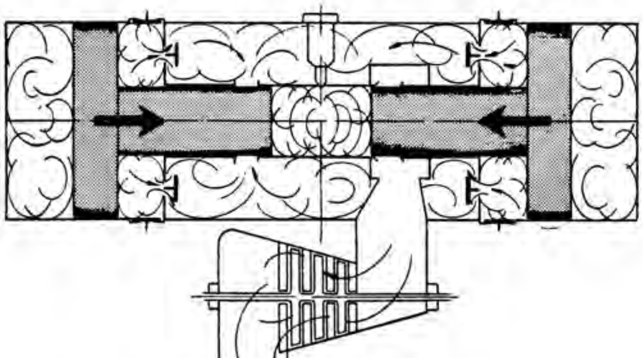


Figure 2-B
Starting air pressure admitted to bounce cylinders. Pistons move inward, closing ports, compressing air in power cylinder, and forcing scavenging air from compressor cylinder into case.

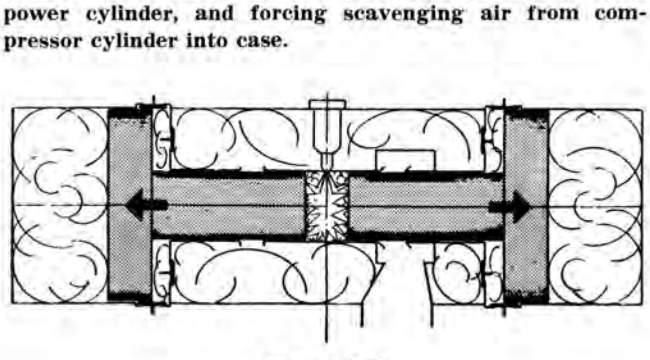


Figure 2-C
Pistons complete inward travel. Fuel is injected into power cylinder. Combustion starts and power stroke begins.

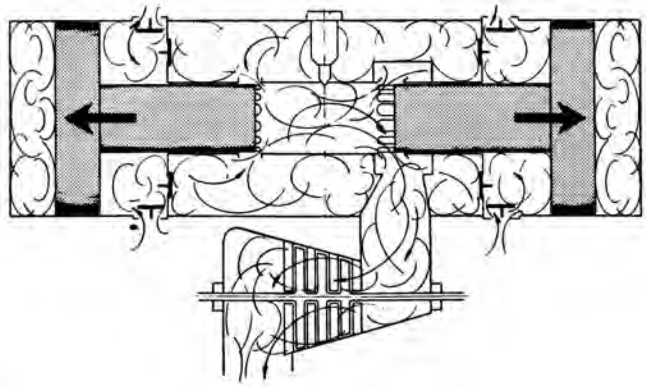


Figure 2-D
Pistons continue outward travel. Air in bounce cylinders is compressed to store energy for return stroke. Compressor intake valves open. Exhaust ports open and gas is admitted to turbine.

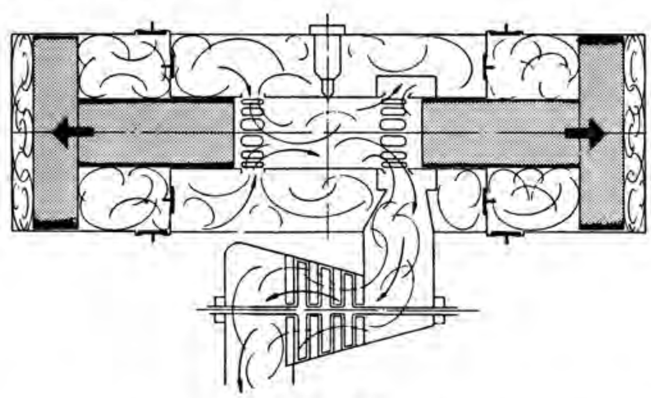


Figure 2-E
Further outward movement of pistons opens intake ports, completing power stroke. Case air scavenges power cylinder and escapes to turbine.

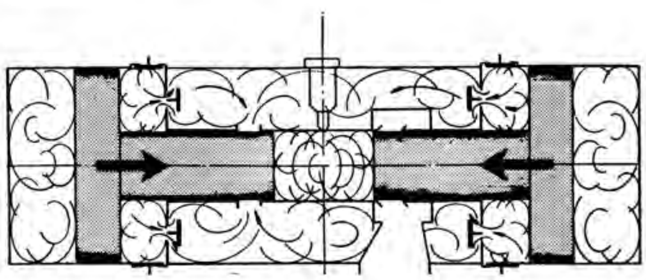


Figure 2-F
Pressure in bounce cylinder moves pistons inward, starting next cycle.

FREE PISTONS

(*Continued from page* 23)

Higher Efficiencies

The compression ratio of the free piston unit is variable from about 25.1 to about 50.1. Under the latter condition, full load, the compression pressure is probably 1200 psi while the combustion pressure is 2000 psi. As would be expected under these intense pressures and their dissociated temperatures, very complete and efficient combustion takes place. This yields over-all gasifier efficiencies of 40-45 per cent.

Economy

These conditions also give rise to relative insensitivity of the quality and character of the fuel required. It has been demonstrated that the free piston engine runs well on kerosene, No. 2 Diesel oil or Bunker "c", a special mixture. Tens of thousands of hours of satisfactory operation have been run with fuels having a sulfur content as high as 4%. The engine can operate on certain crude oil which has not been refined at all as well as 100 octane gasoline. It has even been demonstrated that the engine will run satisfactorily on such combustible materials as whale oil, peanut oil and cottonseed oil, although operation has not been long enough to determine what effects such oils would have ultimately on the operation or condition of the engine. As would be expected, the change in horsepower output is proportional to the heating value of the fuel.

It is of great importance to the supply and use of fuel in our country if this engine could be developed into practical use. The fuel specifications would undoubtedly be held to a minimum compared to the requirements of other engines.

Performance

One of the remarkable features of a free piston engine is the rapidity with which the engine can increase or decrease its output of gas and thus quickly respond to any change in throttle setting. Thus, if the engine is idling and it is necessary to quickly accelerate, power can be made readily available to the output shaft. Since the pistons in the engine must stop and start at the end of each stroke, the speed with which the free piston engine can be made to produce more gases is only dependent upon the speed controls. The response of the pistons is prompt because there is no accelerating of rotating parts over a period of time.

Deceleration is just as rapid because the engine will slow down in its production of gas directly as the fuel is reduced. In fact, if the fuel is cut off completely the engine will stop on the next stroke of its pistons.

An afterburner system, similar in function to that in a jet plane, can supply additional thrust to the turbine when acceleration and peak power are needed for short periods of time.

The gas from the engine at full load still contains about 80% of its original oxygen, at a temperature of 850° F. Additional fuel may be burned to produce instantaneously available power. Temperature increases of 250° F or more may be utilized for short periods without overheating the turbine blades.

Figure 3
The General Motor's XP-500

Smoothness

Since there is no torsional movement in a free piston engine and all of the oscillatory parts are of exactly the same weight, no net reactions occur and the smoothness of this engine is unsurpassed. This is frequently demonstrated by balancing a nickel on a horizontal machine surface while the engine is in operation. Due to this lack of torsional movement, the motor mounts are located to give proper weight support to the engine without strain from expansion and distortion of the chassis frame.

Figure 4
Free piston gasifier Unit of the XP-500

The power turbine used with the free piston gasifier enjoys the same inherent advantages as those of the dual turbine combustion cycle turbine engine. These include torque multiplication similar to an automatic transmission, ie., high stall or initial starting torque. Extreme smoothness and lack of vibration are a few of the desirable qualities.

Quietness

The exhaust noise is extremely low. The five-stage-power turbine smoothes out the power pulses from the engine making a muffler unnecessary. The exhaust gas from the turbine is discharged underneath the trunks of the car through a short single pipe.

The Idling Problem

The free piston engine will not produce less than about 25 per cent of full load. Until recently, it was necessary to discharge part of the exhaust gas to the atmosphere if it was desired to operate the power at less than the 25 per cent load. This inefficient situation resulted in an extremely poor part-load economy.

Today, a method known as "recirculation" is employed to improve the part throttle and idle efficiency. This is simply the action of bypassing part of the air in the box back to the air intake of the compressors. The effect of such recirculation is to heat up the incoming air resulting in two improvements. First, it raises the temperature of the air in the combustion chamber at part throttle and idle, thereby allowing combustion at lower compression ratio.

Secondly, it reduces the pounds of air being pumped by the engine and therefore a dump valve to the atmosphere at low loads is not required. On certain free piston engines now in use, fuel consumption at idle has been reduced to 8 per cent of full throttle fuel requirements.

Specifications

The over-all size of the free piston unit is 40 inches long, 34 inches wide and 18 inches high. It is a two-cylinder device. The power cylinders have a 4-inch bore, the compressor cylinders an 11-inch bore. The nominal stroke is 5 inches. The maximum cyclic speed is about 2,400 strokes per minute, producing 250 horsepower.

The over-all efficiency of the free piston turbine engine is the product of the thermal efficiencies of the engine itself and the mechanical efficiency of the turbine. The engine operates at a compression ratio between 30 and 50 to 1, and therefore, has extremely high thermal efficiency. The gas is generated at an efficiency up to 40-45 per cent at full load. With a turbine efficiency of 80 per cent, this gives an over-all thermal efficiency of 32-36 per cent. This makes it competitive with high compression ratio gasoline engines and diesel engines.

History

The basic free-piston design is not new. Since its inception some 30 years ago many machines have been developed and are in operation. Until recently they have been ponderous machines of 1,000 horsepower or so used in ships, locomotives and power plants. During World War II, Germany utilized free piston air compressors in her submarines. At present, a German firm markets this same type of compressor in a wide range of sizes. The current application for automotive power is a new concept of compactness and light weight.

Future Outlook

The free piston gasifier turbine drive unit is free from the need of critical materials as are necessary in the open cycle combustion gasifier. This would prove a tremendous asset should this power plant come to the production line state.

Figure 5
The XP-500, a glimpse of the Future?

Progress to date indicates that the free piston power plant is a feasible reality. How long before your auto will have such a power plant, if indeed it ever does, is very uncertain. It seems unlikely that the old familiar gasoline engine will yield its position readily.

Acknowledgment

This article is based on information contained in a paper presented at a meeting of the Society of Automotive Engineers by Mr. A. F. Underwood in June, 1956.

"And always remember, children, that the difference between a model woman and a woman model is that the former is a bare possibility, while the latter is a naked fact."

What's doing...... at Pratt & Whitney Aircraft in the field of Aerodynamics

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

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

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

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

Schlieren photographs, above and left, illustrate different phases of airflow investigation. Development of inlets, compressors and turbines requires many such studies in cascade test rigs, subsonic or supersonic wind tunnels.

Modern electronic computers accelerate both the analysis and the solution of aerodynamic problems. Some of these problems include studies of airplane performance which permit evaluation of engine-to-airframe applications.

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

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

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Extra-Curricular Engineering—

SOCIETY NEWS

DON PEPPER, Ag. E. '58

ENGINEERS' CLUB

The last regular meeting of the Engineers' Club was held May 7 in the Student Union. Since there was no important business to take up, the meeting consisted of two films on atomic energy development and The U. S. Weather Bureau's Tornado warning network.

The tentative date for the next meeting is Oct. 1, 1957. The Club also plans to sponsor a booth at the Activities Merry-Go-Round next September.

Reported by
David Snider

A.S.M.E.

The M. U. Student branch of the American Society of Mechanical Engineers had their senior inspection trip in St. Louis May 15th, 16th, and 17th.

Officers elected at the April 30th meeting for the coming year are: Bob Herman, Chairman; Dick Joslin, Vice-Chairman; Jim Schults, Secretary; and Lee Pucker, Treasurer.

Reported by
Tom Harper

ASCE

The American Society of Civil Engineers Student Chapter's calendar for April and May has certainly been a full one. The monthly meeting was held on April 15th. An interesting report on the Table Rock Dam inspection trip was given by President Endebrock. Plans were announced for a spring picnic and the annual spring banquet.

Officers elected for the coming year are: President E. R. Thompson; Vice President John Zollman, Secretary, Jim Monsees, Treasurer, Jim Reed.

Two movies furnished by the Caterpillar Tractor Company, entitled "Research" and "Road Block", were shown as the program for the evening.

Although the weather did its best to discourage the spring picnic, there were about 35 members and guests at the Airport Park Pavilion on Sunday, April 28.

Thirty-six members and guests enjoyed the buffet style dinner served at the Spring Banquet on May 10th in the Daniel Boone Hotel. Doctor Keller of the Geology Department presented an interesting program with his colored slides and discussion of his recent trip to Mexico.

Doctor Pauw and Professor Sangster presented an award to Jack Moberly as the Outstanding Civil Engineering Senior. This is to be an annual award consisting of a plaque and a one year's membership in the American Society of Civil Engineers.

This banquet was the last meeting of the year, but we hope to see all Civils at our first meeting next fall.

Reported by Jim Monsees

ASAE

The annual banquet sponsored by the Mo. Student Branch of ASAE for Agricultural Engineering Students, Faculty, and Guests was held Friday evening May 10 at Harwell Manor. President John R. Parks was Toastmaster. The invocation was offered by Prof. J. C. Wooley and Prof. M. M. Jones introduced the guests. Recipients of awards were presented by Prof D. B. Brooker. They were: John Arms and J. T. Battenburg, outstanding contributors to the local branch. Their names are engraved on a plaque displayed in the Ag. Engineering Building. Ivan Berry, outstanding sophomore award. Berry also received a $500.00 Sears Roebuck Scholarship. Roger Garrett, winner of the Tau Beta Pi Essay Contest.

Eighteen companies contributed favors and door prizes. Mr. Earl D. Anderson, President Elect of ASAE (57-58), Director Agricultural Extension of the Stran-Steel Corporation, spoke to the group on "Adapting Farm Buildings to New Trends in Agriculture".

Reported by
Glen Thompson

CHI EPSILON

Chi Epsilon held initiation for seven new members at 5:30, Thursday May 16 in the Engineering building. The new members are: Joseph William Hoffman, John Phillip Zollman, Harold L. March,

(Continued on page 30)

Newstuff

JIM WILHELM, M.E. '57

TUBE MAZE—Constant vigilance keeps this computer with its myriad tubes in operation in the General Electric Company's Accounting Services at Schenectady where payrolls for more than 30,000 area employees are computed and a special magnetized tape is run off simultaneously for the Social Security Administration.

MAGNETIZED TAPE

A roll of magnetic tape about the size of a dinner plate has replaced a 900 page report to speed the Social Security information of 30,000 General Electric Company employees.

In addition to the savings in time and material for the preparation of the Social Security records, there is also a huge saving in storage space required to keep the records. The tape is approximately 2,400 feet long and weighs about two pounds.

Running a payroll through the IBM machines for the General Electric employees takes about three and a half seconds per employee. The Social Security tape is run off simultaneously. Eventually, the time may be chopped down to two seconds or less per employee.

The master payroll data is initially written on magnetic tape from punch cards. Data fed into the computer for storage on the tape includes names, addresses, department designations and various other payroll statistics pertaining to employees.

When payrolls are prepared, the current information added to that previously fed into the computer is used to compute gross pay, deduct for such items as savings bonds, pension contributions, taxes, union dues and scores of other items, including Social Security. The net amount or take-home pay is computed and a check is prepared for the employee, all by machine. For employees who have requested that their checks be deposited in a bank, a special form is employed to show the employee his earnings, deductions and the amount deposited in the bank of his choice.

An indication of the flexibility of the payroll computing operation can be gained from the fact that it prepares bank deposits for General Electric employees using 500 different banks; calculates 12 different taxes, deducts multiples of any combination of 90 types of deductions and computes payrolls using 33 different bases.

SOCIETY NEWS

(*Cont'd from page* 28)

Jerry Franklin Jordan, John Woodlan Harrison, George Henry Geerling, and Paul Jesse Clark.

The initiation banquet was held immediately afterward in the Grill Room of the Student Union. Following the banquet there was a short business meeting and election of new officers. For the program, each initiate gave a short impromptu speech on topics selected by President Bob Farmer. Guests included members of the Civil Engineering Faculty.

Reported by
Susan Brady

PI TAU SIGMA

The following people were initiated into Pi Tau Sigma on Tuesday May 14, 1957: Jim Jackson; MoTo Davis; Bill Rice; Don Shepherd; Charles Morton.

The initiation was followed by a banquet in conjunction with ASME. On the following Thursday a picnic was held and officers for the coming year were elected.

Reported by
George Roupe

AIChE

The AIChE, in closing its year of activities, held its annual party, on May the 11, at the City Park where a good time was had by all.

The last meeting of the year will be held May 14, with the election of officers for the coming year. There will also be a technical film of interest to everyone.

The members of AIChE are looking for a bigger and better year in 1957 and 1958. We urge all Chem. Eng. who at the present do not belong to the AIChE to attend our last meeting of the year. Also, anyone else desiring to attend this or any of the meetings is always welcome.

W. H. Johnson
Sec. of AIChE

The computer is capable of running 75 inches of tape per second with approximately 200 characters of information per inch.

(*More on page* 32)

Newstuff

JIM WILHELM, M.E. '57

'MOST POWERFUL' X-RAY MACHINE TRACES ATOMIC CHANGES IN METALS

Hitherto unknown changes in the atomic arrangement of iron-aluminum alloys have been discovered through the use of the world's most powerful crystallographic x-ray machine at the Westinghouse Research Laboratories.

Valuable for their superior magnetic properties, iron-aluminum alloys may find wide application throughout the electrical industry for such apparatus as generators, transformers, circuit breakers, and similar electrical equipment.

The crystallographic x-ray machine is at least 15 times more powerful than any comparable device

now in existence. X-ray time has been reduced sharply on iron-aluminum and other alloys under investigation. This unusually high power—and the fact that the x-ray beam can be concentrated on a focal spot less than half the normal size—makes it possible to obtain an x-ray source which is 15 times more brilliant. Thus, x-ray photographs can be taken in one-fifteenth of the usual time, collapsing hours of normal work into a few minutes.

Because of its unusually brilliant x-ray source, the super-powered machine makes possible metals research that previously was considered too costly or otherwise impracticable. Especially is this true in cases where metals must be tested at high or low temperatures. X-ray photos have been taken at temperatures as low as 300 degrees below zero Fahrenheit. This conceivably could be accomplished with less powerful equipment, but it would be difficult to maintain accurate temperature control, and because of the long exposure time which would be necessary, the cost of liquid helium—the cooling agent—would be prohibitive. By reducing exposure time to one-fifteenth of that formerly required, the cost of liquid helium needed for cooling is reduced proportionately.

In addition to conducting studies at low temperatures, the Westinghouse research scientists have photographed metals in a super-heated state. X-ray "snap shots" of metals as hot as 3000 degrees Fahrenheit have been taken, making it possible to study the characteristics of the metal before it vaporizes or undergoes some chemical change at the elevated temperature.

The machine is also equipped with an adaptor which gives an x-ray beam only 400 millionths of an inch in diameter—about one-tenth the diameter of a human hair. This thin, intense beam approaches the dimensions of the tiny crystallites which make up the crystal of a metal, and permits the investigation of individual crystals with an exactness not possible with a beam of larger size.

SCIENTISTS STUDY METALS WITH SUPER-PRESSURE STEAM

Steam almost as hot as pure molten aluminum and under a pressure greater than that behind a bullet fired from a .45-calibre automatic pistol is being used by scientists at the Westinghouse Research Laboratories to push forward the design of the world's most advanced steam turbine for electric power generation.

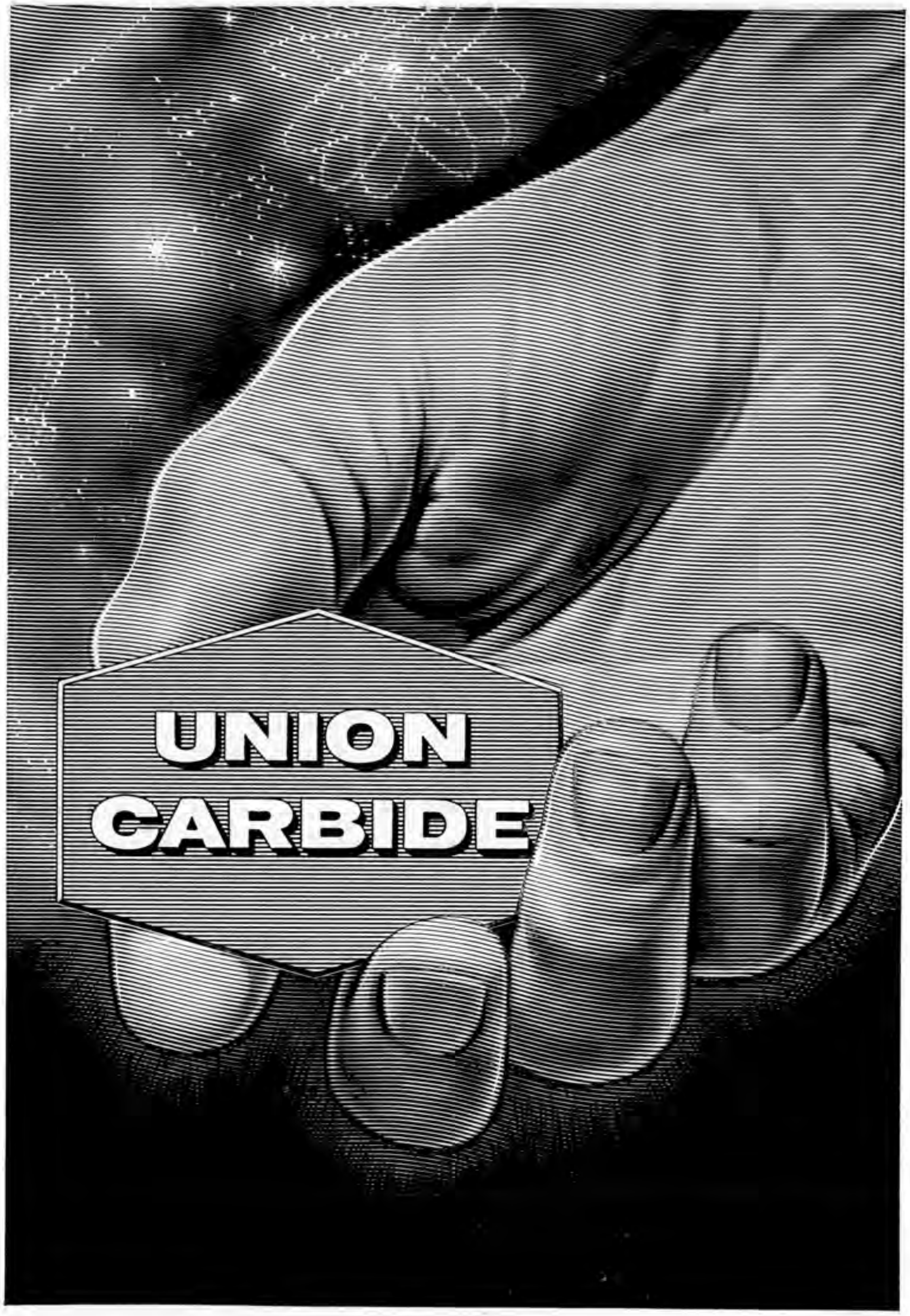
The steam—under a pressure of 16,000 pounds per square inch and at a temperature of 1200 degrees Fahrenheit—is being used to test the strength of the stainless steel casing which will "house" the supper-pressure element of the new turbine.

The turbine and the electric generator it drives will constitute a turbo-generator unit rated at 325,000 kilowatts—enough electric power to supply all the residential needs of a city of about 1,000,000 people.

The turbine portion of the new unit will have the highest operating temperature and pressure, as well as the highest efficiency, of any existing or proposed steam turbine in the world.

It will operate with a steam pressure of 5000 pounds per square inch—about twice the pressure of any present-day turbine for electric utility service. The temperature will be 1200 degrees Fahrenheit, only 20 degreés the melting point of pure aluminum.

(*More on page* 34)


UNION
CARBIDE

GLOWING 'SHELL' OF NUCLEAR REACTOR—This glowing model enables scientists at the Westinghouse Research Laboratories to study the stresses deep inside the pressure vessel, or "shell," of a full-scale nuclear reactor.

Stresses in 'Shell' of Nuclear Reactor Made Visible

Scientists at the Westinghouse Research Laboratories have found a way to see and study the complicated stresses existing deep inside the solid steel pressure vessel of a power-producing nuclear reactor.

The technique uses a model made of special plastic to make visible the stresses in full-scale pressure vessel —a large, complex steel structure which houses the core of the reactor and the inferno of its nuclear "fire."

Use of the technique will help speed pressure vessel design and "insure that this vital structure can easily withstand any design pressures it may be called upon to contain."

The pressure vessels now being studied are those for power reactors of the "pressurized water" type. In a reactor of this type, water is pumped through the pressure vessel, where it acts as moderator for the uranium fission process and also removes the vast quantities of heat the process releases.

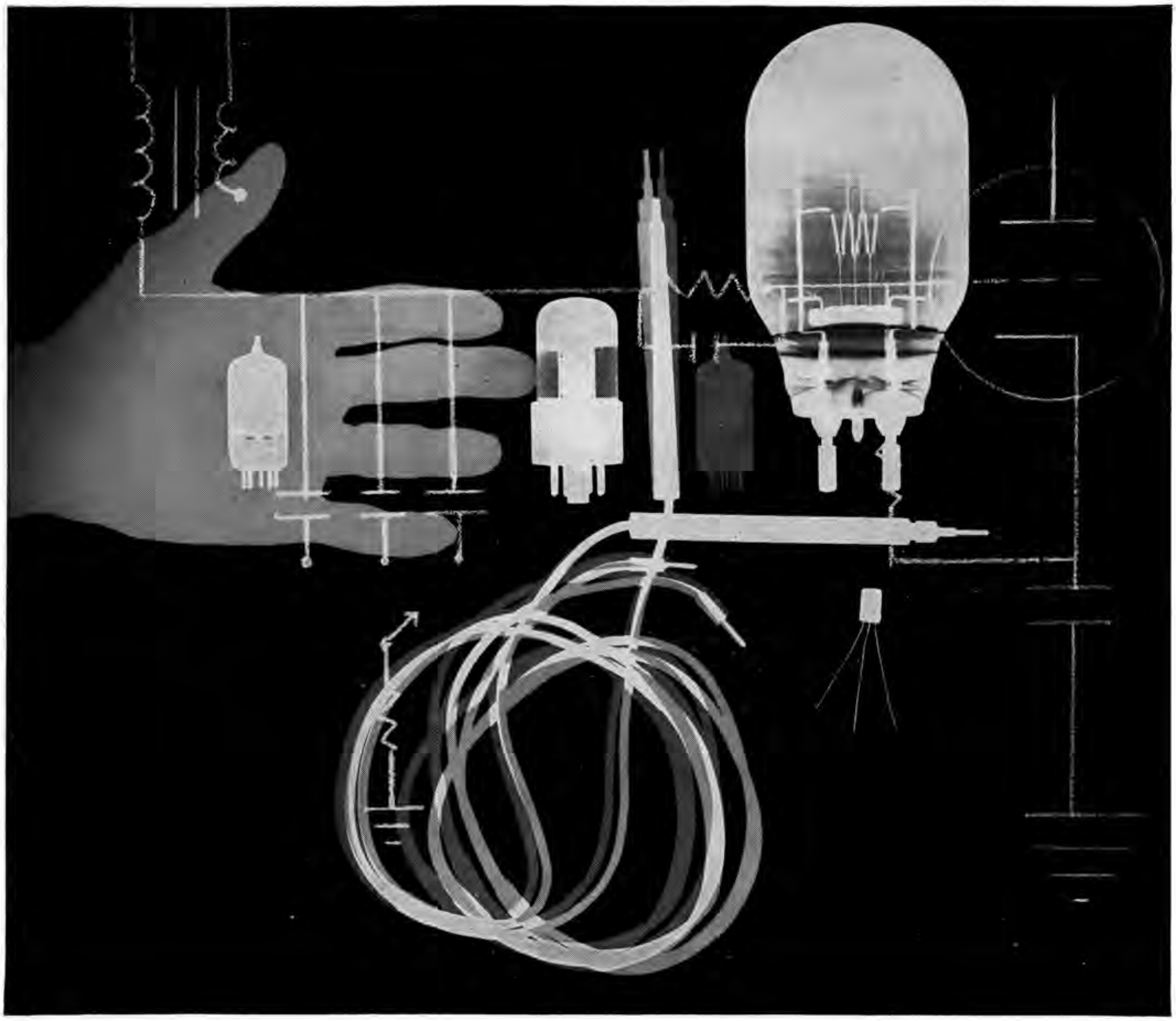
To make this water hot enough to produce the superheated steam required by a ship engine or an electric power station, it must be kept in a sealed system under pressures as high as 2000 pounds per square inch. Being part of the sealed system, the pressure vessel must withstand these pressures. However, it is a large, complex structure and the walls of the vessel and its head are pierced with many holes for control rods, water pipes, and the like. With such complications, it is extremely difficult to calculate all the various stresses which the high-pressure water creates in the walls and head of the vessel.

An exact model of the structure to be studied is constructed from a photoelastic resin, or plastic. Such resins have the ability to show visibly the twisting, bending, or other stresses they undergo when various forces are applied to them. When examined under polarized light, the stresses show up as patterns of colored light.

The plastic pressure vessel model is about two feet high, a foot and one half in diameter, and about 100 pounds in weight. After the model is cast, it is machined to exact shape. Air is then pumped into the model until it is under a pressure of about four pounds per square inch —a pressure large enough to produce in the model the exact stress patterns existing in the actual pressure vessel under its working pressure of about one ton per square inch.

The model is then cured by heating, which "freezes" the stress patterns permanently into the walls of the model. Samples are then cut from the model and examined under polarized light. The "frozen" stresses can then be studied rapidly and with great precision.

'NEW LOOK' AT 'SHELL' OF NUCLEAR REACTOR—These patterns of light show the stresses inside the "shell" of a power-producing nuclear reactor.



The symbolic illustration above was created by photogram, a unique photographic technique of almost unlimited possibilities.

More power to the chemical industry—*engineered by you*

The American chemical industry's enormous growth over the past decade and a half has opened seemingly insatiable markets for electrical creativity. Electrochemistry, as practiced at the Columbia-Southern Chemical Corporation, is particularly sensitive to developments in power facility design and other applications of electrical engineering . . . machinery, circuits and equipment.

Let's look first at some of the fascinating areas that will stimulate your finest thinking. The world's leading merchant producer of chlorine, Columbia-Southern pioneered in control engineering for electrolytic production of commodity chemicals.

The various demands of our modern chemical installations draw electrical engineers of all specialized leanings into new and pilot construction planning at the earliest stages. Light, power, basic instrumentation, communications . . . in developing fresh, better answers you'll work with outside vendors and engineering experts, pooling your plant experience with their know-how in applying ideas and equipment to the practical production of many vital chemicals.

Recognition follows achievement with refreshing speed. A "standardized program," like standardized thinking, has never been a Columbia-Southern habit. Assignments are carefully worked out between you and interested management supervisors, to help you win and exercise responsibility in the shortest time possible.

Columbia-Southern offers truly outstanding career opportunities to electrical engineers of promise. If you would like more information, please write today to the Personnel Manager at our Pittsburgh address or at any of our plants.

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Figure 1
You can't see radioactivity; you can't smell it and you can't taste it. The only indication of its presence comes from the swing of the needle on the radiation meter. Fighting an unseen enemy is an around-the-clock task for technicians in the Bettis "Hot Lab" which is operated for the Atomic Energy Commission by Westinghouse Electric Corporation. Here, technician Rogers Deschamps prepares to leave a "hot cell" after preparing it for testing radioactive materials. He is carrying a radiation monitor to measure the intensity of radioactivity in the cell and to protect him from possible overexposure.

Hot Handy

DON YORK, M.E. '58

The "Atomic Age" has produced a new kind of handy man—the "hot lab" technician. He handles highly radioactive materials, a job requiring a great deal of skill and knowhow. The term "technician" is somewhat a misnomer, for he may be a scientist with a doctor's degree, an engineer, or a skilled worker.

This new atomic occupation is practiced by 40 men in a laboratory designed especially for study of materials that give off invisible and penetrating rays. The laboratory is located at the Atomic Energy Commission's Bettis plant at Pittsburgh, Pa., which is operated by the Westinghouse Electric Corporation. Having been expanded, the lab now may safely handle specimens 1000 times more radioactive than previously tested here.

"Working with radioactive samples is a remote handling job," reports Mr. Ray C. Westphal, supervisor of operation in the hot lab. "The men cannot touch the test pieces, and usually they have to operate testing equipment with remote controls or mechanical hands. At the same time, the man in the lab must be radiation conscious." "Our procedure for handling these materials are based on one simple rule: everything in the lab is considered to be radioactive until it is proven safe by a radiation meter. That's why our people carry radiation detecting instruments and wear protective clothing—head coverings, special coveralls, and plastic shoe coverings—whenever they go into an area that might contain radioactivity."

It takes about six months to train a man to work in the hot lab. It takes that long for him to become adept with the mechanical hands, shown at right, that perform the experiments behind three-foot concrete walls, left. Also, it takes a man that long to get used to the procedures for protecting himself against radiation.

As a safety measure, the men in the hot lab always work in pairs when radioactive materials are being handled. One man always carries the radiation meter. In addition, every man in the lab wears a film badge and a dosimeter (a personal radiation monitoring device).

The Bettis Hot Lab is one of the busiest in the country. Its three new test cells have been constructed to permit testing samples that emit up to 1,000,000 curies of radiation—the same activity emitted from a block of radium that would weigh 2500 pounds (usually radium is used in quantities of a thousandth of one pound).

The new test cells are made of a dense concrete that measures three

Lab Men

Figure 2
Impact tests to determine the amount of energy absorbed in breaking a sample of radioactive material are conducted in the Bettis "Hot Lab" with this remote-controlled machine. Here, Westinghouse technician Don Chapas manipulates his "mechanical hands" from outside the cell in preparation for the test. Layers of plate glass 36 inches thick and separated by oil protect the operator from radioactivity in the test cell.

Figure 3
Working underwater with radiated materials is one of the many unusual techniques employed at the Bettis "Hot Lab" to protect personnel from invisible radioactivity. A lead shielding cask, used to transport "hot" samples, is shown here in the water tank. At the right, technician William Lewis holds a radiation monitor in his right hand to determine the amount of radioactivity, if any, emitting from the water, while in his left hand he holds a stainless steel bucket in which the irradiated sample will be placed when it is removed from the cask. In the center, technician James Exley prepares to remove the specimen from the cask with the special tongs. At the left, technician Tom Schroeder supports a series of four sealed beam headlights used to illuminate the underwater tank area during the handling operation.

feet in thickness. The one door into each cell is made of heavy 22-inch steel plate and weighs over 12 tons. A technician or engineer can watch an experiment in the cell through a glass window 34 inches thick.

After the radioactive samples are subjected to tests of hardness, impact strength, tensile strength and density, they are shielded in lead and concrete containers and then disposed of according to AEC regulations.

The lab operators have to be able to perform most common scientific and engineering tests—and do them behind a three-foot wall. That's why working in the hot lab is developing a new kind of technical personnel — The Hot Lab Handy Man.

EDWARD

(*Continued from page* 19)

before one of his instructors had left the University to accept a position in industry. Someone was needed to replace him. Who else but Edward?

In the two years that followed, Edward became firmly established as a part of the University. He was given honorary membership in a number of professional societies as well as honorary fraternities. Notable among these was Tau Beta Pi; a special key was made for him and he was never seen without the Bent hanging from his "neck". This and a mortar board constituted his only raiment. His recreation was provided by the many athletic events held at the University. One sport, particularly, held his greatest interest. This was football. At any game, his shrill electronic voice could be heard loudly supplicating the University players to "smear 'em" or perhaps "block that kick". For his efforts on their behalf, the footballers made him an honorary captain of the team. At their homecoming game they even allowed him to call the toss of the coin at the beginning of the game. He called it correctly and elected to receive the ball. The University player who caught that ball still holds the record for the longest kickoff return in the stadium; 105 yards and a touchdown (Glen Sanpeer, Missoula vs Southwestern Methodical U., 1958).

Now it is necessary to tell of the untimely end of Edward. Some of the circumstances are shrouded in mystery but there is enough to cast strong suspicion in certain directions. It happened at the end of the spring semester. Edward had never, until this semester, found it necessary to "flunk" a student. On the contrary, the other instructors had found that a previously failing student became a good average student after exposure to one of Edward's courses. In this particular semester, however, Edward had as a student a hopeless case. Juniper Plunkett had existed for twenty thought-free years and appeared to be good for at least another twenty. Edward was forced to conclude that, in all fairness to humanity, he could only fail the poor lad. This he did. And in accordance with long standing tradition, Juniper went to visit his Professor, that he might acquaint him with the dreadful unfairness of the grading system.

Several saw Juniper enter Edward's office. No one saw him leave the office, although one student did see him leaving the Engineering building, obviously excited. The first intimation that all was not well came when one of the instructors entered Edward's office to take him to a faculty meeting. Edward was not there.

After several hours of searching, they found him. He was on page 236 of a textbook in his office. The book was closed. The Dean rushed immediately and phoned the police. Two plainclothesmen appeared shortly and asked to view the body. The Dean led them over to the book and pointed. One of them remarked, "Very funny!" They left.

Edward left a last will and testament. He bequeathed his worldly possessions to the University, the works of his mind to humanity and then made a rather unusual request. He asked that his remains be interred at one end of the football stadium. This was done gladly, for it was the only place large enough to handle the expected eleven thousand mourners. And so it is that after a game has ended badly for the University, and the students are quietly leaving the stadium, the rustling sound they hear is not the wind among the leaves, nor is it the flags flying in the breeze; 'tis Edward, shouting, "Howdy, howdy, howdy-hay! We'll win at this another day!"

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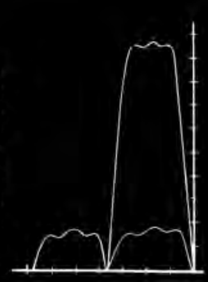
Send the application form printed on the opposite page as an expression of your interest in knowing more about the opportunities at Collins. Your application will be held in the *strictest* confidence and will be answered immediately by a personal letter. Take only a few minutes now to fill out the application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

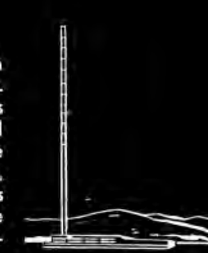
COLLINS in Amateur Radio

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



COLLINS in Broadcast

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



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Newstuff

WESTINGHOUSE SCIENTISTS USE SUPER-FREQUENCY 'RADAR' WAVES TO PROBE SUPERCONDUCTIVITY

The highest-frequency microwaves ever generated by man, plus the lowest temperatures in the world, might well bring to mind some remote radar outpost in the Arctic.

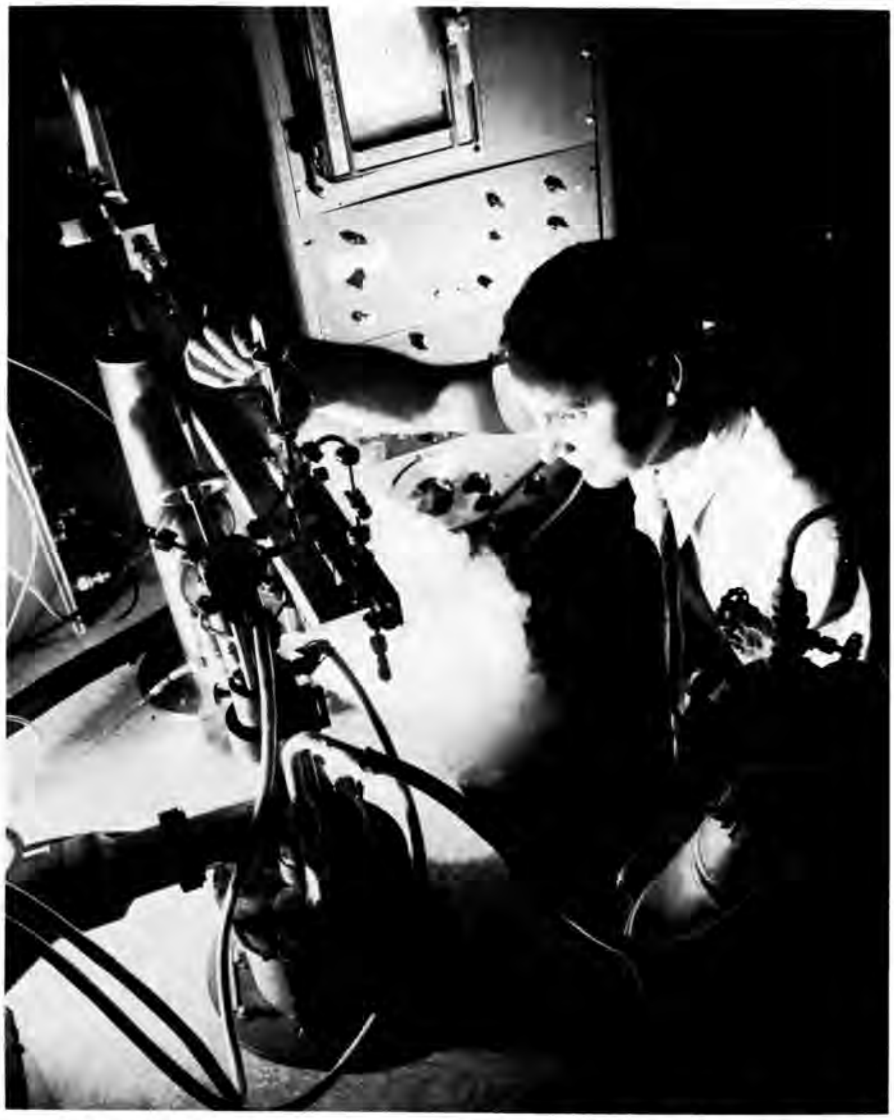
But this is not the place to find them. Actually, this combination of extremes is used by scientists at the Westinghouse Research Laboratories to help unravel one of the greatest riddles of modern physics: the "why" of superconductivity — that strange behavior of certain metals, in which, at low temperatures, electric currents apparently flow forever.

Although superconductivity has been known for about 50 years, our understanding of it is quite incomplete. Occurring only near absolute zero, –459 degrees Fahrenheit, it represents a state of matter completely foreign to what man ordinarily encounters. It is a scientific frontier which offers a real challenge for further investigation.

Materials in the superconducting state exhibit remarkable properties. Best known, perhaps, is their ability to conduct electricity perfectly. In a ring of the purest copper attainable an electric current, once started, dies out in about one second; in a superconductor, as far as we know, it flows forever.

Since electrons are known to be the "carriers" of electricity, those in a superconductor must be in a very special state — one in which they can move about with no friction whatsoever. Physicists have speculated that they may be "condensed" out of the state in which they normally move through the metal.

The super frequency waves are used to "bombard" a superconducting metal such as aluminum or tin that is held at a temperature less than one degree above absolute zero. The waves are absorbed by the metal, which "soaks up" enough energy to lift its electrons from the superconducting to the normal conducting state. Measurements are made of the energy required for different temperatures of the metals.

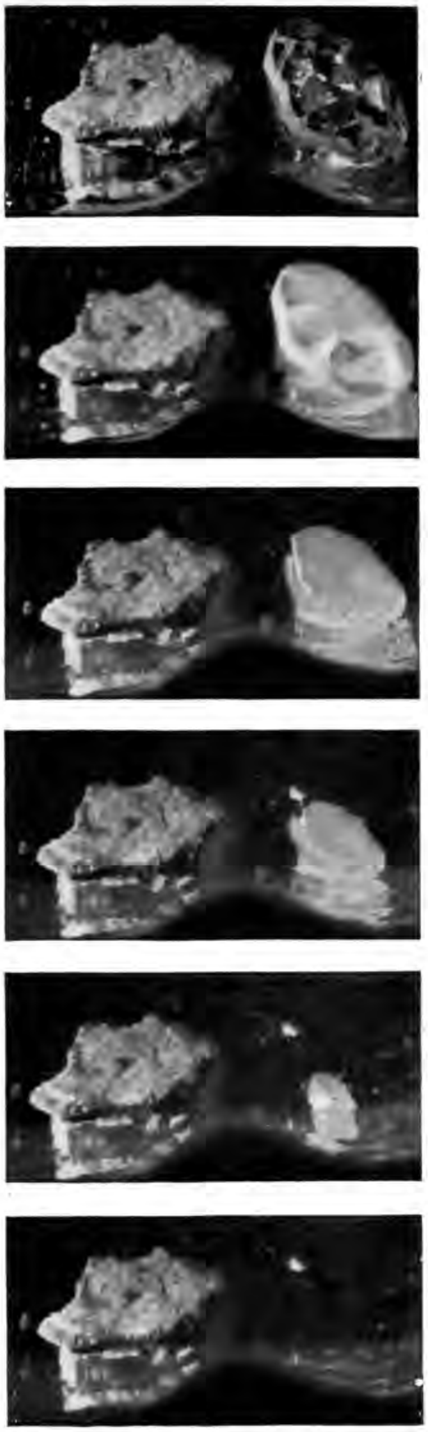


METALS TESTED IN DEEPEST FREEZE POSSIBLE AT WESTINGHOUSE RESEARCH—Dr. M. A. Biondi, Westinghouse research physicist, uses ultra-frequency microwaves to study the superconductivity of metals at temperatures less than one degree above absolute zero, minus 459 degrees Fahrenheit. Liquid helium is used to cool the metal sample. Purpose of the research is to learn why certain metals, at low temperatures, permit electric currents apparently to flow forever.

The microwave experiments must be carried out with unusual care and preciseness. The microwaves, generated by a special "transmitter" and carried by tiny "wave guides," must be of precise frequency and power. They oscillate back and forth at the fantastic rate of 200 billion vibrations per second.

In a typical experiment, the microwave power absorbed by the superconductor is only about one-millionth of a watt. This tiny amount of power raises the temperature of the superconducting metal about one-thousandth of one degree. Yet, so sensitive are the thermometers used in the experiment, they can detect temperature changes a hundred times smaller, or only ten-millionths of a degree.

Because of the tiny temperature changes involved, keeping the superconductor (at nearly 459 degrees below zero) completely isolated from the heat of the laboratory is a major problem. To do it, the metal is immersed in liquid helium inside a special flask, which is itself surrounded by a similar insulating flask containing liquid nitrogen at a temperature of minus 320 degrees Fahrenheit.



DEATH OF A DIAMOND — Photo sequence, taken at 30-second intervals, shows a diamond (right) vanishing in 2½ minutes at 2000° F, while borazon (left) remains hard enough to scratch diamond. Many materials withstand temperatures, at which diamond burns; the significant part of this demonstration is that borazon combines the hardness of diamond with much greater resistance to oxidation at high temperatures. After this demonstration, the piece of borazon was used to scratch the face of another diamond. Another diamond myth exploded by General Electric Research Laboratory.

Newstuff

By J. P. WILHELM, M.E. '57

BORAZON

"Borazon", General Electric's name for its cubic boron nitride, scratches diamond with ease and remains hard at high temperatures where diamond literally burns up.

Borazon is guessed to be about the same hardness as diamond; borazon scratches diamond almost exactly as diamond scratches diamond — and diamond scratches borazon. In actual lapping tests, borazon powder has polished away the surface of a large diamond at the same rate as diamond powder. But in another important characteristic, borazon appears to be superior to nature's most glamorous substance. Diamond, being basically carbon, literally "burns up" in air at about 1600 degrees Fahrenheit. Borazon can withstand temperatures of more than 3500 degrees Fahrenheit and thus should be better for many industrial applications.

Borazon's resistance to oxidation will make possibe superior methods of mounting stones in industrial tools and also may allow bits and wheels to be operated at higher speeds, performing their cutting and polishing jobs more quickly and efficiently.

The first borazon exhibited consisted of tiny crystals no larger than grains of sand, but even in this form the material is expected to be suitable for a variety of industrial uses. The material is generally black, brown, or dark red, although milky white, gray, and yellow crystals have been made.

Ordinary boron nitride is a white solid material similar in slipperiness, density, and crystal structure to black graphite. Boron and nitrogen straddle carbon in the periodic table of elements.

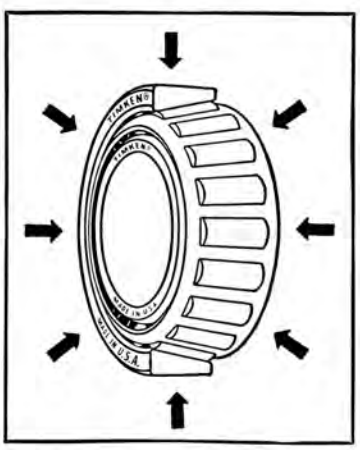
Superpressures above 1,000,000 pounds per square inch and temperatures exceeding 3000 degrees Fahrenheit are used to produce crystals of boron nitride with a structure that is not hexagonal (like graphite) but cubic (like diamond).

X-ray diffraction tests of borazon reveal that the alternate atoms of boron and nitrogen are packed together almost as closely the carbon atoms in diamond. The density is also about the same.

Tear out this page for **YOUR BEARING NOTEBOOK...**

How to keep the world's biggest mouth chewing

This gigantic power shovel bites off 90 tons, lifts it ten stories, and moves it 290 feet. The engineers who designed the shovel had to provide for the tremendous loads, from all directions, placed on the hoist sheaves and swing machinery. To take the combination radial and thrust loads, keep wheels and shafts turning smoothly under punishing operating conditions, the engineers specified 34 Timken® bearings at all critical points.



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

Some bearings can take loads from the sides—some from above. Because of their tapered design, Timken bearings take *both* radial and thrust loads or any combination. And because the load is carried along a full line of contact between rollers and races, Timken bearings have extra load-carrying capacity.

Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "Career Opportunities at the Timken Company". The Timken Roller Bearing Company, Canton 6, Ohio.

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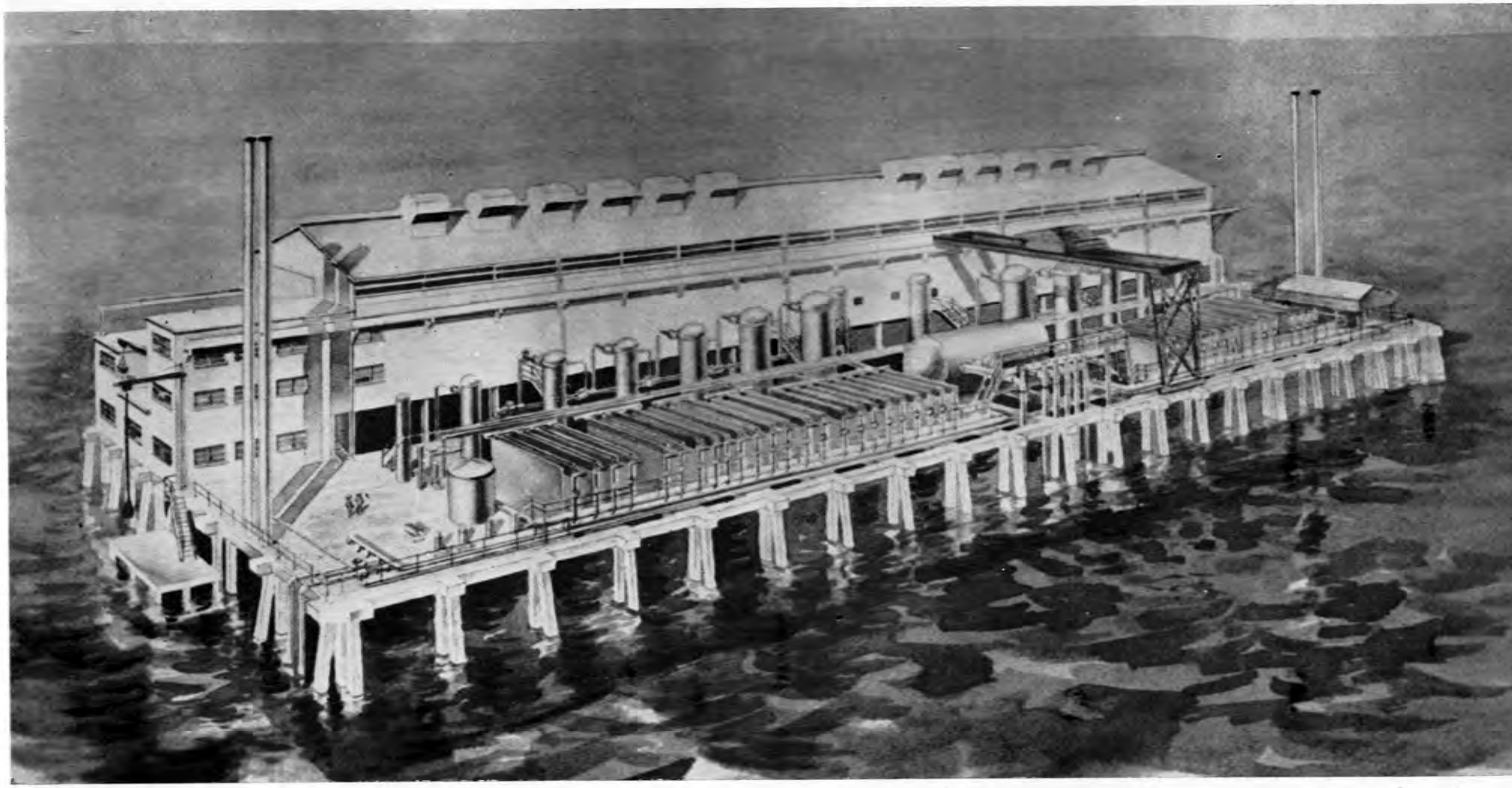

Gas Turbines Pump Gas

Three hundred million cubic feet of gas will be pumped back into the earth daily by the most powerful concentration of gas turbines in the world. Built by the Westinghouse Electric Corporation, twelve 8000-hp combustion gas turbines with a total maximum rating of 96,000 hp will be installed seven miles out on Lake Maracaibo, Venezuela, on a platform 440-ft long, 131-ft. wide, mounted on concrete piling in 80 feet of water. They will drive centrifugal compressors which will inject natural gas, derived from oil operations, under high pressure into the oil field that is under Lake Maracaibo and the surrounding area. This gas conservation plant will recover substantial quantities of additional petroleum and conserve large quantities of gas, in fact, 120 per cent more than its earlier counterpart in the same area.

Eight of the units will be direct connected to the centrifugal compressor, four will be geared. The twelve turbines will operate in two strings of six units each.

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

How to write a success story

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

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

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

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

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

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

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BULLARNEY

By WHIT

CHEMICAL ANALYSIS OF WOMEN

ATOMIC WEIGHT: Reputed to be 120. Isotopes are known through 90 to 180.

OCCURRENCE: Found both free and combined. In combined state it is found with man.

PHYSICAL PROPERTIES: All colors, sizes and shapes. Seldom found in pure state. Boils at nothing and will freeze without reason. Surface is usually covered with film of point or oxide in various colors and depths. Unpolished specimen turns green in presence of highly polished one. All varieties melt if used incorrectly. Density is not so great as generally supposed.

CHEMICAL PROPERTIES: Highly explosive and dangerous in inexperienced hands. Extremely active in the presence of men. Possesses great affinity for gold, silver, platinum and all precious stones. Has the ability to absorb great quantities of expensive food and drink. May explode spontaneously when left alone with man. Sometimes yields to pressure. Fresh variety has great magnetic attraction, but ages rapidly.

USE: Chiefly experimental. Efficient cleaning agent. Acts as a positive or negative catalyst in the production of fevers.

UNSOLVED PROBLEM: The thing that mystifies many engineers is the fact that the most streamlined specimens offer the most resistance.

♣

Even when the gal is as pretty as a picture, most fellows like to take a peep at the frame.

♣

MY SLIDE RULE

There are many like it but this one is mine.
My slide rule is my friend
And I shall learn to love it like a friend.
I will obey my slide rule.
When my stick tells me that 5x5 is 24.8,
Then by god, five times five is twenty-four point eight!
I will learn the anatomy of my slide rule,
Though I die in the struggle, I will use every side,
The black scale and the red, the inverted C and the inside out log.
The reversed A and the mutilated D.
I will master them all, and they will serve me well, they will!
I will cherish my slipstick and never shall profanity sear its long, graceful mahogany limbs.
My slide rule shall be my brother in suffering through long hours of midnight toil.
We will work together, my slide rule and I.
And on the great day when my slide rule and I have finished our appointed task and the problems are done and the answers are right,
I will take that damn stick and have one hell of a fire, I will!

♣

"You can't beat the system," moaned the student after his last semester's grades. "I decided to take basket weaving for a snap course, but two Navajos enrolled and raised the curve, and I flunked."

♣

Have you heard about the two engaged nudists who decided to break it up because they had been seeing too much of each other?

♣

"Pa, what does it mean here by diplomatic phraseology?"

"Son, if you tell a girl that time stands still while you gaze into her eyes, that's diplomacy; but if you tell her that her face would stop a clock, you're in for it."

♣

A customer at a bar ordered a dozen Manhattans. He poured the liquor on the floor, and began munching contentedly on the glasses themselves. The stems, however, he would not touch.

A barfly watched the performance with absorbed interest, and then pointed to the twelve stems. "You darn fool," she said, "you're leaving the best part."

♣

A group of prohibitionists looking for evidence of the advantages of total abstinence were told of an old man 102 years old who had never touched a drop of liquor. So they rushed to his home to get a statement. After propping him up in bed and guiding his feeble hand along the dotted line, they heard a violent disturbance coming from another room — furniture being broken, dishes smashed, and the shuffling of feet.

"Good heavens, what's that?" gasped a committeeman.

"Oh," whispered the old man as he sank exhaustedly into his pillows, "that's Pa—he's drunk again."

♣