MISSOURI SHAMROCK

October 1955

FEATURES

♣

100 Welcomes

♣

Meet Your Engine Club President

♣

The Flying Dutchman

♣

Manufacturing Engineering

♣

25c

Let The Man With The Facts tell you about careers with Westinghouse

You have a tough decision to make . . . about that all-important first job. Which company offers you your best future?

Let The Man With The Facts discuss with you the varied and challenging opportunities at Westinghouse.

He is a man with broad personal experience who can tell you the specific things you want to know . . . the many kinds of careers . . . training program . . . further education . . . advancement . . . how you can grow with Westinghouse.

Westinghouse is one of the fastest growing companies in America. It is expanding rapidly into challenging new fields like atomic power, semiconductors, director systems, automation. Let The Man With The Facts tell you about these and many other fields that offer almost unlimited opportunities . . . at Westinghouse.

It's your decision, but before you make it, ask your Placement Officer to make a date with the Westinghouse Man With The Facts. In the meantime, ask for your copy of our 48-page book, *Finding Your Place in Industry.*

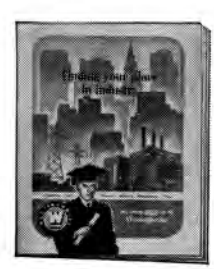
G-10291

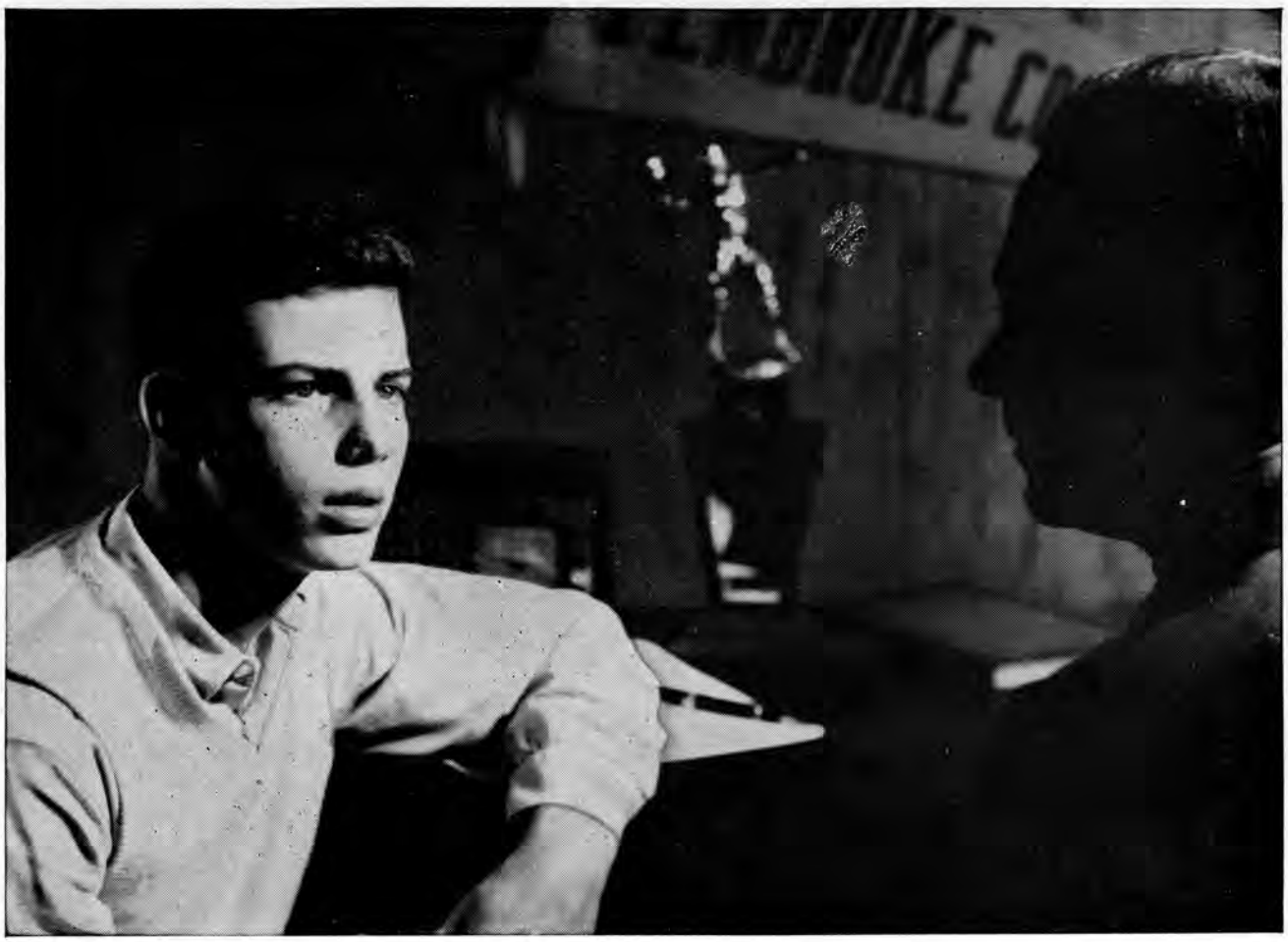
YOU CAN BE SURE...IF IT'S

Westinghouse

Ask your Placement Officer about career opportunities at Westinghouse, or write for these two booklets: *Continued Education at Westinghouse* (describing our Graduate Study Program) and *Finding Your Place in Industry.*

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





When Your Kid Brother Asks Your Advice About College:

As a college student, you are looked up to by that kid brother (or young friend) still in high school. He'll be coming to you for advice about what college curriculum to take, and how to prepare for college.

As a college engineer, you doubtless will tell him the reasons *you* have chosen an engineering career. You can tell him of the opportunities in engineering or chemistry. He'll be interested to know, for example, that the demand for engineering graduates is tremendous (last year: 40,000 engineers needed; less than 20,000 graduated).

You can tell him that beginning salaries are high (36% higher than in 1949). And, that the future in engineering or chemistry is almost unlimited.

But, most important, that high school student should know how to *prepare* for a college education in engineering. He should know that high school is where the groundwork for college engineering must be laid. From your own experience, you can explain that colleges cannot teach freshman engineering students algebra and geometry or primary physics and chemistry. These courses should be taken in high school, and should be started no later than the junior year.

So next chance you have, sit down with that kid brother. Explain the opportunities in engineering and urge him to see his teachers about including math and science as possible in his high school courses.

In this way, you can help him prepare for what we at Spencer Chemical Company believe is one of America's most exciting, most rewarding careers.

SPENCER CHEMICAL COMPANY, 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) • Cylinder Ammonia.

SPENCER®

America's growing name in chemicals

ADVANCED EDUCATIONAL PROGRAM AT ALLISON HELPS YOU FIND THE BEST JOB SUITED TO YOUR TRAINING

DIVERSITY of technical skills required by Allison in the design, development and production of turbo-jet and turbo-prop engines offers a wide range of opportunities to young graduate engineers.

And, the Advanced Educational Facilities help the young graduate find the work best suited to his academic training and liking.

For instance, there's Wayne McIntire (above) Mechanical Engineer, Purdue University, who came to Allison upon graduation in 1950. After completing the training program, Wayne now is doing the kind of work he wanted, and is technically qualified to handle. He is Project Engineer, mechanical design of gea r boxes. He is shown making an adjustment on the propeller linkage control on the cutaway model of the Allison T56 aircraft engine. This, incidentally, is America's first production turbo-prop engine, and is used in the Lockheed C-130 Hercules, a 54-ton transport. The Allison Model 501, which is the commercial version of the military T56, is the powerful turbo-prop engine proposed for commercial airline use.

In his present job, Wayne works on initial design . . . helps decide what components—such as propeller brakes, accessory drives, oil pumps, etc.—are needed for the specific project.

The nature of Allison business continually presents a variety of interesting and challenging problems to the engineering staff, which—along with the Mechanical, Aeronautical, Electrical, Metallurgical, Chemical and Industrial Engineers—includes majors in Mathematics and Physics.

We'll welcome the opportunity of telling you more about the Allison Advanced Educational Facilities, and the benefits and advantages which can be yours at Allison. Arrange for an early interview with our representative when he visits your campus, or write for information about the possibilities of YOUR engineering career at Allison: R. G. GREENWOOD, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Ind.

ALLISON
TURBO-PROP ENGINES
American built for the new era in air travel

This year marks the beginning of a new era, "women engineers." Our cover is pert Elizabeth "Bets" Crecelius who, with our five other coed engineers, will brighten the halls and classes with their feminine curiosity and gentle personalities.

—photo by Jerry Herdan

MISSOURI
SHAMROCK

VOL. XXII OCTOBER, 1955 NO. 1

CONTENTS

FEATURES:

DEPARTMENTS:

MEMBER
ENGINEERING COLLEGE MAGAZINES
ASSOCIATED

Chairman, Thomas Farrell, Jr., State University of Iowa
Publisher's Representative, Littell-Murray-Barnhill, Inc., 101 Park Avenue, New York 17, New York, and 605 Michigan Avenue, Chicago, Ill.

Published monthly except June, July, August, September, by Board of Publications of Engineers Club, University of Missouri. Office of Publication: Room 233 Engineering Building, University of Missouri, Columbia, Missouri. Entered as second class matter at the post office at Columbia, Missouri under the act of March 3, 1879. Printed by The Missouri Farmer, Columbia, Missouri. Single copies 25 cents; subscriptions, $1.50 per year, $2.50 for 2 yrs.

Dr. Ward Kuentzel and Dr. Edmund Field, co-inventors, observe operation of the new Magne-Dash autoclave in Standard Oil's Whiting research laboratory.

Orders for inventions taken here

MODERN RESEARCH creates a need for brand-new types of equipment. In petroleum laboratories, mixing up some stuff in a beaker usually isn't the answer. The research pioneer may have to use high temperatures and high pressures. If he must stir his mixture, he has a tough job. How can he prevent leakage past the shaft of the stirrer?

To meet this and other difficult situations, Standard Oil has set up a "Special Devices Program". A group of scientists creates the apparatus needed to solve today's problems.

An example is the Magne-Dash* autoclave. It has a magnetically operated agitator, and no external moving parts. Leaks cannot occur. Research men now use freely the high pressures that lead to new plastics and other new products.

Like many other inventions made by Standard Oil scientists to solve our own problems, the Magne-Dash is licensed for production and sale by a maker of scientific equipment.

The Special Devices Program is just one of the creative activities at Standard Oil. Young scientists find it stimulating to work in such an atmosphere.

*Manufactured under Standard Oil license by Autoclave Engineers, Inc., Erie, Pa.

Standard Oil Company

910 South Michigan Avenue, Chicago, 80, Illinois

STANDARD

"Off We Go . . ." Frank Eggers, senior M.E., shows proper form in climbing into a T-33 jet. Pic taken this summer when he was at Air Force ROTC summer camp.

Notice that piece of angle attached to the leading edge of the wing at the extreme right of photo—it causes the wing to stall first in the root section; aileron control is last to be affected.

"The Lower Form"

Of all those persons in college the freshman must surely be the finest. When things go bad on the football field, who shouts the loudest and prays the hardest? The frosh, of course. When the game is over and the sound of our alma mater is heard who knows the words? Always the frosh. When the student leaders (upperclassmen, of course) hold their conclaves and a need for money becomes the topic, what do we hear? "The freshmen, we'll have to get them to join!". When Joe Senior (President of the student organization) rises to give his speech, who applauds? The frosh. As the great Dean gives his speech and says, "We have 7,000 students enrolled this year", who is he talking about? Mostly freshmen. Who whistles at girls to confirm what the mirror tells them? The noble freshman. So if ever you think that the freshman is the lowest form of life, consider this question: Where would a chief be without any Indians?

P. D. G.

100 WELCOMES

A TALK WITH THE DEAN

Dean H. O. Croft of the College of Engineering

It was over three generations ago (in June 1856) that the first students were graduated in engineering from the University here in Columbia and during these 100 years since the fall of 1855, there must have been at least one "welcome" per year extended to the new entering students. Through tradition then, this becomes the 100th annual welcome to you students of engineering beginning a new academic year.

It is a pleasure on behalf of the faculty to welcome you to a joint adventure in education for the engineering profession. One hundred years ago, William Barr and Thomas Field were the first engineers graduated from the University and if it were possible, I am sure, they would likewise extend their welcome and encouragement on behalf of the alumni.

We welcome you likewise for the other 2500 alumni who have graduated since June 1856 and who have given the best in engineering services to their own generations. These alumni have probably contributed more than their share to the rapid industrial expansion, the health, the general welfare, and the protection of this great nation of ours.

During these 100 years engineered labor saving devices have removed the toil from the backs of men on the farm, in the manufacturing of goods, and in the home. Today one may drive his car in an hour over billiard-table smooth paving a greater distance than a man could travel in three days by coach-and-four, and a trip from New York to California which used to require months may now be made in eight hours. Radar senses the unseen and in every home the refrigerator holds foods from far places that even queens could not afford 100 years ago. Instead of stilted daguerreotypes of men and events, television screens present living pictures at your finger's touch.

Most of these engineering innovations have been introduced in the last two generations and many more will be discovered, produced and sold by you for your generation.

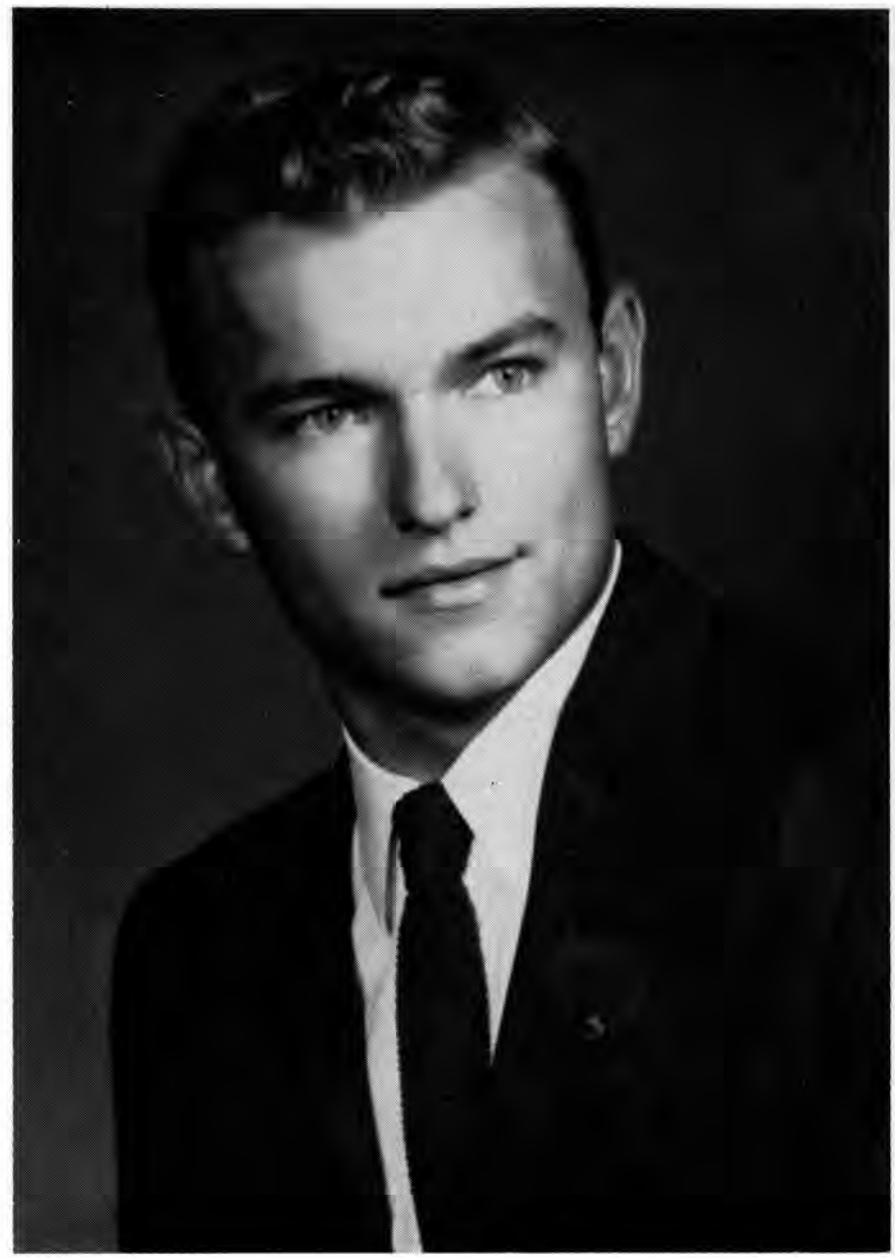
To me, however, the most interesting result of engineering progress over the years has been the great leveling process occurring in all economic planes of American civilization.

Years ago, only the most wealthy could afford to give their children the advantages of a college education —now the children of a day laborer can and do go to college. The automobile was owned only by the well-to-do, now almost every man who works has a car. Only those who had capital, owned the first phonograph and saw the best plays, now television sets with their varied programs are commonplace in the low-rent residential areas. Thus, through the works of engineers during the past 100 years, the things used and enjoyed by people in our civilization are found at all levels of the economic scale.

Obviously the field of engineering has expanded considerably since 1842 when the University offered a course in "Mensuration, Surveying and Leveling." The vast explosion of scientific knowledge during the years since 1842 has resulted in the engineering application of this knowledge to all human endeavor. To keep pace with this diffusion of science, the offerings of the College of Engineering have increased to some 200 separate courses, including a course in Nuclear Engineering. Thus, you may select a program of study which is abreast of the times and worthy of your mastery.

So, on behalf of the past 100 years record of successful alumni, earnest teachers, and virile students, we offer you 100 welcomes and wish you success in your studies for the engineering profession.

Meet Your Engine Club President



DAIL STONE

EDITOR'S NOTE—Dail Stone is a Senior in Mechanical Engineering. He is a member of Tau Beta Pi, Pi Mu Epsilon, Pi Tau Sigma, ASME and of course, the Engineer's Club. He is 22 years old and comes from Bucklin, Missouri.

Welcome to the University and especially to the College of Engineering. You were wise in choosing this institution for your education because it is top-notch academically and has many extra-curricular benefits. A lot of hard work has been done to prepare a balanced and integrated program for you. It is my sincere desire that you will make the most of the opportunity afforded you.

Among the many benefits that this school offers is the Engineers' Club. This organization is of interest both to the freshman and to the senior. Let me acquaint you with the Club.

The Engineers' Club, Inc. 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."

What can the club offer you? It offers so much that it is hard to put it on a single page such as this. The most important benefit is meeting other engineering students—to meet fellows in other departments, the surveyor, the spark jockey, the plumber, and so on. It offers you this magazine, the SHAMROCK. I don't think you'll find a finer student publication anywhere and Paul Gernhardt, this year's editor, intends to keep it that way, too. A scholarship fund has been set up to help those who need financial aid. The Engineers' Club offers you the activities of St. Pat's Week, a tradition which was originated on this campus some 53 years ago. It offers dances, parties, movies, and many distinguished speakers from industry. It offers to those seniors who have distinguished themselves in their college careers, the honor of being "dubbed a Knight of St. Pat."

This year the club will offer more than ever because this is the 100th anniversary of the College of Engineering. Plans were started last spring to make this year's St. Pat's Week something to be remembered for a long time. It is your cooperation, as a student and member of the Engine Club, that will make this the best year in the history of the College.

A person might say that the Engineers' Club is the official voice-box of the student engineers. To be effective in this capacity the organization must be and has to be strong. This is where we need you, every one of you. Each of you has something to contribute to this club so let's have it! I'll see you at the next meeting.

THE FLYING DUTCHMAN

By P. D. GERNHARDT

Today we accept aviation as a well established field of engineering. Until recently this was not true. One of the men who laid the principles which make aviation the science it is today is the subject of this story.

He was born in the Dutch East Indies in 1890, the son of a wealthy coffee plantation owner. Before he had reached the age of thirty, great nations vied for his services and his name was known throughout the world as one of the pioneers of aviation. He had the many narrow escapes and hair-raising adventures of an early pilot. When the art of flying was in its infancy, he not only taught himself to fly but built his own airplane in order to do so.

Among his many achievements he could count the invention of the synchronized machine gun for aircraft and the introduction on a production basis of cantilever wing construction and metal structures in aircraft. Although a citizen of Holland, a neutral nation in World War I, he flew a German fighter plane in combat for a short time. One of his designs, the tiny "Dreidecker" or triplane, was probably the most maneuverable airplane ever built and certainly was among the most unusual looking of aircraft. Perhaps his greatest achievement was as a smuggler, for he once smuggled an entire aircraft factory from one nation to another! His name was Anthony Herman Gerard Fokker.

When Tony Fokker was six years old, his family moved to the small town of Haarlem, Holland and there he spent his youth. In school he did very little to indicate future success; he was a very poor student and frequently ran afoul of the school authorities. Probably all concerned breathed a sigh of relief when he left school at eighteen announcing that he was working on an invention.

His first invention was a non-puncturable tire for automobiles. Financed by his father, he spent a year developing it. When he was almost ready to market it, he discovered that a French concern had already patented it and was producing it. At his father's expense, he had learned the value of a patent search before spending large sums of money in developmental work.

For several years Fokker had been interested in aviation, studying whatever literature he could find on the subject. His father sent him to an automotive trade school in Germany but before enrolling there he discovered that an aviation school was being formed nearby. He immediately changed his enrollment to the school

Fokker E-4

of aviation. This was in 1910—just seven years after the Wright brothers' first flight. There were then very few people who could be called experts on aviation. The director of the school was no expert but hired a bogus claimant to that distinction, a man who claimed to be a pilot.

The first school project was the construction of an airplane. In those days, if you wished to fly, you had first to build the airplane.

It was finally completed and the great day arrived. The school "aviator" climbed into the plane, the engine was started, it rolled along the field and rose into the air. Fokker, who had stationed himself at the opposite end of the field, was overjoyed for a brief moment. Then he saw that the pilot was going to attempt to land without turning about. He watched in anguish as the plane touched the ground and then crashed into a ditch bordering the field. The pilot climbed out with nothing worse than bruises but the airplane was completely destroyed and with it the aviation school.

Fokker was discouraged, but not for long. He decided that it was time for him to build his own airplane. His father agreed to finance him and thus armed, he set to work.

When completed, his plane was similar in general appearance to the other aircraft of the time, with a few noteworthy exceptions. The wings had a pronounced upsweep at the tips in order to provide automatic lateral stability. Because of this feature, no ailerons were used. The wing main framework was of metal tubing instead of the more popular wooden construction then prevalent. This use of metal tubing for structural members was to become a trademark of Fokker aircraft.

Shortly before Christmas 1910, Fokker tested his plane. It was the first flight for pilot and plane. Of the two, the plane was perhaps the more successful, exhibiting much better stability than any previous design. Fokker had achieved his ambition—he had flown. Now he had to find a way of obtaining a livelihood from aviation so that he might continue in it.

His solution was twofold; first, he would make exhibition flights and second, he would manufacture and sell his aircraft. In the years from 1911 to 1913 he attempted to sell his designs to the Dutch, Russians, Germans and English with little success. The Dutch bought airplanes from a Frenchman, Henri Farman; in Russia, it was necessary to wrap your calling card in a banknote; the Germans were obsessed with the Schlieffen plan of land warfare; the English were concentrating on developing their own designers. Thus it was that Fokker found his greatest early success as an

(Continued on next page)

exhibition flyer. He was the first to loop-the-loop in Germany, after the Frenchman Pegoud, had demonstrated that it could be done. In his first attempt, he pulled up very sharply, thinking this was the best way to perform the loop. The maneuver put an immense strain on his wings, but they stayed on and he was spared for his next attempt. He decided to try a more gently pull-up in his second attempt and was surprised to find that the plane encountered practically no strain when treated in this manner. His ability to perform this feat put him in great demand for air shows throughout Germany and enabled him to stay in aviation until his first real opportunity came along.

Near the end of 1913 the German army sponsored a competition for a small scouting airplane. One of the requirements was that the airplane must be easily moved overland. Fokker designed a small plane with this requirement in mind and easily won the competition; not so much in the air as on the ground, where his plane could be quickly disassembled and transported on a single truck. He received an order for ten airplanes and was manufacturing them when the first World War began.

The value of the airplane was forcibly thrust upon the belligerent nations. It could dart about like an avenging wasp above the lumbering columns of foot soldiers, divining their purpose and transmitting it to the army commander so that he might take counteraction. Napoleonic maneuvers became impossible when the eyes of the airplane were added to warfare.

Fokker found himself swamped with orders for his aircraft; the military were desperate; anything with wings was accepted. For the first time he could keep his ledgers in the black.

In the first part of the war airplanes were used for scouting purposes only. Air combat consisted of an occasional pistol shot or perhaps a brickbat heaved at an unsuspecting enemy scout. Then an enterprising Frenchman, Rolond Garros, fitted a machine gun on the nose of his small scout and attached steel wedges on the propeller to deflect bullets which might otherwise strike it. Using this device, he shot down a number of German aircraft. The Germans discovered his secret, however, when he was forced to land behind their lines as a result of engine failure. They took his plane to Fokker with the request that he duplicate its mechanism.

After studying the French plane Fokker decided that a better mechanism would result if the propeller were linked to the gun instead of the two operating independently. He set to work on this problem and in three days had completed and installed on one of his planes the first synchronized machine gun. The Germans refused to believe their eyes when he demonstrated it to them. They insisted that he, a citizen of Holland, should fly over the front lines and shoot down an allied plane to demonstrate its effectiveness. Fokker was given no choice in the matter. He was bundled to the front and found himself flying for Germany. After several uneventful flights, he finally happened upon a large French observation plane equipped with a pusher propeller. As he slowly flew up behind them, they watched him with only casual interest, not realizing that a deadly stream of bullets might soon send them to their deaths. Fokker had them in his sights but could not pull the trigger. Instead he returned to the German airfield and forthwith resigned from the German Imperial Air Force—probably the only person to accomplish this feat!

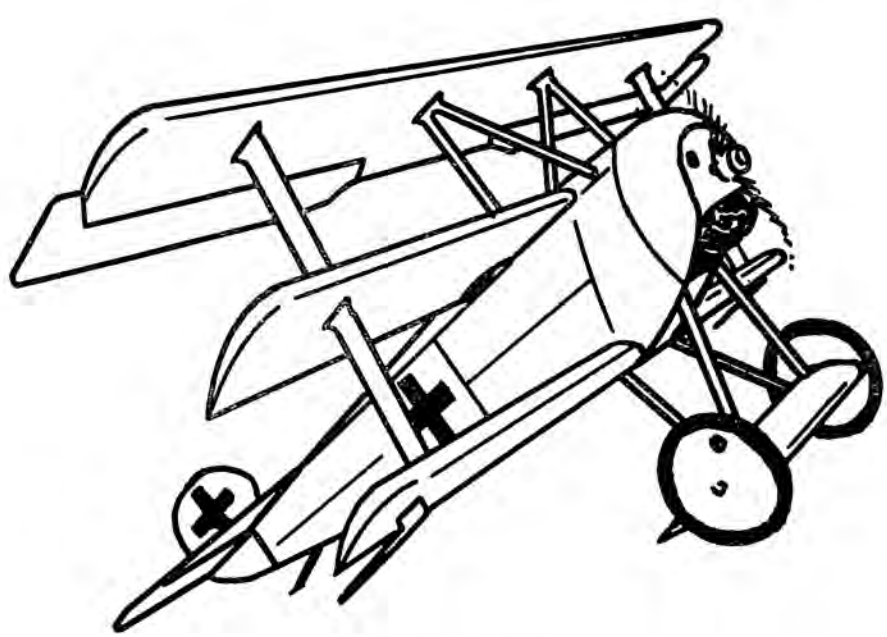
In his stead a young German pilot, Oswald Boelck, flew the plane and shot down an enemy plane on his third patrol. Boelck was to become the first German ace.

Fokker immediately went into full scale production of the plane, designated the E-4, and for a period of six months the Germans held a clear advantage over the Allies.

In the English Parliament, an investigation was held to determine why Fokker had not been obtained for the Allied side. On the front, the Allied airmen referred to themselves as "Fokker Fodder." Finally a German airman, lost in a fog, landed on an Allied field and the secret was out. Henceforth, the advantage in the air would depend upon who had the best flying ability, the best plane and the greater numbers. Throughout the remainder of the war the Allies had greater numbers of aircraft and their pilots were as good as the German pilots. Thus, the Germans were forced to rely upon better quality airplanes to maintain equality in the air.

The chief bottleneck in German air-

(*Continued on next page*)



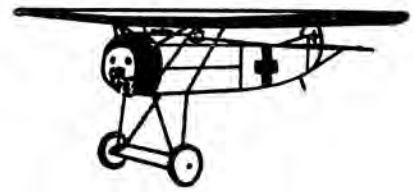
Fokker Triplane DR-1

craft production was engines. Only one really good engine existed, the Mercedes, and rival manufacturers vied to obtain it. The Albatross firm, through intrigue at headquarters, obtained the full production of it. Their plane, the D-3, was in many respects an excellent airplane but it had a fatal weakness. In a prolonged dive or any abrupt manuever the lower wing was apt to fail, sending the luckless pilot to his death. Boelck met his death in this manner. Nonetheless, the Albatross firm received the total output of Mercedes engines, and Fokker was slowly being squeezed out as a major manufacturer. He saw that in order to stay in production he must design an airplane around the second best engine, the Oburersul rotary, with only 110 h.p. to the Mercedes' 160 h.p. and yet equal the performance of the Albatross. From the outset it was obvious that the plane he designed could not equal the Albatross in speed; with the lighter engine it must rely upon better climb and manueverability. The resulting design, the Fokker Dr-1 triplane, fulfilled these requirements perfectly. It had an excellent climb and was the most maneuverable plane used in the first World War. It is doubtful that a more manueverable plane has ever been built. With its three wings, comma shaped rudder and snub nose it had a very distinctive appearance and Allied airmen soon learned to respect it. Richthofen, the foremost German ace, flew it until his death, even though it was superseded by later designs. His airplane was painted red from propeller to tail and those of his fellow pilots were also gaily painted so that the Richthofen squadron became known as the "Flying Circus."

Fokker D-7

This success was gratifying to Fokker, but it did not obtain the coveted Mercedes engine for him. It became obvious to him that he could obtain the Mercedes only if he could obtain the support of the front line pilots. To further his purpose he used a clever stratagem. He contacted the leading aces with the idea that they would send a delegation to headquarters requesting an open competition of all manufacturers, with each plane to be equipped with the Mercedes engine. The plan succeeded, and a date was set for the competition. For his entry, Fokker had designed a biplane, the D-7. It incorporated all of the best features of his earlier designs and with the Mercedes engine was an unbeatable combination. There was a complete lack of the customary wing bracing wires, with but a single "N" strut between the wings on each side. The wings had straight leading and trailing edges as viewed from the top but were tapered when viewed from the front. The root airfoil was thick, tapering to a thin section at the tips of the wing. Because of the thick airfoil the D-7 had excellent high altitude characteristics and was equally good at lower altitudes. It remained the standard German fighter till the end of the war. It was so successful that the other firms were required to produce it on a royalty basis and cease production of their own types.

Even with this success Fokker's troubles did not cease. The other firms connived to obtain an ever increasing share of the engine production so that Fokker was now being squeezed out of the production of his own design. He decided to once again use the Oburersul rotary engine to get out of his predicament. Around it he designed a small monoplane, the D-8, using a full cantilever wing tapered both in planform and in thickness. He entered it in the second open competition and won again. Before the Germans would accept it, however, they required that he strengthen the rear spar of the wing. They had not seen a full cantilever wing before and so applied the traditional biplane concepts of design to it. This proved to be a fatal mistake. The first few planes had hardly been delivered when a series of wing



Fokker D-8

failures occurred. An official investigation was held, but no evidence of faulty construction could be found. Fokker finally hit upon the trouble. In strengthening the rear spar the wing had been made too rigid in the back. Thus when a pilot dived the plane, the rear held rigid while the front deflected, presenting an ever increasing angle of attack to the airstream, which in turn caused the wing to deflect still further, an endless chain of events which could only result in the failure of the wing. By the time the difficulty was corrected, the war was almost over, and the D-8, nicknamed the "Flying Razor," saw little service.

Fokker had the distinction of being the only manufacturer whose planes were mentioned in the Armistice. The Allies specified that all Fokker Aircraft must be turned over to them. One of the D-7 type is now on display in the Smithsonian Institute in Washington, D.C.

With the end of the war came revolution and inflation in Germany. It was obviously a poor place to conduct a business and Fokker decided to leave. The country was in such a state of disorder that he felt that he might also be able to take some of his equipment with him. Accordingly he had sixty boxcars loaded with all sorts of aircraft tools, fittings and raw materials. Railroad officials along the right-of-way were bribed and the train successfully rolled into Holland. With this success, Fokker resolved to try again and before he was through, six trains of sixty cars each had been passed into Holland. He had smuggled the entire contents of one of the largest German aircraft factories into Holland. He even took one hundred and fifty German workmen with him!

In Germany Fokker had experimen-

(*Continued on page* 22)

Manufacturing Engineering

By J. A. MILLER

Mr. Miller is Division Staff Supervisor, Mfg. Engr. Dept., Transportation & Generator Division, Westinghouse Electric Corp. *This paper was contributed to the ASME Diamond Jubilee Semi-Annual Meeting, Boston, Mass.—June 19-23, 1955.*

INTRODUCTION

Does your organization have a "key" which opens the door between engineering design and manufacturing processes? How often have you been confronted with the problem of either having a sound engineering design that costs too much to manufacture profitably or conversely, a new manufacturing technique that apparently does not have application to existing designs? Certainly in this age of specialization of industrial personnel, these and many other problems involving the correlation of rapid advancements in both engineering principles and manufacturing techniques confront industrial management. Just as certainly, it is extremely difficult, if not impossible, to have within either of these two separate phases of an organization sufficiently experienced or trained personnel to correlate advancements.

Through the introduction of a third member to the organization, the Transportation and Generator Division of Westinghouse Electric Corporation has found a means of bridging this gap and providing a "key" with which to open this double-swinging door.

This third member of the organization, by the very nature of its being, has been called "Manufacturing Engineering." Its introduction has produced some outstanding results, and its role in the future planning of the division is becoming every day of increasingly greater importance. Recognizing that the nucleus of this group is still in the formative stage, and that modifications in both organizational structure and functional responsibilities will have to be made as experience is gained, it is still believed that at this time the experience gained and the results achieved are of such import as to merit a presentation at this session.

FUNCTIONS AND RESPONSIBILITIES

Basically, the Manufacturing Engineering organization is a staff function with direct responsibility to the manager of the manufacturing organization. As such, it is the responsibility of this group to assist him in the control of manufacturing costs and instigate whatever action is deemed advisable in the development of new methods, processes, or equipment to achieve this end. In addition, it is their responsibility to review and make recommendations on engineering designs that might lead to improvement from a manufacturing standpoint.

Control of Manufacturing Costs

The control of manufacturing costs is probably accomplished most satisfactorily through the action of a cost-reduction program which has been formed within the division. The responsibility for the co-ordination of this program lies with the Manufacturing Engineering Department. This program has been so established that all basic functions of the operating division work jointly on reductions in material, labor, and overhead costs. Through the instigation of co-ordinators within the Engineering, Manufacturing, Production, and Purchasing Departments and the establishment of various working subcommittees, the program is self-activating and perpetuating in nature. By establishing "bogies" or "goals" for each of the various committees, an over-all divisional Cost Reduction Program is obtained. Each of the subcommittees meets semi-monthly and through the review of dockets on the ideas for cost reductions, which pertain to their particular activity, progress is systematically insured. Monthly summaries and the relationship of each committee's progress toward its goal are prepared by the Manufacturing Engineering Department based on monthly reports submitted to them. These monthly reports are reviewed closely by both this department and the Accounting Department to insure their accuracy and to make certain that these reductions are reflected in the costing system.

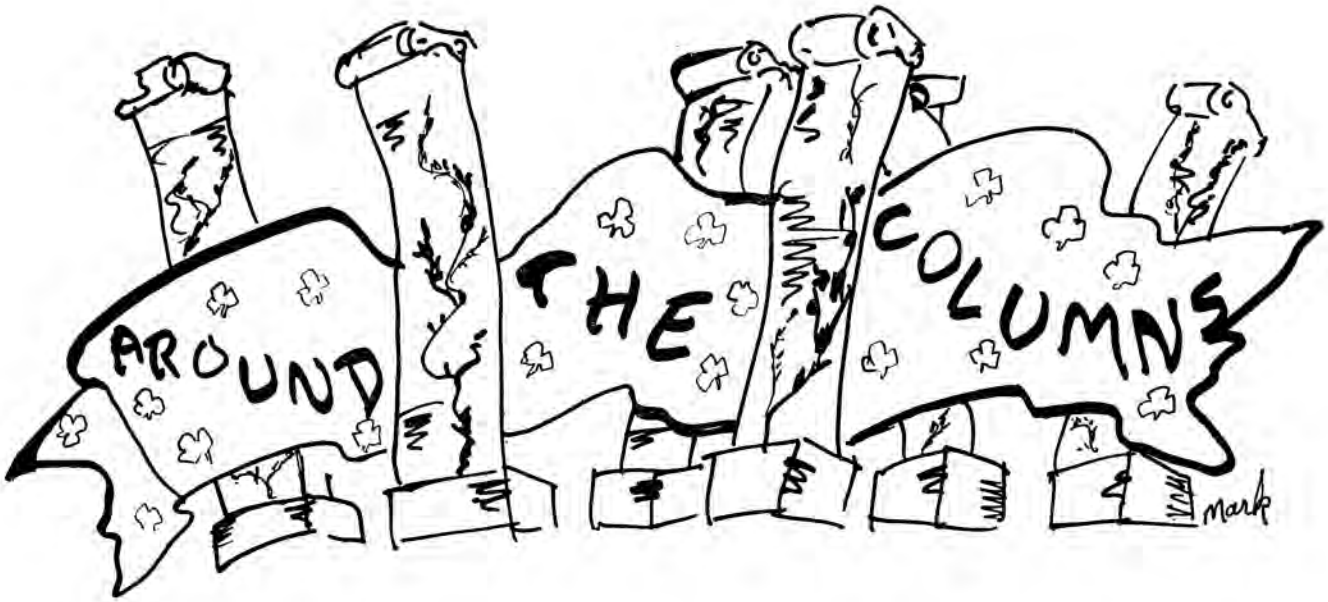
By effective co-ordination of the efforts of these subcommittees, it is also possible to correlate the action on dockets originated within one function which may pertain to a combination of other functions. In addition to the co-ordination of the entire program, personnel within the Manufacturing Engineering Department serve as active members of the various subcommittees. For example, personnel within the department sit in with the Engineering Department subcommittees when reviews of engineering designs are made. They also sit in with the various manufacturing section subcommittees, which are usually comprised of representatives of line supervision and the Quality Control and Time Study Departments. By sitting in on these various subcommittees, a transplanting of information between committees is easily obtained.

Outstanding results have been obtained through the Cost Reduction Program, not only in reductions in manufacturing costs but also in improved designs, better materials, and improved product quality.

Developing New Tools and Processes

One of the paramount problems within the Transportation and Generator Division, whose products are generally not standardized, is in the development of new processes, tools, equipment, etc., with a minimum of lost production time. Generally speaking, the product repetition is limited to such an extent, and the apparatus is of such a physical size, that production and development must proceed hand-in-hand. As a solution to this problem, the Manufacturing Engineering Department is presently installing and

(*Continued on page* 24)



By JERRY HERDAN, M.E. '57

NEW FEMININE ENGINEERS HERE AT MIZZOU

The faculty and personnel of the Engineering School, as well as the Shamrock Staff, join together in extending a warm welcome to the new students, and the old, and particularly to the four new female engineers of this Fall. It is apparent that from year to year more girls choose the field of engineering here at Mizzou. We can credit these girls with courage and valor for pioneering in this new era of "women engineers." We would like for you to meet each and every one of these girls as the year rolls on. At the exact moment you are probably not with one of them, so let us tell you what we have learned from meeting them, and the information should be of some avail for your use.

Marie Ann Rabyor, a Freshman in E.E., is from Kansas City, Mo. She is currently eighteen years old. Asked why she chose engineering here at Mizzou she replied, "I want to work for an aircraft company. I like mathematics and the sciences and I can't stand foreign languages." She has already joined the Engineer's Club—not going to waste any time doing things. When asked if she planned on attending our fabulous "picnic" this Spring, the reply was, "NO." But we wondered if she objected to the fellas drinking ale: "Not if they can hold it!" She wanted to take flying lessons this summer, but it was either them or clothes for school—well now, no one should have trouble making that decision. She took clothes!

Charlene Korando, age 21, from South St. Louis says, "Mathematics is interesting to me; and I feel there are many opportunities in the Chemical Engineering field." She's a Freshman Chem.E. and a member (we sure love these early birds) of the Engine Club. Charlene has worked for four years in the analytical lab of the Ralston Purina Food Company in St. Louis, Mo. We asked: are you going to the "picnic"? "I don't know yet." (Ed. note: All these girls will probably be there after their run-in with the courses here.) Charlene wishes there were more girls in engineering here at Mizzou (we agreed).

Mrs. Betty M. Gollahan is enrolled in Mechanical Engineering. She is, however, not a new student at the University of Missouri. Mrs. Gollahan holds a B.S. degree in Physical Education from ole Mizzou, and currently applies these arts at Stephens College. Her decision to enroll in engineering was the result of vocational guidance tests taken at Kansas University. The tests indicated that she should take up engineering.

Elizabeth "Bets" Crecelius (See Cover Photo) hails from South St. Louis also. She is eighteen years old, and is going to take the Industrial Option of the Mechanical Engineering Department. "Aptitude tests indicated I should be in engineering," she says, "also many personal advisors and friends suggested the field because of its broadness and opportunities particularly for women." Miss Crecelius likes to read, play the piano, talk and swim. When asked about attending the "Spring outing," a crisp "Yes" was the answer. Her main worry is making it through Engineering School. About M.U. she replied, "I love it. I can't get over how friendly the people are."

Would like to welcome Miss Eleanore S. Schroeder and Miss Susan Brady, our other two feminine engineers; and best of luck to these six wonderful girls who have chosen the finest School on campus.

ELECTRONIC ANALOG COMPUTER SOLVES

Room 70 of the Electrical Engineering Lab is an unimpressive location for a very impressive electronic com-

(*Continued on page* 32)

NEWSTUFF

By DANIEL R. CAPPS, B.S., E.E., '56

A 300,000 MILE TIRE

A blowout-proof tire for trucks and buses that will outlast the vehicle is now a reality, thanks to a successful research program conducted at the Newburgh Works of U. S. Steel's American Steel and Wire Division in Cleveland, Ohio.

Here they have developed a high tensile, specially stranded wire for reinforcing cord. One of the nations leading tire manufacturers has started a widespread promotion of its 300,000-mile tire made with the new wire cord and is predicting that the next two years will see a 500,000-mile tire on the market.

Not to be confused with bead wire which for years has been used in the core of the bead to hold the tire on the rim, the new cord wire is built into the plies, two to four of which are formed in the carcass of the tire.

With a tensile strength of 375,000 to 425,000 pounds per square inch, far in excess of any available fabric cord, wire makes possible a safer, stronger tire with a thinner cross section. This in turn provides greater resiliency and reduces accumulation of heat. The metal-core ply also eliminates casing stretch.

Cord wire is made of high carbon steel and is supplied in coils to the processing line as a hard drawn process wire .033 inches in diameter.

This is specially heat-treated in a 30-foot furnace equipped with six lines, each containing a controlled atmosphere. After leaving the furnace, the wire is quenched, acid cleaned and then cold washed prior to electroplating. The brass plating is done in a 30-foot line.

After plating, the wire is cleansed in boiling water, dried and then coiled. At this point, it is given a tensile test and is also tested for weight of coating.

The coated wire is then drawn through a series of dies which impart approximately a 97 per cent reduction. One foot of process wire elongates to 33 feet of finished drawn wire which is wound on spools in 140,000 foot lengths.

The first step in preparing tire cord is a stranding operation. Three wires are stranded into cord lengths of 22,500 feet. Then seven of the triple-wire strands are layed into lengths of 22,000 feet. After straightening, the cord is ready for use in bus and truck tires.

DRAFTING TWENTY TIMES FASTER

A reduction of more than 95 per cent in time needed to produce engineering drawings has been achieved by the General Electric Company's Medium Voltage Switchgear Department. New and ingenious techniques in the use of photo-mechanical materials and processes now permit making in a matter of minutes a tracing which formerly took 6 to 18 hours.

The new techniques were perfected after extensive experiments and tests by L. G. Frankau, Supervisor of the Medium Voltage Switchgear Department's Blueprint Section and A. F. Pisacane, Supervisor of Drafting Practice. Speedy methods are needed because the department annually supplies many thousands of copies from thousands of drawings of equipment shipped to purchasers. Theoretically billions of different arrangements of components are possible and conventional preparation of drawings and tracings is too slow.

In applying these new methods it is merely necessary for the engineer or draftsman to prepare a simple coded order to the Blueprint Section. This order embodies all necessary instructions for the preparation by a clerk of a composite positive film transparency, comprising reusable positive film overlays, from which a translucent auto-positive is printed by conventional photo-mechanical methods. The auto-positive, which thus becomes the original tracing, has many advantages. It is tougher than conventional tracing paper and can stand rough handling. It has sharper contrast with dense, crisp, black lines which permit high printing speeds. Erasures can be made quickly and easily by moistening the image and using a soft eraser.

A major advantage realized in use of this system is greater drafting accuracy with a saving in time of skilled engineers and draftsmen, due to the elimination of a substantial amount of detailed sketching and checking. Several other departments of the General Electric Company are now studying the system with a view of adopting it to their operations. The new techniques are another phase of the Company's program toward streamlined drafting operations for obtaining greater efficiency.

BURBANK, Calif., Sept. 15 — Lockheed Aircraft Corporation recently announced it is stretching production lines of the new Electra turboprop airliner from Burbank, Calif., to Dallas, Tex. — under terms of the largest commercial subcontracting program in its history.

(*Continued on page* 34)

Charlie Stickels asks:

Does Du Pont hire graduates who are draft eligible?

CHARLES A. STICKELS is currently working toward his B.S.E. degrees in chemical and metallurgical engineering at the University of Michigan. Mr. Stickels is past Editor-in-Chief of the *Michigan Technic*, vice-president of his student chapter of A.I.Ch.E., and a member of several honorary engineering fraternities. His editorial work has made him especially aware of contemporary employment questions facing engineering graduates.

JOHN OLIVER, also a University of Michigan man, received his B.S. in Mech. Eng. in 1938. Right after graduation, he began working for Du Pont in the Engineering Section of its Belle, W. Va., plant. Following this came an assignment as Departmental Engineer in the Wilmington offices, and today John Oliver is again at Belle—this time as Assistant Plant Manager.

John Oliver answers:

The answer to that is definitely "Yes!", Charlie. We've employed quite a number of college graduates with definite military commitments, sometimes knowing that they could work only a few weeks before reporting for active duty.

The reason is that Du Pont is 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 being considered for employment. After working only one day, an employee is guaranteed full re-employment rights—that's the law. But if a man works for Du Pont at least a full year before joining the service, he gets a bonus of two months' salary. If 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, Charlie, we definitely recommend your talking with Du Pont's representatives—and those of other companies, too. The very least you'll gain will be valuable background and some contacts which may be 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 "Chemical Engineers at Du Pont," a booklet that tells you about pioneering work being done in chemical engineering—in research, process development, production and sales. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Delaware.

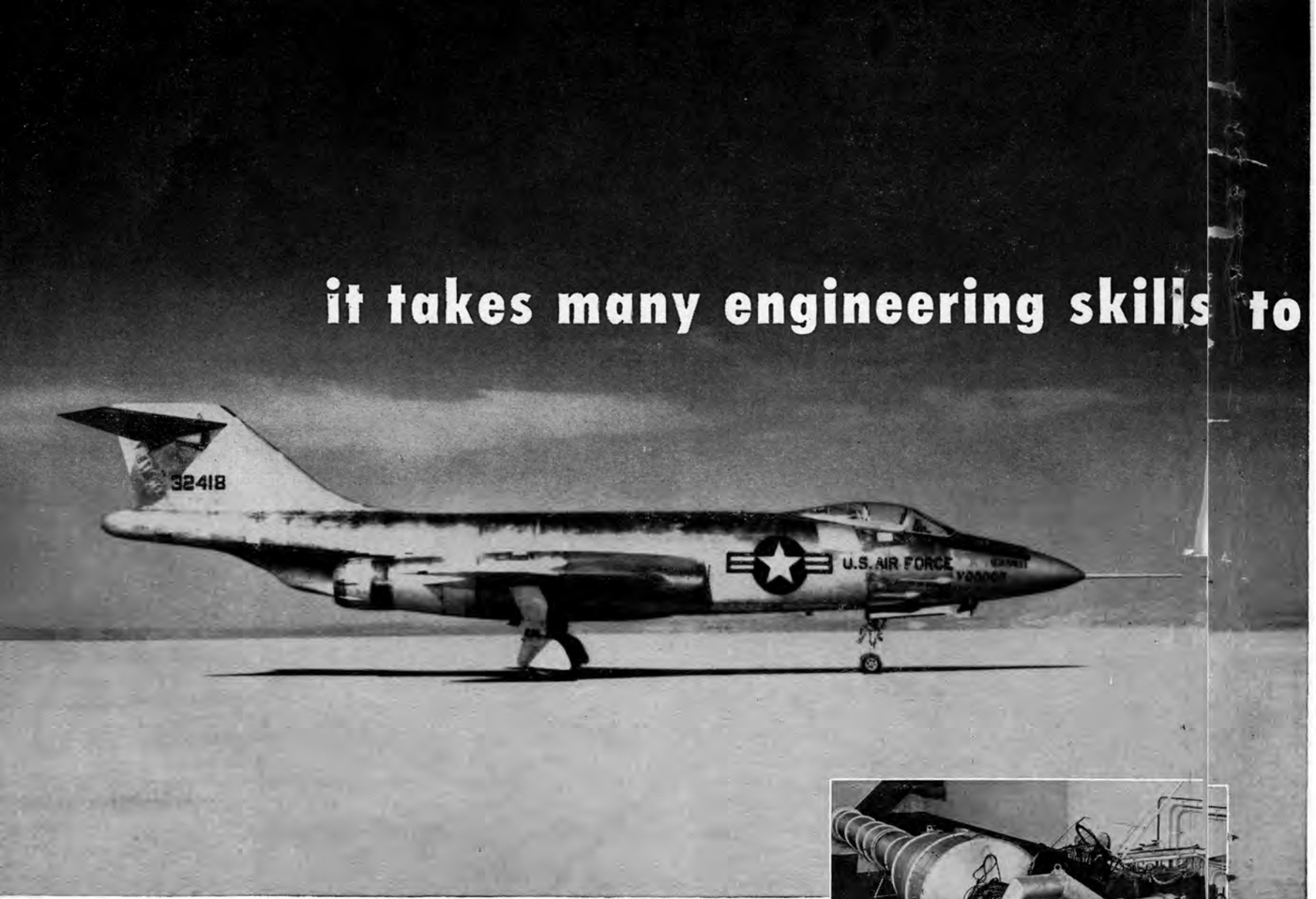
DU PONT

REG. U. S. PAT. OFF.

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

WATCH "DU PONT CAVALCADE THEATER" ON TV

it takes many engineering skills to create the top aircraft engines



McDonnell "Voodoo", *the most powerful jet fighter ever built in America.*

An aircraft powerplant is such a complex machine that its design and development require the greatest variety of engineering skills. Pratt & Whitney Aircraft's engineering team has consistently produced the world's best aircraft engines.

The best planes are always designed around the best engines. Eight of the most important new military planes are powered by Pratt & Whitney Aircraft J-57 turbojets. The first two jet transports in the United States will use J-57s. Further, no less than 76 percent of the world's commercial air transports are powered by other Pratt & Whitney Aircraft powerplants.

Such an enviable record can only be built on a policy which encourages, recognizes and rewards individual engineering achievement.

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

EAST HARTFORD 8, CONNECTICUT

World's foremost designer and builder of aircraft engines

J-57 POWERED AIRCRAFT

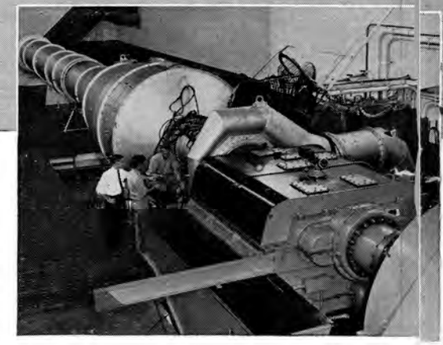
MILITARY

F-100	F8U
F-101	A3D
F-102	B-52
F4D	KC-135

COMMERCIAL

Boeing 707

Douglas DC-8



MECHANICAL ENGINEERS are concerned with many phases including experimental testing and development, mechanical design, stress and vibration analysis, combustion research, heat transfer and nuclear reactor development.

AERONAUTICAL ENGINEERS work on innumerable internal and external airflow problems concerned with design, development and testing of aircraft powerplants. Some who specialize in analytical engineering forecast engine-airplane combinations a decade in advance of design.

ELECTRICAL ENGINEERS directly contribute their specialized skills to the analysis and development of controls, systems and special instrumentation. An example is the "Plottomat" which automatically integrates and plots pressures, temperatures and air angles in performance testing.

CHEMICAL ENGINEERS, too, play an important role. They investigate the chemical aspects of heat-producing and heat-transferring materials. This includes the determination of phase and equilibrium diagrams and extensive analytical studies.

METALLURGISTS investigate and develop high temperature materials to provide greater strength at elevated temperatures and higher strength-weight ratios. Development of superior materials with greater corrosion resistance is of major importance, especially in nuclear reactors.

WORLD'S MOST POWERFUL production aircraft engine. This J-57 turbojet is in the 10,000-pound thrust class with considerably more power with afterburner.

FLYING DUTCHMAN

(*Continued from page* 15)

ted with a commercial type of airplane, the F-2. He had constructed one and had it flown into Holland. Thus, he was ahead of the competition in the commercial field, also. The F-2 was a five passenger plane in which the passengers sat in a closed cabin and the pilot rode in an open cockpit. It had a cantilever wing similar to that on the D-8. The wing was mounted atop the rectangular steel tube fuselage. The pilot's cockpit was just in front of the wing and directly over the engine. One can imagine the discomfort of such an arrangement.

With the F-2 design Fokker was able to establish a secure business in his homeland. In addition to his sales in Holland, he also exported airplanes. The United States Army Air Force bought a few of his aircraft. Among them was the Fokker T-2 which made the first non-stop flight across the United States, with Lieutenants Kelly and Macready at the controls. This 1923 flight was from New York to San Diego and lasted twenty six hours and fifty minutes. The account of the flight indicates that the pilots were very brave men, indeed. The airplane was hardly able to take off because of its great load of fuel and then was unable to gain appreciable altitude until it had crossed the state of Pennsylvania. During all of this part of the flight the pilot had to dodge hills because he could not go over them. When they reached the Rocky Mountains the fuel was largely consumed but the hills were higher and they had to repeat their "dodging" tactics. This plane can now be seen at the Smithsonian Institute.

In 1922 Fokker had established an American branch of his business, under the name "Atlantic Aircraft Corporation". It was primarily a manufacturing venture, however, most of the design work still being done in Holland. Because of this business interest, Fokker began to take part in various aviation events in America. Among them was the Ford Reliability Tour of 1925. For this event Fokker altered a standard F-7 single engine plane by adding two more engines, one under each wing. The resulting design won the Reliability Tour and created a sensation in the industry. It opened the "Trimotor" airliner era in America. The original plane was purchased by Richard E. Byrd under the auspices of Henry Ford. Rechristeden "Josephine Ford", it made the first flight over the North Pole in 1926. Byrd and Floyd Bennett were the pilots.

Fokker Trimotor F-10

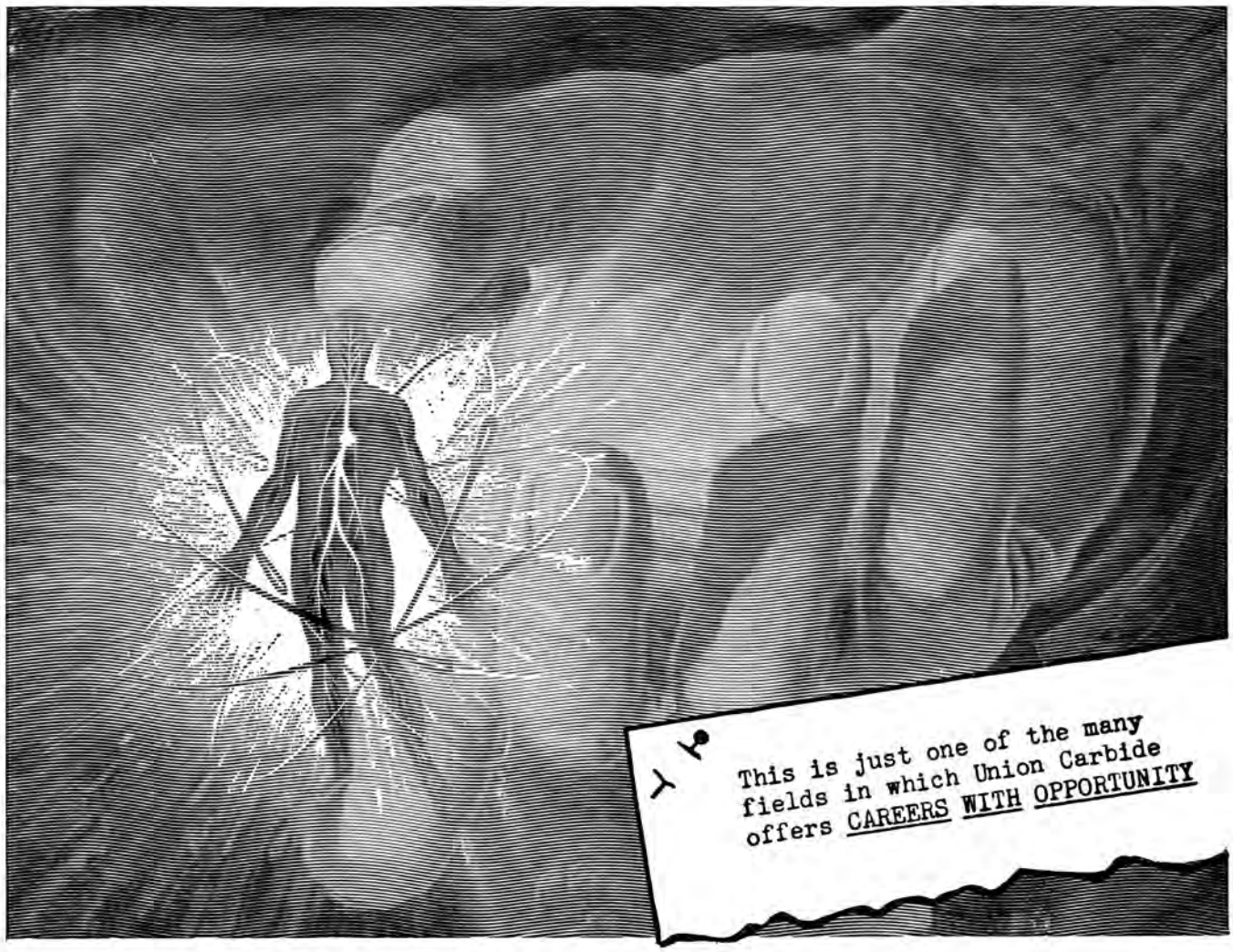
In the period 1925-1928 a number of spectacular flights were made. Fokker Trimotors figured prominently in these flights. Perhaps the most publicized of the Fokker flights was the flight from New York to Paris in 1927. A number of groups were competing to be first across the ocean, among them Clarence Chamberlain in a Bellanca single engine monoplane, Charles Lindbergh in a Ryan single engine monoplane and Richard E. Byrd in a Fokker Trimotor. Byrd always emphasized the scientific approach to his flights. To what extent this was justified is problematical, but the delay inposed by the "scientific" method of preparation was enough to allow both of the other aspirants to make their flights first. Lindbergh was first; Chamberlain and his passenger, Charles A. Levine were next; then came Byrd in the "America." With him were George O. Noville, radio operator, Bert Acosta and Bernt Balchen, pilots.

The main thing these flights proved was the wonderful reliability of the Wright Whirlwind engine which was used in all three planes.

Another flight in a Fokker Trimotor was actually much more important. This was the flight from Oakland, California, to Hawaii by Lieutenants Maitland and Hegenberger of the Army Air Force. Here the destination was a tiny pinpoint in a vast ocean, a much more difficult target than the whole coast of Europe. Their airplane, the "Question Mark", was equipped with radio receiving instruments and shore stations sent a signal to guide them on their path. This was the first use of a radio guide beacon on an extended overwater flight, a truly scientific achievement.

Until the end of this period Fokker had held an enviable position as a designer. His designs were always in the forefront of aviation progress. Perhaps the first indication that this might not always be so was the Ford Trimotor. It was an obvious copy of the Fokker design but with the important exception that it was an all metal aircraft. The similarity was less important than the difference. As Fokker continued to cling to his wooden wing and tubular steel fuselage, other designers began to think in terms of stressed skin metal structures. The technical term for this type of construction is "monocoque" and it means that the skin or covering of the airplane is an integral part of the load carrying structure of the airplane. Later Fokker designs were more reactionary than revolutionary. Among the more notable of these were the F-32, a huge landplane with two engines in tandem slung under each wing, the F-20, a super streamlined Trimotor, the D-23, a pusher-tractor fighter design, and the G-1, a fighter plane closely resembling the Lockheed Lightning. The latter two planes, which appeared in 1939, must have the dubious distinction of being among the last planes Fokker personally worked on. He passed away in 1939 as the war clouds were once more gathering in Europe. He was forty-nine years old.

The Fokker Company still exists in Holland and they have learned to build aircraft in metal quite well. The Fokker Company was among the first to build a jet airplane especially for training purposes. They are continuing the proud tradition of Tony Fokker.



Your health will be better since doctors can now use

the voice of the atom

DOCTORS have long wanted to learn more about the human bloodstream—how it supplies nourishment . . . defends against disease . . . becomes diseased, itself.

THAT WISH IS REALITY today, because atomic energy has given a voice to certain of nature's elements. When these elements are exposed to the powerful radiation of splitting atoms, they become radioactive, themselves, and are called *radioisotopes*. The radiation they give off can be detected and heard with special instruments.

Now doctors introduce isotopes of iodine, iron, sodium, or other elements into the bloodstream. Their course can then be followed to determine the location and nature of the trouble. Isotopes are also becoming increasingly important in actually treating ailments.

ISOTOPES are being used in similar fashion by industry and agriculture to analyze materials, measure wear, control processes, and to help answer mysteries of how plants absorb nourishment from the soil and how it affects their growth and health.

THE PEOPLE OF UNION CARBIDE operate, under Government contract, the Oak Ridge National Laboratory, the Nation's chief source of radioisotopes, as well as the huge atomic materials plants at Oak Ridge and Paducah.

STUDENTS AND STUDENT ADVISERS: *Learn more about career opportunities with Union Carbide in* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Write for booklet 5E-2.*

UNION CARBIDE
AND CARBON CORPORATION
30 EAST 42ND STREET UCC NEW YORK 17, N. Y.
In Canada: UNION CARBIDE CANADA LIMITED

UCC's Trade-marked Products include

SYNTHETIC ORGANIC CHEMICALS · PRESTONE Anti-Freeze · EVEREADY Flashlights and Batteries · PREST-O-LITE Acetylene · Dynel Textile Fibers · ELECTROMET Alloys and Metals · HAYNES STELLITE Alloys · UNION Carbide · LINDE Oxygen · LINDE Silicones · BAKELITE, VINYLITE, and KRENE Plastics · NATIONAL Carbons · ACHESON Electrodes · PYROFAX Gas

MANUFACTURING ENGINEERING

(*Continued from page* 16)

equipping a Manufacturing Laboratory. This laboratory provides a means to overcome the problem of lost production time due to development, and has expedited development completion. It has also provided a means of establishing the process completely, the sequence of operations, a time-study breakdown, and a place in which systematically to train the operators. Development work, conducted by personnel genuinely interested in its successful completion, free from production schedule pressure, and systematically conducted is, needless to say, a most desirable goal.

Manufacturing Development Budget

One of the important factors in the successful conduct of this development work has been the establishment of a manufacturing development budget. This budget, annually organized and requested by the Manufacturing Engineering Department, provides a means with which investigations and development work can be conducted in an expeditious manner. Appropriations for major expenditures are, of course, not generally included within this budget. However, much information is gained by the expenditure of these funds in the investigation of new methods, processes, and designs. Manufacturing process tests can be run in conjunction with engineering design tests. Experience has shown that even though all such investigations are not successful, a very sizeable return on the investment is obtained.

Production Schedules

The establishment of detailed routing to the proper manufacturing section and assistance in maintaining production schedules are other important responsibilities of the Manufacturing Engineering Department. Generally speaking, routing is established on the basis of most economical manufacturing cost, and for this reason, the manufacturing engineer must keep abreast of new designs and the changes in manufacturing - process costs throughout the shop. It is his responsibility to confer with the interested line and staff personnel so that accurate manufacturing costs are available and agreement is reached on any changes in routing.

Assistance in maintaining production schedules is another function of this department, even though it does not always directly involve controlling the cost of manufacturing. Customer satisfaction plays an important part in this activity and indirect increases in costs of manufacturing may or may not be involved. Technical assistance in overcoming production bottlenecks may be required. This may produce required changes in the manufacturing process, the application of special tooling or fixturing, or recommendations for the purchase of additional equipment. Often a review with the Engineering Department results in a change in design to alleviate the condition. In other cases, an investigation of these problems may result in a recommended temporary re-routing of parts to another manufacturing section or even to an outside supplier. As business cycles rise and fall, it is often necessary to send work to outside suppliers or obtain work from outside concerns in order to maintain properly loaded manufacturing facilities. Assistance to and co-ordination of efforts on the parts of these suppliers or customers, as the case may be, is also a function of the department.

Study of Manufacturing Processes

The necessity for constant surveillance of manufacturing processes and sequences make the manufacturing engineer a vital member in plans for the purchase of new equipment and the rearrangement of existing equipment. He is often called upon to establish the manufacturing facilities, floor area, and man-power requirements to produce new products or existing designs requiring a change. Changes in volume of business also often require the expansion or contraction of facilities to meet desired schedules or to minimize transportation and material handling problems.

Close co-ordination with the Design Engineering Department is a major responsibility of this department. Regularly scheduled visits to the Engi-

(*Continued on page* 26)

RCA's New Orthophonic High Fidelity Sound Opens a New World of Music

From Ceylon to Chile, people of the world can now enjoy a wonderful new kind of recorded music.

This is made possible by RCA's development of New Orthophonic Sound that weds the beautiful tone of RCA Victor records with the superb performance of new high fidelity "Victrola" phonographs. Born of RCA's acoustical and electronic research, New Orthophonic Sound reproduces a noticeably wider range of sound frequencies, perfectly balanced for musical realism.

The experience and skill behind this achievement are inherent in all RCA products and services. And continually, RCA scientists at the David Sarnoff Research Center in Princeton, N. J., are working toward new thresholds of "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.

NEW ORTHOPHONIC HIGH FIDELITY "VICTROLA" PHONOGRAPH, $129.95
With Panoramic Speaker System — 3 speakers scientifically angled to diffuse sound throughout room. Mahogany or modern oak finish. Legs optional, extra. Model 6HF5. Other high fidelity instruments to $1600.

RADIO CORPORATION OF AMERICA
ELECTRONICS FOR LIVING

MANUFACTURING ENGINEERING

(*Continued from page* 26)

neering Drawing Department are made daily to review completed tracings with the engineering representatives. This review is made with the intent of noting and correcting problems which might occur as the result of the tracing itself or the design called for. In addition, frequent consultations are made at the time the tracings are on the drawing board. Such problems as finish requirements, welding requirements, tooling required, types of materials, suitability for efficient machining techniques, ease of assembly, and tolerance requirements are reviewed. A system requiring that all tracings receive a manufacturing engineer's initialed approval has been established, thus insuring that a thorough review is made of each new design. This approval must occur before the tracing can be released for manufacture.

In addition to the system of reviewing drawings, regular committees have been established within the Engineering Department and a manufacturing engineer is a regular member of each of these committees. Semi-monthly meetings are held to review cost data on lines of apparatus. Those items requiring attention are scrutinized from a design standpoint with the intent of introducing design changes which will not only improve manufacturing costs but performance as well. Major reductions in cost have been achieved in this manner and such reviews have led to radical departures in design practices resulting in major design improvements.

Organization Structure

As in the case of any staff department, it is essential that the personnel within the Manufacturing Engineering Department be so organized that their functions tie in directly with the other departments with whom they contact. Since, in the case of the Manufacturing Engineering Department, the primary contacts are with the Product Design Engineering Department and the shop manufacturing section supervisors, their organization must be patterned to deal effectively with each.

Engineering departments are usually organized by lines of apparatus or machines. The shop manufacturing sections on the other hand, with the exception of assembly sections, are generally grouped by similarity of processes. Normally this would mean that such operations as fabricating (burning, welding, shearing, etc.) machining, and other pre-assembly operations would be grouped together without too much regard for type of apparatus, with size being the main criterion for segregation. Other staff organizations then are generally patterned so that their structure is basically the same as one or the other of the foregoing organizations.

The Problem of Co-Ordination

This condition, in the case of the Manufacturing Engineering Department which must function equally well in conjunction with both the Engineering and Manufacturing Sections, poses a problem in organizational structure. Some industrial divisions have resolved this problem by creating an organization, with responsibilities similar to the Transportation and Generator Manufacturing Engineering Department, having a structure basically the same as the shop manufacturing sections. This type of organization works satisfactorily on manufacturing process development, but leaves much to be desired on an over-all product co-ordination of costs, routing, and design. In addition, co-ordination with the Engineering Department is extremely difficult because of the multiplicity of personal contacts required.

Another solution to this problem has been found in the creation of two separate "Manufacturing Engineering" organizations, one patterned along Engineering Department structure and the other along the lines of the Manufacturing Section organization. This does resolve the problem of over-all product co-ordination of design and costs, but again it presents a problem of overlapping responsibilities and makes co-ordination of efforts of the personnel within the two parts of the organization extremely difficult.

Single Organization Desirable

Experience gained within the Trans-

(*Continued on page* 28)

Build your future on these 3 Growth Industries...

MANUFACTURING — There are 51 Allis-Chalmers motors in this lineup of machine tools designed for high automobile production.

CONSTRUCTION—Crushers like these from Allis-Chalmers process the enormous quantities of aggregate for the booming construction industry.

THERE IS much talk today about growth companies. Allis-Chalmers is one of them, supplying machinery for three basic industries—manufacturing, construction and power.

Therein lies an opportunity for you, since Allis-Chalmers builds many types of equipment.

. . . for a manufacturing industry that must increase output $3.5 billions by this time next year.

. . . for the construction industry that is destined to spend many billions of dollars on highways in the next ten years.

. . . for the electric power industry that will double its capacity by 1956.

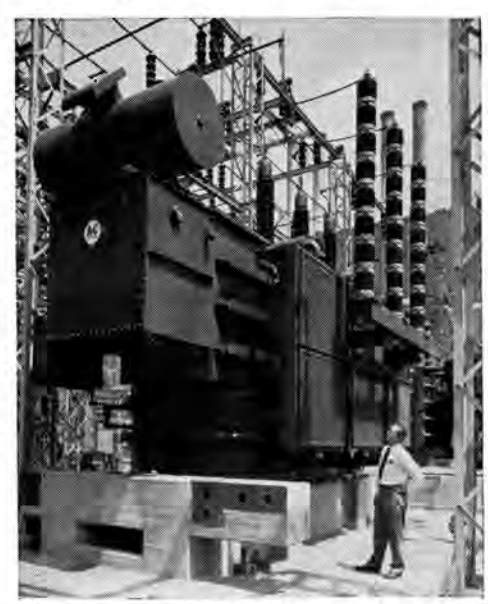
Here's what Allis-Chalmers offers to Young Engineers:

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.



POWER GENERATION—Allis-Chalmers is helping meet growing power demand with equipment such as this 150,000 kva transformer.

A-4684 **ALLIS-CHALMERS** A-C ALLIS-CHALMERS **Plants and Sales Offices all over the World**

MANUFACTURING ENGINEERING

(*Continued from page* 26)

portation and Generator Division which has a multiplicity of products and a wide range of manufacturing processes, indicates that a single organization of Manufacturing Engineering is desirable. Basically, this organization is comprised of two parts, under the guidance of separate supervisors, but co-ordinated within a single department by a departmental supervisor. One part of the organization consists of personnel who are grouped by lines of apparatus or products. These apparatus or product groups are directed by a group leader and have a responsibility for the overall co-ordination of costs of a particular type of apparatus. The other part of the organization consists of personnel who are organized by manufacturing processes. These process, or as they are called within the Transportation and Generator Division, "service-groups," act as consultants to the "apparatus-groups" and, in addition, spend considerable time on the development of manufacturing processes in the combined apparatus manufacturing sections. This organizational structure provides both overall product co-ordination, and at the same time, provides a workable solution to the problem of manufacturing process development with a minimum of overlapping of responsibilities and efforts. In addition, maximum use is made of the talents of the entire group so that machining, fabricating, and other process experience is provided for all lines of apparatus, and projects which entail development common to more than one line of apparatus are easily coordinated.

Department Size

The correlation of the size of a Manufacturing Engineering Department to the other phases of the division is a very important factor for consideration. It is also necessary to consider the problem of personnel assignments within the Manufacturing Engineering Department relating to the types and volumes of products being manufactured by the Division.

On some kinds of work, it is possible to measure a man's worth directly in dollars and cents, and consequently, manning a department to the optimum point of return is easily accomplished. In other cases, however, where a major portion of a man's work is involved in intangible and indirect costs, such a measurement is extremely difficult. Certainly it can be agreed that a return in divisional profits, which is three to four times an engineer's cost to the division in salary and indirect expenses, is a very desirable circumstance.

Detailed studies, with sufficient data to verify them, have not been made, but some preliminary observations have indicated that the work of some manufacturing engineers has resulted in cost-reduction reports of several thousand dollars per month due in the main to their efforts. A minimum figure of a return of 25 per cent over the cost to a division in salaries and expenses would represent a work-

(*Continued on page* 30)

Boeing engineers are kept free for creative assignments

Thanks to draftsmen and engineering aides, Boeing engineers are free to handle stimulating projects like this: determining antenna properties in an electrolytic tank. Results taken with the three-dimensional plotter will influence the configuration of "years-ahead" Boeing airplanes and guided missiles now in the design stage.

At Boeing, engineers have the same relationship to draftsmen and engineering aides that doctors have to technicians and laboratory assistants. The abilities of a Boeing engineer are fully utilized: in investigating heat, compressibility and other problems of supersonic flight; in jet, ram-jet, rocket and nuclear power; in electronic control of missiles, and much more—calling for a variety of skills in all the engineering fields.

This electrolytic tank is one example of the superb equipment at Boeing engineers' disposal. Other facilities include the world's most versatile privately owned wind tunnel, a new tunnel under construction, capable of velocities up to Mach 4, the latest electronic computers, and splendidly equipped laboratory and test equipment in the new multi-million-dollar Flight Test Center.

Achievements of each Boeing engineer are recognized by regular, individual merit reviews, and by promotions from within the organization. Boeing offers exceptional career stability and growth: this soundly expanding company now employs more than twice as many engineers as at the peak of World War II.

Of technical graduates at Boeing, 30% are mechanical engineers, 24% electrical, 19% aeronautical and 9% civil engineers. The remainder are chemical, metallurgical, and other kinds of engineers, and physicists and mathematicians with advanced degrees.

In planning for your professional career, look to Boeing for a truly creative job. Begin now to prepare for a place on one of Boeing's engineering teams in design, research or production.

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

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

BOEING

Aviation leadership since 1916

SEATTLE, WASHINGTON WICHITA, KANSAS

MANUFACTURING ENGINEERING

(*Continued from page* 28)

able figure to use in establishing a departmental size. Another figure advanced is 1 per cent of a division's total personnel as being profitable in establishing the department size. Contributing factors such as rapidity of design changes, volume of sales, delivery date requirements, and the organization and functioning of related staff departments all have a marked effect upon this establishment.

It is certainly difficult to measure the savings or improved product quality which might have resulted if there were sufficient personnel effectively to investigate the multitude of ideas which are originated. It is also true that the investigation of these ideas produces other ideas, which in effect creates an ever-expanding field of investigation. Experience alone is, in the final analysis, the only certain method of establishing the size of the department.

Assignment of Personnel

The assignment of personnel within the department by lines of apparatus and services, in relation to the volume of sales of a particular product, has not been found to be too successful. Probably the main factor which contributes to this apparent inconsistency of organization lies in the basic functioning of the group itself. In general, it has been found that those products which present the majority of manufacturing problems are also the ones which require the most emphasis from a quality and sales standpoint. It is thus necessary to devote considerably more attention to the solution of these problems, with the resultant effect of creating an unbalance in distribution of personnel. This can be overcome, however, by a minor shuffling of personnel without destroying the structure of the organization, and actually has, in some cases, resulted in a transplanting of ideas between product lines which might not otherwise have come to light.

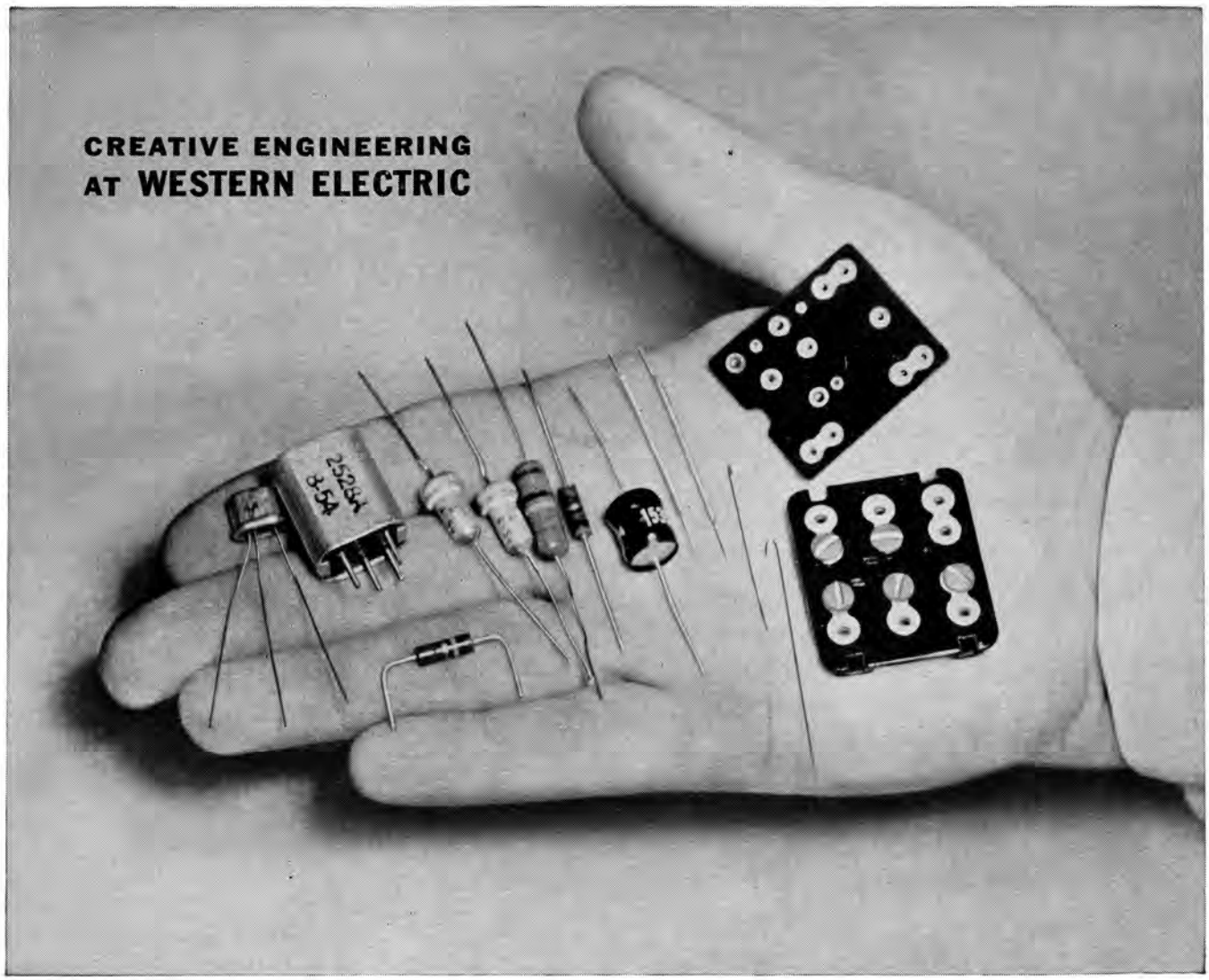
PERSONNEL REQUIREMENTS

Basically, this Manufacturing Engineering Department is composed of a combination of technically trained personnel working in conjunction with functionally experienced personnel. This, in view of the present general national shortage of graduate engineers, is, of course, of extreme importance. Present experience within the department seems to indicate, in addition, that this combination of personnel also results in a better working balance within the group. Shortcomings in practical experience within the manufacturing sections, on the part of the graduate engineers, are thus balanced by the experience of the functionally trained personnel and conversely, technical knowledge and methods of analysis, lacking in the functionally trained personnel, are balanced by the engineering background of the others. Certainly this is important in order for such a department to properly function between both the manufacturing and engineering sections of the organization.

Although, by nature of the products manufactured within the Transportation and Generator Division, many of the technical problems introduced are electrical in nature, experience has shown that the technically trained personnel within the Manufacturing Engineering Department should not necessarily be graduate electrical engineers. An organization comprised of graduate electrical, mechanical, and possibly metallurgical and industrial engineers produces a more efficient organization.

The functionally trained personnel, as in the case of the technically trained personnel, should be people with diversified backgrounds. The great number of problems concerning machining and the rapid advancements being made in cutting tools and methods make it mandatory that personnel with machining experience be included within such a group. A careful screening of graduate machine apprentices provides a very satisfactory source of manpower. In addition, a screening of other personnel within the manufacturing organization will produce people with experience and

(*Continued on page* 32)



Use of the transistor in Bell telephones

Shown here are the parts of the small amplifying unit in Western Electric's new Volume Control Telephone.

Because of the use of a transistor (shown above, extreme left on index finger) this amplifying unit is no larger than an ice cube and can fit inside the housing of a standard telephone.

Manufacturing of transistors on a commercial basis represents a solid engineering achievement... for it means volume production of an item that must be made under rigidly controlled laboratory conditions. For example, harmful impurity atoms in the germanium must be reduced to less than 1 for every 10,000,000,000 germanium atoms and then helpful impurity atoms added until there is approximately 1 for every 50,000,000 germanium atoms.

Western Electric has been making transistors since 1951 when our engineers set up the first commercial production line. This history-making achievement is representative of the way we work as the manufacturing unit of the Bell System... translating Bell System designs and inventions into the many things—from tiny semi-conductors to huge switching systems—used in the nationwide Bell telephone network.

It's a job that presents an unending challenge to our engineering staff.

VOLUME CONTROL TELEPHONE:
A twist of control knob increases listening volume... a boon to those who have difficulty hearing.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

Manufacturing plants in Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Burlington, Greensboro and Winston-Salem, N. C.; Buffalo, N. Y.; Haverhill and Lawrence, Mass.; Lincoln, Neb.; St. Paul and Duluth, Minn. Distributing Centers in 29 cities and Installation headquarters in 15 cities. Company headquarters, 195 Broadway, New York City

MANUFACTURING ENGINEERING

(*Continued from page* 30)

manufacturing "know-how" that can be used to great advantage within the Department.

By nature of the Manufacturing Engineering Department's functions, it is essential that, in addition to having a good technical or functional background, the personnel within the Department have certain other personal attributes. In order to function properly with the many personnel of the other departments with whom contacts are made, the ability to express thoughts clearly, create good impressions, and think clearly, become of prime importance. The manufacturing engineer, in a sense then, becomes a combination of technician, salesman, politician, and analyst. Experience thus far gained indicated that a system of pretesting personnel before their addition to the group can do a great deal toward satisfying the stated condition. Correlation of these test results with job performance has proven this rather conclusively.

Training Ground for Management Personnel

It should be noted that the department serves the division as a valuable training ground for future management positions. Its wide coverage of work and the contacts that, of necessity, are made are valuable experience for potential supervisory personnel. Because of the high personal characteristics required of its personnel and the chance for observation of the performance of these individuals, many opportunities for advancement have been opened to personnel within the department. These personnel obtain a broader view of the division's operations than would be possible in almost any other line of endeavor.

CONCLUSIONS

In summarizing, it would be well to briefly review the role played by the Manufacturing Engineering Department within the operations of the Transportation and Generator Division of the author's company. As a department, it is organized to serve as a control on manufacturing costs, product quality, and delivery completion. It has, from a standpoint of facilities, funds, and experience, the ability to review problems arising in either manufacturing or engineering, and through co-ordination of thinking and efforts on the part of both, expeditiously to resolve the problem. Because of the nature of its work and allowed freedom of movement within the division, it is able to initiate or assist in the development, follow, and application of improved methods, processes, tooling, equipment, and work-area facilities. It has, through the resultant cost savings attained, proven that such a department can be a very valuable asset to the operation of the division.

The Manufacturing Engineering Department is truly a "key" to unlocking the door between engineering design and manufacturing processing with a resultant increase in production and quality and a reduction in manufacturing costs. Through its proper functioning, the door is opened for the ready admittance and rapid transference of new developments into actual production.

AROUND THE COLUMNS

(*Continued from page* 17)

puter. This "gadget" (See background of Dean Croft's photo elsewhere in this issue) solves differential equations in a few thousands of a second. It is used for research and by seniors here at M. U. The computer is utilized in engineering problems. For example: "controls such as for industrial processes, engines, vehicles in all media, and servomechanisms; vibrating systems and shock stabilizers; mechanism of physiological response; chemical reactions; and electronic circuitry itself."[1]

The equipment is manufactured by the George A. Philbrick Researchers, Inc. of Boston, Mass. "They work entirely electronically, having no moving parts such as motor drives or servo gears or mechanical recorders."[1] Professor E. J. Vredenburgh, in charge of operations of the computer, explained that the solution to a given problem is in the form of a curve produced on the machines oscilliscope screen, and must be interpreted from there. The famous Land Polaroid camera (pictures ready in sixty seconds) is used to photograph the observed curves (answers).

NEW FIELD ENGINEER

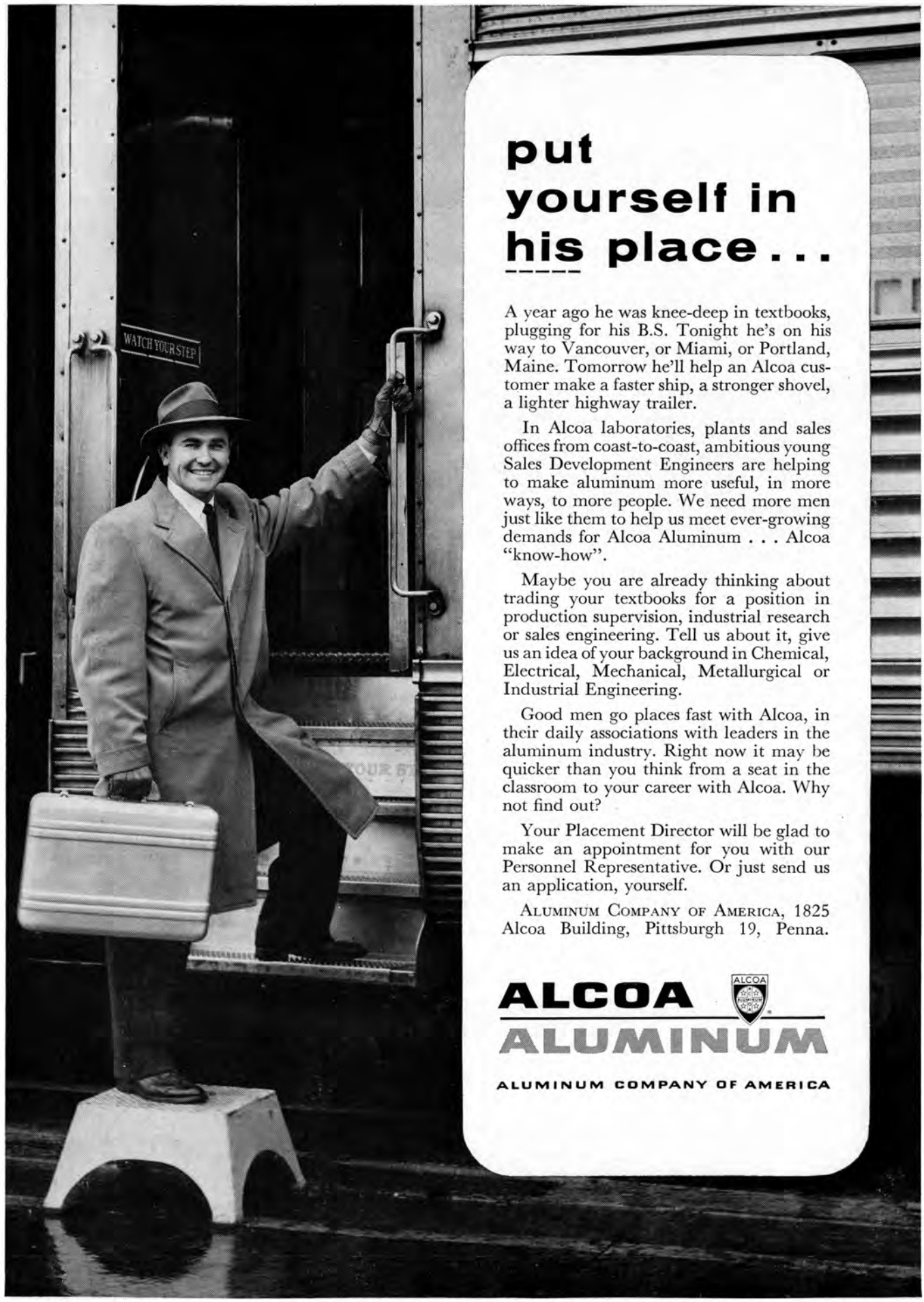
Keith M. Saville is the new field engineer for the Calcium Chloride Institute. He will provide engineering service for users in the Eastern coastal states from northern Virginia to the New England states. He will work out of Washington, D. C.

Keith is from the District of Columbia Department of Highways where he served as a materials engineer since May, 1954, following his service with the U. S. Army Corps of Engineers, as instructor at Fort Belvoir, Va. He graduated from the University of Missouri in 1951 where he received his Civil Engineering degree.

It is interesting to note that Keith is the tenth member of the Saville family to receive a degree from the University, including his father Virgil

(*Continued on page* 34)

[1]From the general catalog, G. A. Philbrick Researchers, Inc., Boston, Mass.



put yourself in his place . . .

A year ago he was knee-deep in textbooks, plugging for his B.S. Tonight he's on his way to Vancouver, or Miami, or Portland, Maine. Tomorrow he'll help an Alcoa customer make a faster ship, a stronger shovel, a lighter highway trailer.

In Alcoa laboratories, plants and sales offices from coast-to-coast, ambitious young Sales Development Engineers are helping to make aluminum more useful, in more ways, to more people. We need more men just like them to help us meet ever-growing demands for Alcoa Aluminum . . . Alcoa "know-how".

Maybe you are already thinking about trading your textbooks for a position in production supervision, industrial research or sales engineering. Tell us about it, give us an idea of your background in Chemical, Electrical, Mechanical, Metallurgical or Industrial Engineering.

Good men go places fast with Alcoa, in their daily associations with leaders in the aluminum industry. Right now it may be quicker than you think from a seat in the classroom to your career with Alcoa. Why not find out?

Your Placement Director will be glad to make an appointment for you with our Personnel Representative. Or just send us an application, yourself.

ALUMINUM COMPANY OF AMERICA, 1825 Alcoa Building, Pittsburgh 19, Penna.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

ALCOA ON TV brings the world to your armchair with "SEE IT NOW" featuring Edward R. Murrow. Tuesday evenings on most CBS-TV stations.

AROUND THE COLUMNS

(*Continued from page* 32)

B., now district engineer, Missouri Highway Department.

Keith is 26 years old, married, and a member of the American Society of Civil Engineers.

The Engineers Wives held their annual Fall family picnic at Cosmopolitan Park Saturday night, September 17th. About 75 adults and children attended. Games and prizes were enjoyed by all.

NEWSTUFF

(*Continued from page* 18)

Four prominent aviation manufacturing firms have been awarded contracts to engineer and build complete sections of the new Electra, according to Burt C. Monesmith, vice president and general manager of Lockheed's California Division. Agreements have been signed with:

Menasco Manufacturing Co., Burbank, Calif., to produce all landing gear;

Northrop Aircraft, Inc., Hawthorne, Calif., to build the Electra's empennage (tail);

Rohr Aircraft Corp., Chula Vista, Calif., to make up so-called power packages, the complete engine-nacelle installations for fitting to the new airliner's wing;

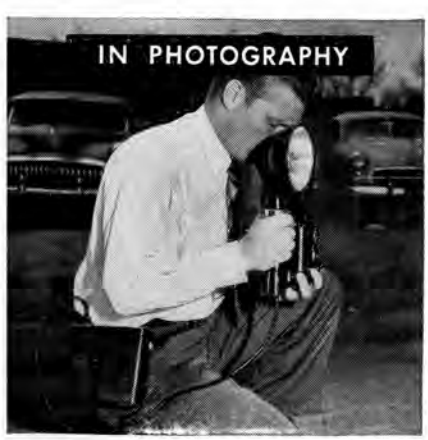
Temco Aircraft Corp., Dallas, Tex., to manufacture wing flaps and ailerons.

The multi-million dollar program is designed to (1) speed production of the Electra to meet airline demands and (2) ease heavy loads on Lockheed's engineering manpower and production facilities, taxed by the aircraft firm's present production of three new civil types of Super Constellations concurrently with the Electra.

"We shall provide each subcontractor with the basic engineering design and specifications," Monesmith said, "but they will be responsible for all the rest of the work—detail engineering, planning, tooling and manufacture—on a given section of the plane."

"Lockheed, of course, will retain the ultimate responsibility for qual-

(*Continued on page* 38)



HONEYWELL OFFERS DIVERSIFIED OPPORTUNITIES

THE opportunities for engineers in the automatic control field are unique in their variety and in the insight provided into all of the industries of today's modern world.

The development and manufacture of tiny transistors for electronic control . . . the design and manufacture of quality electronic photo flash units . . . the challenge of finding fish with underwater sonar . . . of providing automatic flight for supersonic jets . . . temperature controls for today's modern home . . . for atomic piles . . .

These are a few of the fields in which Honeywell's several divisions are engaged, providing automatic controls for industry and the home.

These controls are made possible by the creative imagination of highly trained engineers working with the very latest research and test facilities.

With twelve separate divisions located throughout the United States and with factories in Canada, England and Europe, Honeywell offers unlimited opportunities in a variety of challenging fields. Based on diversification and balance between normal industry and defense activities, Honeywell will continue to grow and expand because automatic control and instrumentation are so important to the world's progress.

That is why we are always looking for men with ideas and imagination and the ambition to grow with us. In addition to full time engineering and research employment we offer a Cooperative Work Study program, a Summer Student Work Study program and Graduate Fellowships. If you are interested in a career in a vital, varied and diversified industry, send the coupon for more information.

MINNEAPOLIS
Honeywell

First in Controls

Division: Appliance, Aeronautical, Commercial, Doelcam, Heating Controls, Heiland, Industrial, Marine, Micro Switch, Ordnance, Transistor, Valve.

MINNEAPOLIS-HONEYWELL
REGULATOR CO.
Personnel Dept., Minneapolis 8, Minn.

Gentlemen: Please send me your booklet, "Emphasis on Research", which tells more about engineering opportunities at Honeywell.

Name _____

Address _____

City _____

Zone _____ *State* _____

BULLARNEY

By DUNK

A gangster rushed into a saloon shooting right and left, yelling, "All you dirty skunks get outta here".

The customers fled in a hail of bullets—all except an Englishman, who stood at the bar calmly finishing his drink.

"Well", snapped the gangster, waving his smoking gun.

"Well", remarked the Englishman, "there certainly were a lot of them, weren't there?"

♣

A credit collection letter states: "We've done more for you than your own mother did—we've carried you for twelve months."

♣

Porter: Did you miss your train, sir?

Irate Traveler: No, I didn't like its looks, so I chased it out of the station.

♣

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

♣

Woman: What's your cat's name, little boy?

Boy: Ben Hur.

Woman: That's a funny name for a cat. How did you happen to pick up such a name for it?

Boy: Well, we just called him Ben until he had kittens.

♣

Doctor: The best thing for you to do is to give up drinking and smoking, get up early every morning and go to bed early every night.

Patient: Somehow, doctor, I don't deserve the best. What's second best?

Why do men have hair on their chests? Well, they can't have everything.

♣

Absent-minded Prof. — "Madam, what are you doing in my bed?"

She—"I like your bed, I like your house and I like your neighborhood. Furthermore, I'm your wife."

♣

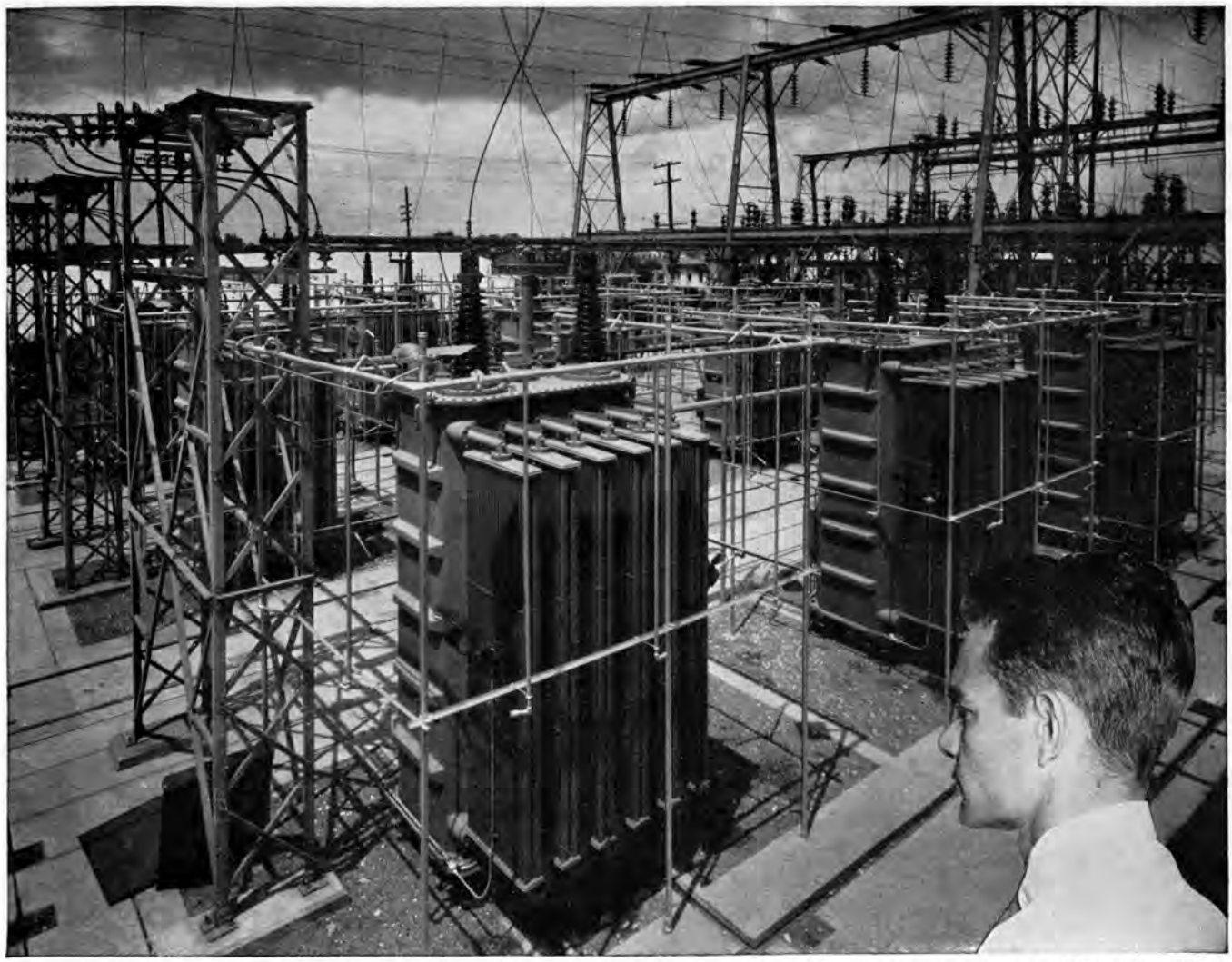
A small boy was seated on the curb with a pint of whiskey in his hand, reading Esquire and smoking a big cigar. An old lady passed and asked, "Little boy, why aren't you in school?"

The infant replied, "Dammit, lady, I ain't but four".

♣

Realtor's slogan: Get a lot while you're young.

♣



Wagner transformers serving the City of New Orleans

Check Your Chance for Success at Wagner

The Wagner Electric Corporation, with its more than 46 acres of manufacturing space, and its nearly 100 million dollar annual sales, is big enough to offer any number of opportunities for development, advancement and ultimate success to the ambitious graduating engineer. Yet, the company, with its 7000 to 8000 employees, is not so big that the individual gets "lost". Personal interest, guidance, encouragement, recognition, and help is the rule, not the exception, at Wagner.

Established in 1891 by two engineers, the Wagner Company, during 64 years of pioneer engineering and development, has become one of the most outstanding manufacturers of quality motors, transformers, and automotive brake equipment and related products in the Middle West. The present top management of Wagner includes men who began their careers with the company as graduate engineers.

Wagner products are sold throughout the country through a nationwide network of sales and service branches maintained in all principal cities, and they are sold throughout the world by foreign distributors.

CHECK THESE ADVANTAGES AT WAGNER:

1. Good working conditions and salary.
2. Advancement from within.
3. Excellent group insurance and retirement plan.
4. Athletic and recreational programs and many other benefits and activities.

OUTSTANDING TRAINING PROGRAM

At Wagner you'll receive further training in the area of your own special interest and talents, whether product engineering, manufacturing, or sales.

For further information about career opportunities, see your college placement officer or write to the Wagner Industrial Relations Division.

Wagner Electric Corporation

6400 PLYMOUTH AVENUE, SAINT LOUIS 14, MO., U. S. A.

LOCKHEED HYDRAULIC BRAKE PARTS and FLUID . . . NoRoL . . . CoMaX BRAKE LINING . . . AIR BRAKES . . . TACHOGRAPHS . . . ELECTRIC MOTORS . . . TRANSFORMERS . . . INDUSTRIAL BRAKES

ER1-55

NEWSTUFF

(*Continued from page* 34)

ity," he added.

Present military and commercial assignments plus orders in the offing will continue to increase engineering, planning and tooling work loads at Lockheed even with the subcontracting planned, Monesmith said.

The plan also conforms — even though it is a commercial program—with the government's stated policy of maintaining a broad base in the aircraft industry by allocating substantial projects to other aircraft companies and distributing work geographically, the Lockheed vice president said.

♣

MORE BULLARNEY

An overly-inquisitive motorist drew up beside a car parked on a lonely road.

"Hey, you two in there! Got motor trouble?"

"Nope."

"Out of gasoline?"

"Nope."

"Tire down?"

"Didn't have to".

♣

A man and his wife were in the midst of a violent quarrel, and he was on the verge of losing his temper. "Be careful," he said to his wife, "you'll bring out the beast in me." "So what," she replied, "who's afraid of mice?"

♣

Employer: Kathryn, who told you that you could neglect your office duties just because I give you a kiss now and then?

Stenographer: My attorney.

♣

The Lord gave us two ends to use. One to think with; one to sit with. Success depends on which we use. Heads we win; tails we lose.

♣

Wife: How do you like my new gown? I got it for a ridiculous price.

Husband: You mean you got it for an absurd figure.

♣

A cute little trick from St. Paul
Wore a "newspaper dress" to a ball
The dress caught on fire
And burned her entire
Front page, sporting-section and all!

Westbound Rio Grande freight in Ruby Canyon of Colorado River.

The freight rolls away an hour sooner

because photography cuts yard bookkeeping

The Denver and Rio Grande Western Railroad microfilms its waybills in minutes, cuts running schedules, saves costs in train idling time.

You don't find a Rio Grande freight idling at the terminal while waybills are copied by hand. Instead, Recordak Microfilming copies them. Then they're put aboard and the train is off in just about one-fifth the time it used to take, thus saving hours of valuable crew and train time. Then the wheel reports are made up from the films and teletyped ahead.

Railroading is but one of over a hundred types of businesses now saving money, time and space with microfilming. It is one of the fast growing and widely used ways photography works for industry.

Small businesses and large are finding that photography helps in simplifying routine procedures, in product design, in personnel relations. It improves production, saves time and cuts costs.

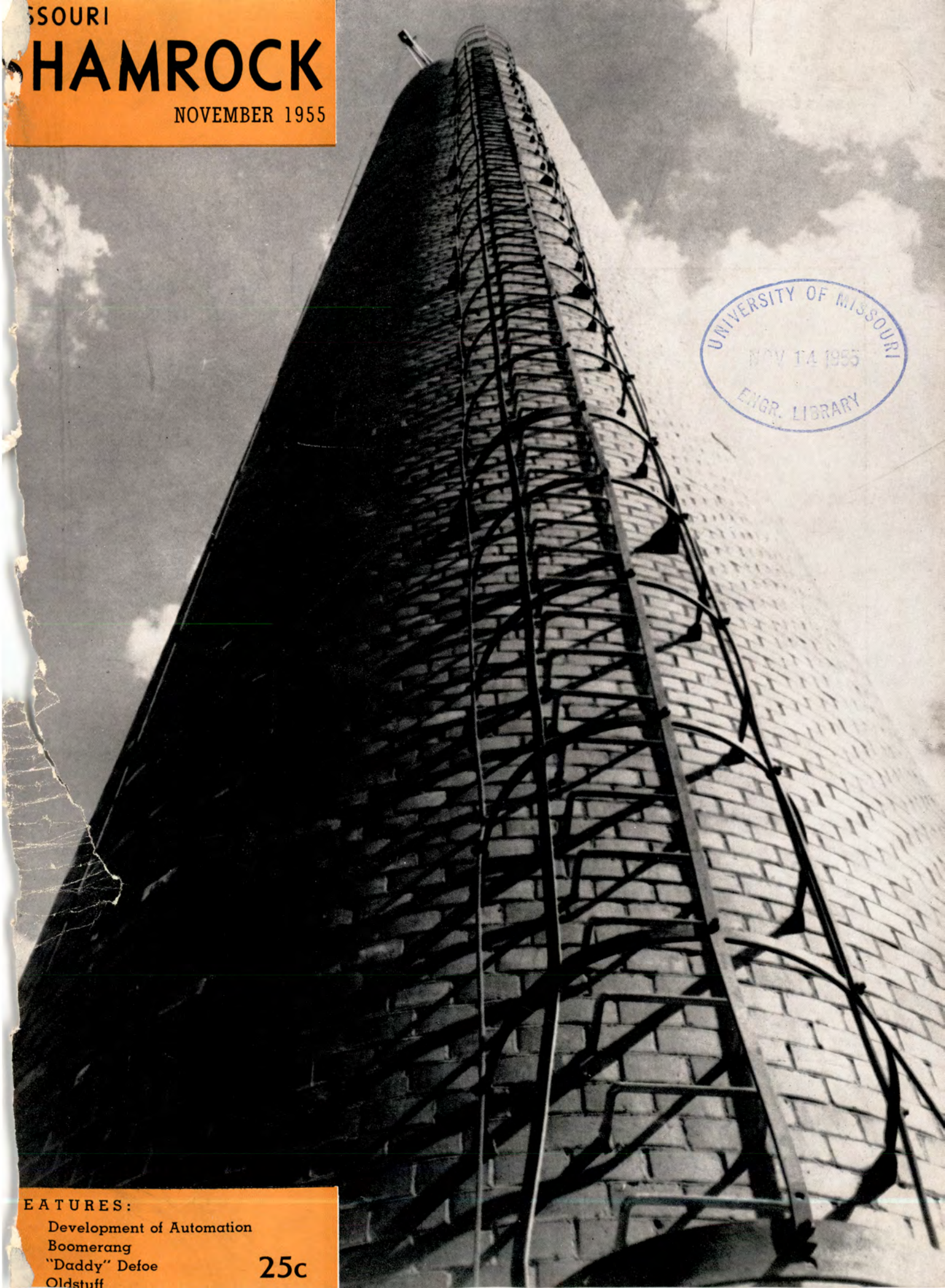
Graduates in the physical sciences and in engineering find photography an increasingly valuable tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. Whether you are a recent graduate or a qualified returning service man, if you are interested in these opportunities, write to Business & Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N.Y.

Eastman Kodak Company, Rochester 4, N.Y.

SSOURI

HAMROCK

NOVEMBER 1955



EATURES:

- Development of Automation
- Boomerang
- "Daddy" Defoe
- Oldstuff

25c

John W. Hirt, Class of '49
speaks from experience when he says,

"U. S. Steel offers an interesting and challenging future in a key industry."

Following graduation with a B.S. degree in 1949, Mr. Hirt went directly to the Irvin Works of United States Steel as an operating trainee. U.S. Steel trainees are given extensive training as well as practical experience in many phases of the steel industry. In this way, they are fully prepared to accept responsibilities as they move up. Just 16 months after starting as a trainee, John Hirt was advanced to Relief Foreman—Rolling, in the 80" Hot Strip Mill. He found the job, "one of the most interesting processing sequences in modern industry."

Two years ago Mr. Hirt was promoted to General Foreman — Hot Strip Finishing. In this capacity, he says, "I am responsible for coordinating the many finishing processes required to produce hot rolled strip." Mr. Hirt now supervises a labor force of over 300 men in finishing 45,000 tons of hot sheets and coils per month. He sees a need for "a wide range of talents necessary to fill the great variety of vital jobs in the steel industry. There's a solid future in steel," says Mr. Hirt.

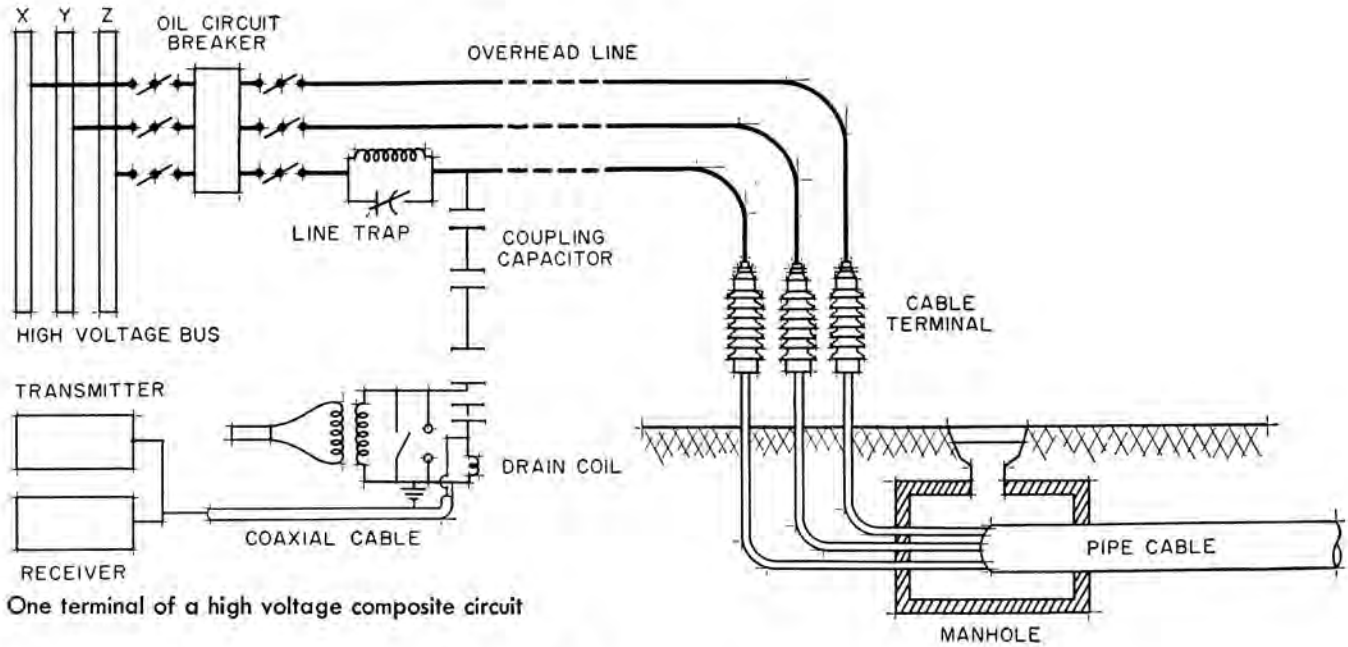
If you are interested in a challenging and rewarding career with United States Steel and feel that you can qualify, you can obtain further information from your college placement director. Or, we will gladly send you our informative booklet, "Paths of Opportunity," upon request. Just write to United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

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

USS

UNITED STATES STEEL

AMERICAN BRIDGE . . AMERICAN STEEL & WIRE and CYCLONE FENCE . . COLUMBIA-GENEVA STEEL . . CONSOLIDATED WESTERN STEEL . . GERRARD STEEL STRAPPING . . NATIONAL TUBE
OIL WELL SUPPLY . . TENNESSEE COAL & IRON . . UNITED STATES STEEL PRODUCTS . . UNITED STATES STEEL SUPPLY . . *Divisions of* UNITED STATES STEEL CORPORATION, PITTSBURGH
UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY 5-2098



One terminal of a high voltage composite circuit

HERE'S A PROBLEM FOR ELECTRICAL ENGINEERS

To protect short transmission lines against severe damage due to internal short circuits, Detroit Edison normally uses a pilot wire differential system to activate circuit breakers and thus stop the flow of electricity along the damaged wires. This system is technically limited to the protection of relatively short transmission lines.

Longer lines of all overhead construction can be economically protected by carrier pilot relaying systems. However, where there are long composite lines—overhead lines which go underground and come back overhead again—variations in line characteristics make it difficult to preselect the correct frequency for the usual carrier pilot relay.

How would you determine whether carrier pilot will work on a composite line? And, if carrier won't work, what system would you use to protect this type of line construction?

★ ★ ★ ★ ★

The above problem is typical of those you would encounter as a member of Detroit Edison's outstanding electrical engineering staff. If you can confront and solve such interesting and diversified problems, you have a firm foundation for building a successful career.

The future of Detroit Edison is a bright one. Edison's constant expansion in a thriving industrial area means more opportunities for you. Why not see our representative when he's on campus; visit us when you are in Detroit, or write . . .

THE DETROIT EDISON COMPANY

2000 Second Avenue, Detroit 26, Michigan

FACTS ABOUT DETROIT EDISON

Serving Southeastern Michigan, Detroit Edison supplies electricity for eleven counties . . . covering 7,600 square miles . . . 3.8 million people. Compared to other investor-owned power systems, Detroit Edison ranks eighth in plant investment . . . eighth in customers served . . . and seventh in electricity generated.

ADVANCED EDUCATIONAL PROGRAM AT ALLISON HELPS YOU FIND THE BEST JOB SUITED TO YOUR TRAINING

DIVERSITY of technical skills required by Allison in the design, development and production of turbo-jet and turbo-prop engines offers a wide range of opportunities to young graduate engineers.

And, the Advanced Educational Facilities help the young graduate find the work best suited to his academic training and liking.

For instance, there's Wayne McIntire (above) Mechanical Engineer, Purdue University, who came to Allison upon graduation in 1950. After completing the training program, Wayne now is doing the kind of work he wanted, and is technically qualified to handle. He is Project Engineer, mechanical design of gear boxes. He is shown making an adjustment on the propeller linkage control on the cutaway model of the Allison T56 aircraft engine. This, incidentally, is America's first production turbo-prop engine, and is used in the Lockheed C-130 Hercules, a 54-ton transport. The Allison Model 501, which is the commercial version of the military T56, is the powerful turbo-prop engine proposed for commercial airline use.

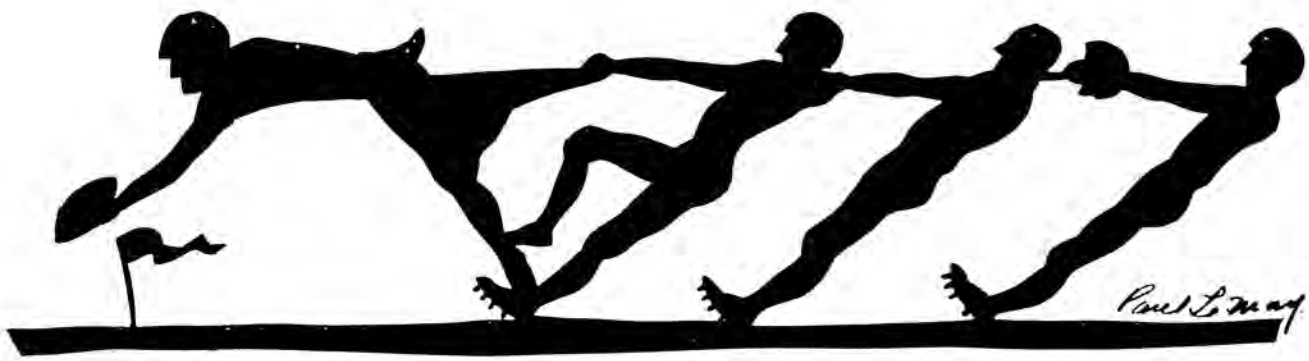
In his present job, Wayne works on initial design . . . helps decide what components—such as propeller brakes, accessory drives, oil pumps, etc.—are needed for the specific project.

The nature of Allison business continually presents a variety of interesting and challenging problems to the engineering staff, which—along with the Mechanical, Aeronautical, Electrical, Metallurgical, Chemical and Industrial Engineers—includes majors in Mathematics and Physics.

We'll welcome the opportunity of telling you more about the Allison Advanced Educational Facilities, and the benefits and advantages which can be yours at Allison. Arrange for an early interview with our representative when he visits your campus, or write for information about the possibilities of YOUR engineering career at Allison: R. G. GREENWOOD, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Ind.

ALLISON
TURBO-PROP ENGINES
American built for the new era in air travel

Determine NOW To Reach Your Goal



The choice of your career association means much to you in realizing your ambition. CONVAIR-FORT WORTH offers exceptionally attractive career opportunities worthy of investigation and consideration by every Engineering Graduate.

As a division of General Dynamics Corporation, CONVAIR of Fort Worth occupies an important place in the long-range development of the Nation's military and commercial aviation. CONVAIR'S scope of activity offers interesting career opportunities for men with engineering talents.

At CONVAIR-FORT WORTH you work in ideal, air-conditioned surroundings. A company-sponsored, in-plant program enables candidates to earn graduate degrees in Engineering. CONVAIR has paid vacations, excellent insurance and retirement programs. Advancement is entirely on merit.

Fort Worth in the Great Southwest has an abundance of community life of interest to college graduates — Southwest Conference athletics, excellent musical and theatrical bookings, seven large lakes in nearby area, year-around climate conducive to outdoor living and recreation.

Write now for information about CONVAIR'S interest in Engineering Graduates.

Address . . . H. A. BODLEY
CONVAIR Engineering Personnel Dept.
Fort Worth, Texas

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

FORT WORTH, TEXAS

An enlarged reprint of the above cut-out silhouette, suitable for framing or pinning up, will be sent free to any engineering student on request.

On the cover—In case you haven't noticed, the University power plant has a new stack and the Shamrock has a new cover. The former is here to stay. The tenure of the latter we will relegate to the disposition of our readers who have endured long and whom we herewith proffer surcease from shades of Saorstat Eireann. The grandeur that was green, the glory that was Gaelic is gone. Hail, William of Orange!
—photo by Jerry Herdan

MISSOURI
SHAMROCK

VOL. XXII NOVEMBER, 1955 NO. 2

CONTENTS

FEATURES:

DEPARTMENTS:

MEMBER
ENGINEERING COLLEGE MAGAZINES
ASSOCIATED

Chairman, Thomas Farrell, Jr., State University of Iowa
Publisher's Representative, Littell-Murray-Barnhill, Inc., 101 Park Avenue, New York 17, New York, and 605 Michigan Avenue, Chicago, Ill.

Published monthly except June, July, August, September, by Board of Publications of Engineers Club, University of Missouri. Office of Publication: Room 233 Engineering Building, University of Missouri, Columbia, Missouri. Entered as second class matter at the post office at Columbia, Missouri under the act of March 3, 1879. Printed by The Missouri Farmer, Columbia, Missouri. Single copies 25 cents; subscriptions, $1.50 per year, $2.50 for 2 yrs.

Editorial

Have you ever considered that we have two main representatives outside of Columbia, Missouri? Who are they? We submit that they are our alumni and this magazine, the "Shamrock". Recently, we came across some data which indicates that our alumni are doing a fine job as our representatives. In a listing of percentage of graduates named in "Who's Who", Missouri ranked quite high.

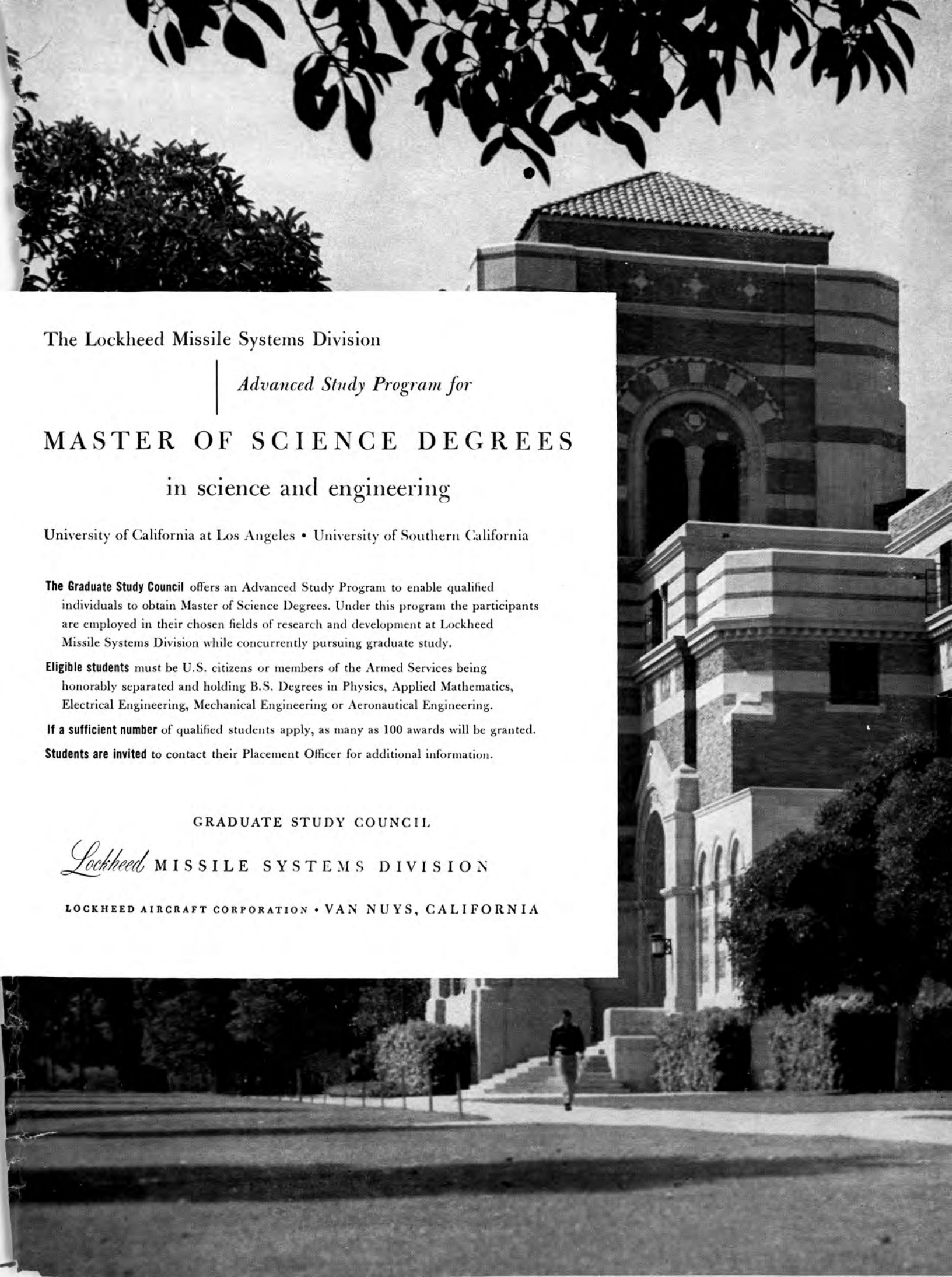
How about the "Shamrock"? Is it a good representative? We are not the ones to answer that question. One thing is certain, however, it can be a better one than it has been. Too many times "Shamrock" editors have been forced to use outside material to "fill" the magazine. Some fine articles have come from outside sources, but do they represent the Missouri Engine School?

We feel that the material which appears in this magazine should represent the activities and ideas of the students, faculty members and alumni of Missouri. To paraphrase Don Faurot we might say, "Missouri writers for the Missouri Shamrock".

Do our articles have to be technical? Not necessarily. We look at formulas all day in the classroom. This magazine is our opportunity to prove that we are people, too. Is fiction acceptable? Surely it is—especially so if it has an engineering "tie-in". How about technical articles? Yes, but not if it's something we will study in the classroom.

As Editor, it is my job to see that each page has something on it. As students and graduates, it is your job to see that the "something" really represents Missouri!

P. D. G.



The Development Of Automation In Metal Working

By ANDERSON ASHBURN
Special Projects Editor, "American Machinist"

Edited by P. D. GERNHARDT

This paper was contributed by the Materials Handling Division for presentation at a joint session of the Materials Handling and Production Engineering Divisions at the ASME Diamond Jubilee Semi-Annual Meeting, Boston, Mass.—June 19-23, 1955.

INTRODUCTION

First of all, what are we talking about? Do we mean "automation" as a word that has recently caught the popular fancy, or do we look beyond the word to mean the automatic handling of work in process, or do we look beyond the handling and refer to the automatic control of work in process. Or do we mean, as some people have claimed, something beyond all this—a "second industrial revolution."

Not an Industrial Revolution

Let me say at once, lest there be any misunderstanding of what follows, that a broad look at these developments over a period of several years indicates that this is not a second industrial revolution, not a revolution at all, but a logical step in the evolving science of production methods. In this country we made our major shift from an agricultural to an industrial economy—our industrial revolution, if you will—during the last half of the last century.

The roots of this industry go much farther back, of course. Those who have visited Thomas Jefferson's home at Monticello are likely to conclude that here lived the father of automation. Certainly Jefferson delighted in gadgetry to convey wine from cellar to dining table, to open doors, to tell him the direction of the wind, and to perform other chores.

But the first genius of automation seems to have been Oliver Evans who in the 1780's designed a grist mill in Philadelphia containing an ingenious combination of belt conveyors, screw conveyors, and endless-chain buckets that took the grain automatically through cleaning, grinding, and bolting. The mill was automatic from the point at which the grain was unloaded from a wagon into the first hopper until the flour dropped through a chute into a barrel. This seems to be the first example of an automatic manufacturing process. The only thing Evans lacked was the word automation. There is some dispute as to whether Evans built a mill incorporating all of his patented devices. But we do know that Thomas Elliott built one a few years later in Virginia.

And a quarter century later a Russian traveler, Paul Svinin, was writing home, with some exaggeration, that everything in America was done with some special sort of machinery, even sawing rocks, cobbling shoes, making bricks, and forging nails.

In England, Bentham and Brunel applied interchangeability, more or less unintentionally, in mechanizing the manufacture of pulley blocks. Bentham secured patents in 1791 and 1793, and Brunel had a working model of his special mortising and boring machines by 1801. By 1808 their plant was producing 130,000 blocks per year, and continued operation for many years until the iron block outmoded the wooden design. Strangely their principles were not picked up by others and it was a half century that interchangeability was introduced into England as the "American System."

The American System Proposed by Whitney

This "American System" was first proposed by Eli Whitney in 1812. We now know the French had attempted it in 1717 and 1785, the second attempt having been reported by Jefferson (5). Whitney's methods were adopted by North and the Armories at Springfield and Harper's Ferry, then in more advanced form by Colt in 1854.

By the time the Frenchman, Tocqueville, made his famous tour of America in 1835, he was able to report a conversation in which he asked an American sailor why his ship was built to last so short a time and was told that the arts of shipbuilding and navigation were making such rapid progress that the finest vessel he could build would be obsolete in a few years. "In these words," wrote Tocqueville, "which fell, accidentally and on a particular subject, from an uninstructed man, I recognize the general and systematic idea upon which a great people direct all their concerns."

Enter the Mechanical Engineer

But it was in the last half of that century that we began to get really industrial. Civil and mining engineers had to make room for mechanical engineers. In the year 1880, when The American Society of Mechanical Engineers was founded, there were 10,000 patents granted for labor-saving machines. That was the year we achieved our first high-speed steel, though it was another 20 years before the familiar and basic 18-4-1 composition was to be developed.

Colvin gives us a vivid description

(*Continued on next page*)

of a metalworking shop of about 75 years ago. He worked in the Rue Manufacturing Company in Philadelphia. This firm produced a boiler feeder in a second-floor shop with 34 machine tools. Power came by a system of belts and line shafts from a Corliss steam engine in the basement. This was a "big" 25-hp engine—for 34 machines. Machine tools were hazardous affairs of exposed gears and uncontrolled drives. This shop appears to have been rather typical of its day, perhaps better than the average.

AUTOMATICITY GAINS ACCEPTANCE

Since then we have seen a steady spread of the automatic approach. We have but to look around to see that there is a high degree of automation in the reduction of ore, the refining of oil, the production of chemicals, the processing of food, the making of cigarettes—in fact, in almost every form of manufacturing except metalworking.

This does not mean that the third of industry we call metalworking, that produces such a wide assortment of products from pins to battleships, from typewriters to automobiles, from wrenches to airplanes, is entirely backward. We had to evolve through many preliminary stages before the present concept of automation as applied to metalworking could be developed.

Those machines of 75 years ago took a lot of skill. They also took a lot of brawn. All too often, they took a hand, an arm, or the life of the operator for good measure.

Development of Metalworking Machines

Metalworking history since then has been in part the development of machines that take very little brawn, that make the operator far safer at work than he is at home, and that take considerably less skill to operate. Thus, by World War II it was possible to increase the volume of metalworking production about six times from the 1938 prewar level to the 1943 peak because we could train a machine operator in a few hours for many jobs. In 1880, it took several years to train a machinist and it takes about as long in 1955. But today you don't need a machinist to run the average production machine. (Parenthetically, I need hardly add that this has not resulted in a reduced need for machinists, though it has certainly increased the need for machine operators. The machinist is still needed in the tooling stage and the simpler the machine operation becomes, the more complex is the tooling needed.

This sixfold increase was accomplished by approximately doubling the number of machines installed and tripling the hours of utilization.

Standards Required

But this was only part of the history. We had to develop standards for fits, threads, tapers, for a thousand elements of both machine and product design. Too much credit could hardly be given to the ASME for the part it played in this necessary development.

We had to develop machines with more power, and the generator and electric motor made this possible. We had to improve machine rigidity and find tools that would hold size longer. Better tool steels, then carbides, came to our rescue there.

We had to develop a more accurate standard of measurement than the micrometer that the machinist had kept in his hip pocket along with his tobacco pouch for several years. The master gage block came to the rescue with a reliable standard. Then faster and more accurate measuring systems brought fixed-limit gages, optical, air, and electronic equipment into play.

Interchangeable Parts

It had all started with the advance from hand-fitted assembly to interchangeable parts, a shift that became universally necessary whenever the assembly line was adopted. But the accuracy with which we could produce parts hasn't always kept up with the requirements for those parts. Thus we went almost the full circle and developed selective assembly. This was practical only with gaging machines that automatically would sort parts into size groups and mark each part.

To digress a moment, let us examine this development. One of the places where selective assembly first became necessary was in automotive pistons. The original method was to weigh pistons and measure them, then stamp the weight and size class on each. By 1932, we had mechanized this operation. A description of the operation follows:

"As the balance comes to rest, the operator notes the letter designating the weight of that particular piston. He picks up the weighed piston in one hand and places another piston on the balance with the other. While the balance is coming to rest with the second piston, he places the first one, head end down, over the proper stencil (there are 23) in the stamping machine and pulls the trigger. This draws the spindle down about 9/16 in. and compresses the spring shown in front. The spindle is then automatically released and the stencil strikes the piston, giving the desired mark. This is done as rapidly as the operator can handle the pistons and pull the trigger, which automatically returns to its idle position".

In contrast to this we have the modern automatic piston-gaging machine introduced a few years later. One machine inspects and marks four pin hole sizes and ten skirt sizes, then sorts into twelve classes at 1700 per hr.

A shop that made a lot of a product used to be operated on a process basis. A batch of parts would go to one spot for turning, then to another department for drilling, then across town to be hardened, then back to a third department for grinding. When we had all the parts made, we'd take them across the street and put them together—coming back to fix any that wouldn't fit.

Assembly Line Is Born

A basic change in this approach took place in 1913 when Henry Ford, presumably reasoning that if meat packers could take a pig apart on a chain conveyor, he could put a car together on an assembly line, made his famous innovation at Highland Park, Mich., attaining a production rate of 10,000 cars a year. When detailed news of this was given by Colvin in a series of 16 articles in 1913 and 1914, the first reaction was one of frank disbelief. A British paper commented, "No manufacturer can possibly build that many cars in one year; and even if he could, he wouldn't be able to sell half of them." But the

(*Continued on page* 30)

water has many uses

Fortunately, not much water is used like this.

Engineers know that America's greatest natural resource has many other vital uses. Supplying homes and industries with adequate water . . . today and for the future . . . is a job both challenging and rewarding . . . one that merits the talents of America's best young engineers.

Cast iron pipe plays an important part in that job. Today, practically every city in America—large or small—uses it for water and gas mains. Over 60 American cities are still served by cast iron pipe *laid over a century ago.*

That's why engineers turn to cast iron pipe for the efficient, economical distribution of water.

CAST IRON PIPE RESEARCH ASSOCIATION

Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

®

CAST IRON

CAST IRON PIPE SERVES FOR CENTURIES

BOOMERANG

By JERRY HERDAN, M.E., '57

A discussion on the origin, uses and theory of the boomerang.

You perhaps are under the impression that a boomerang is only a toy. Nothing could be further from the truth. For hundreds of years the "curved stick" has been employed as a weapon and for hunting. Just how effective as weapons are boomerangs? Do they really return to the launcher and if so, why? How are they used in hunting? What are the basic principles of their operation? We will attempt to answer these questions in the following paragraphs.

It is generally thought that the boomerang is exclusively an Australian device. Actually the boomerang is found almost everywhere in the world in one form or another. The Indians of the Southwestern United States have used boomerangs since prehistoric times and still employ them in killing small game. The Horniman Museum of London has a special exhibit of primitive weapons. The oldest boomerang in their collection is about 3,500 years old and is still in usable condition. It was found in an ancient Egyptian tomb.

Australia is the contemporary home of the boomerang for many of the bush tribes "down under" have never progressed to the point of developing the bow and arrow. They have had to depend on the boomerang and as a result are highly skilled in its use.

There are two types of boomerangs. They are the non-returning or hunting boomerang and the returning boomerang. The non-returning boomerang is a functional weapon while the returning type is used primarily for exhibition purposes. To illustrate the use of the hunting type let's suppose that you are an Australian aborigine and are investigating your chances for a good solid meal. You see a group of ducks about one hundred yards away. If you throw a rock at the ducks your chances of hitting them are practically nil.

Few men can throw a stone that far with sufficient force or accuracy to kill small game. Throwing a club that far is even harder due to the greater size for a given weight. Now suppose you throw a boomerang at the ducks. It takes a straight flight path for many yards and then begins to rise so that its effective range is greatly increased. If you have aimed correctly, it's ducks for dinner. Acting in your favor is the fact that the boomerang is a relatively large missile, considering its range. It might be three feet from tip to tip and would have the effect of a scythe, literally mowing down anything in a three foot path before it. One question remains unanswered; what caused the boomerang to rise after traveling horizontally for a considerable distance? To answer this we must examine the construction of the boomerang.

One side of the boomerang is completely flat. The other side is curved to form an airfoil like the wing of an airplane. Looking down upon it we see that it has a bend in it. This bend might be anything from fifty to one hundred and twenty degrees, depending upon what distance and path you wish it to take. The edges might be razor sharp; this is to increase its effectiveness as a weapon rather than to improve the aerodynamic qualities. In using the weapon, the thrower stands with the wingtip of it held in his hand. He brings his arm straight over his shoulder and throws the boom straight out. At the instant of release he gives it a snap to start the boom spinning. It proceeds on the level portion of its flight spinning in a vertical plane. As it travels through the air one "wing" is always meeting the air at greater velocity than the other. This causes an unbalanced force to act on the spinning boom. Anyone familiar with a gyroscope knows that if you try to push the axis of a spining gyroscope in one direction it will always react by tilting in a direction at right angles to the plane of the original "push". This is what happens to the boom. At the same time the unbalanced force is laying it over into a horizontal plane the gyroscopic action (precession) is trying to "lift" it. In addition another action which we might call the "autogyro effect" is occurring. The forward component of lift of the airfoil is causing the boom to pick up both angular and forward velocity. In the hands of a skilled thrower these effects can be made to supplement one another and ranges as far as seven hundred feet or more can be achieved.

Many people have the idea that boomerangs always return to the thrower. This is true of some of them but is by no means the limit of their capabilities. By giving the "wings" a slight twist in opposite directions the boom can be made to perform a number of antics. It may be designed so that it will make circles in the air before returning, wobble in flight, or hover like a helicopter. These returning type boomerangs are used for "Australian boomerang throwing" exhibitions. They are far more dramatic in effect than the hunting boom but have no practical application. The returning boomerang seldom has a sharp edge.

Cross Transfer-Matic machine, equipped with 32 Wagner motors, mills, drills, bores, taps, reams and chamfers 72 tractor cylinder blocks in one hour.

Outstanding Opportunities for Engineering Graduates at Wagner

For many years, Wagner has been a leader among manufacturers of electrical and automotive products. Good positions and outstanding training programs are now open to qualified engineering graduates interested in product engineering, manufacturing, or sales. For your career opportunity with Wagner, sign up with your college placement officer to meet the Wagner representative. For further information, write to the Wagner Industrial Relations Division.

CHECK THESE ADVANTAGES AT WAGNER:

1. Good working conditions and salary.
2. Advancement from within.
3. Excellent group insurance and retirement plan.
4. Athletic and recreational programs and many other benefits and activities.

OUTSTANDING TRAINING PROGRAM

At Wagner you'll receive further training in the area of your own special interest and talents, whether product engineering, manu-

Wagner Electric Corporation

ER2-55

6400 PLYMOUTH AVENUE, SAINT LOUIS 14, MO., U. S. A.

LOCKHEED HYDRAULIC BRAKE PARTS and FLUID . . . NoRoL . . . CoMaX BRAKE LINING . . . AIR BRAKES . . . TACHOGRAPHS . . . ELECTRIC MOTORS . . . TRANSFORMERS . . . INDUSTRIAL BRAKES

NEWSTUFF

By DANIEL R. CAPPS, B.S., E.E., '56

DRILLING INVISIBLE HOLES

General Electric's instrument makers have gone one-up on the old bromide about splitting hairs. They have drilled holes in hair and then threaded wire through the holes.

The company's General Engineering Laboratory uses a .001-inch drill, too small to be seen by the naked eye and so delicate it could be snapped or bent by accidental contact with a piece of paper tissue.

It takes a microscope and a steady hand to thread such a tiny hole—but GE instrument makers have succeeded in lacing one-mil wire, a thousandth of an inch in diameter, through something that is even smaller than human hair—a strand of nylon stocking.

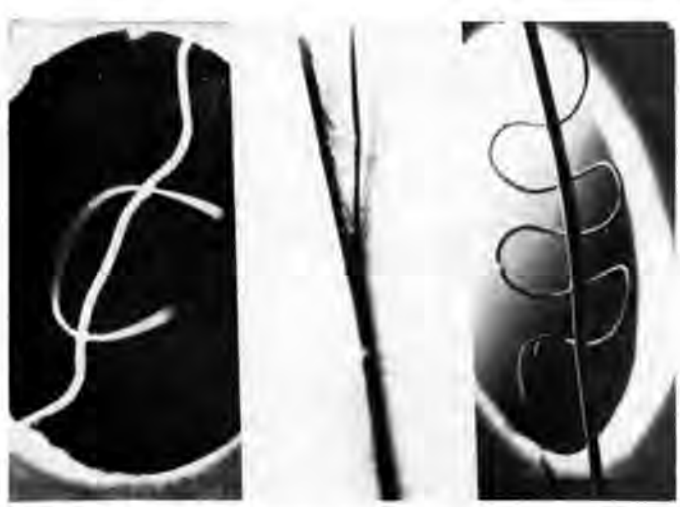
The laboratory uses this microscopic drill for such jobs as drilling tiny fuel injection nozzles, making orifices in leak disks that control the flow of gas into a vacuum chamber, and making apertures for electron beams in sensitive X-ray equipment.

Contrary to standard shop practice, drill operators must slow down the drill press to approximately 1,800 r.p.m. when using the one-mil size. In drilling operations, the usual formula is the larger the drill, the slower the speed, but the formula works in reverse on the tiny drills.

The ultra-sensitive drill press is located in the laboratory machine shop, where highly skilled instrument makers are "on call" for many unusual tasks in connection with experimental developments.

MICROSCOPIC DRILLING

Shavings, seen through a microscope trained on a .001-inch drill, are pulled from a hole only a thousandth of an inch wide at the General Electric Company's General Engineering Laboratory. The tiny drill is too small to be seen by the human eye.



LOUSE'S-EYE VIEW

To show the precision of a one-mil drill, one of the world's tiniest, General Electric instrument makers not only split a human hair (center) but also threaded one-thousandth-inch wire through a strand of hair (right) and a strand of nylon stocking (left), which is thinner than hair.

NEW STEEL

A new grade of stainless steel containing little or no nickel was described recently in a paper read before the Cleveland Regional Technical Meeting of the American Iron and Steel Institute.

Dr. Dennis J. Carney, author of the paper, is Superintendent of No. 2 Electric Furnace Department at U. S. Steel's South Works in Chicago, Illinois. A patent application has been filed on the new product which

was developed through studies aimed at conserving nickel, currently in short supply.

According to the author, more nitrogen is used in the nickel-free and low nickel stainless steels than was thought possible prior to the study. He asserted that by the proper adjustment of the chemical composition of the steels — particularly with regard to the chromium and manganese contents — sound ingots can be made with a nitrogen content of more than double the old limit.

"This discovery opened the door to an entirely unexplored area for a reduction in the use of nickel," he said.

Dr. Carney, a native of Charleroi, Pennsylvania, is the author of some 17 technical papers on subjects ranging from "Gases in Liquid Iron and Steel" to "Sampling and Testing of Sinter." His studies have embraced practically the entire field of iron and steel making and the metallurgy of ferrous metals.

He is a graduate of Pennsylvania State College where he received his B. S. degree in metallurgy in 1942. He continued his studies at Massachusetts Institute of Technology and there earned his Sc. D. in metallurgy in 1949. From 1946 to 1949 he served as Research Assistant in metallurgy at both M.I.T. and at Carnegie Institute of Technology in Pittsburgh, Pennsylvania. He has also taken post-graduate work at C.I.T., Harvard Graduate School of Business Administration and Colorado University.

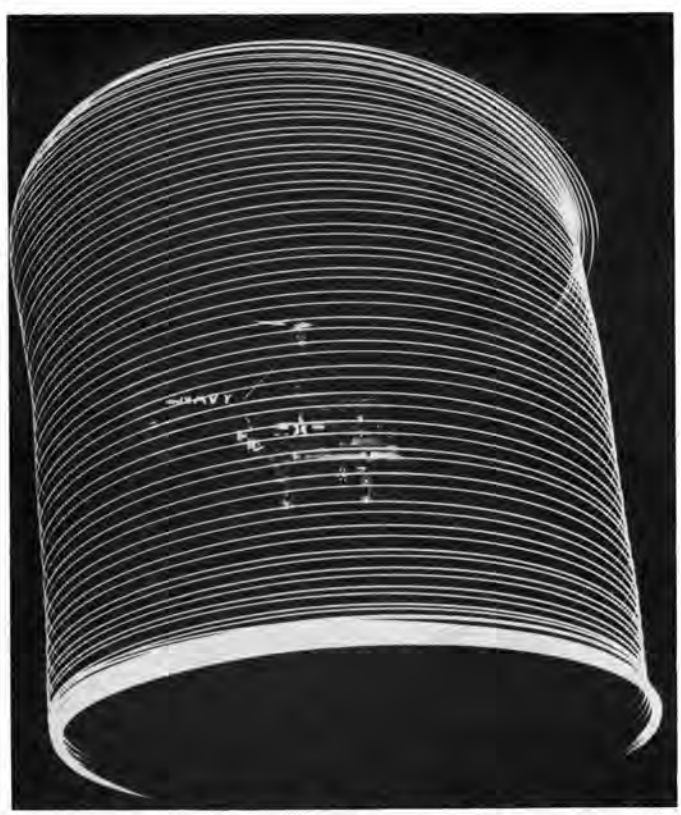
Dr. Carney has held at South Works the posts of Physicist, General Supervisor of Research and Chief Development Metallurgist prior to his present position in the Electric Furnace Department. In this time he has filed patent applications on a method of controlling the formation of crystals in molten metal as it solidifies, a method for producing low-sulphur blast-furnace iron, a method for producing rimmed-type, fully killed

(*Continued on page* 35)

COOKED CONCRETE

This king-sized "pressure cooker" is used for a strange form of culinary art at General Electric's Power Transformer Department.

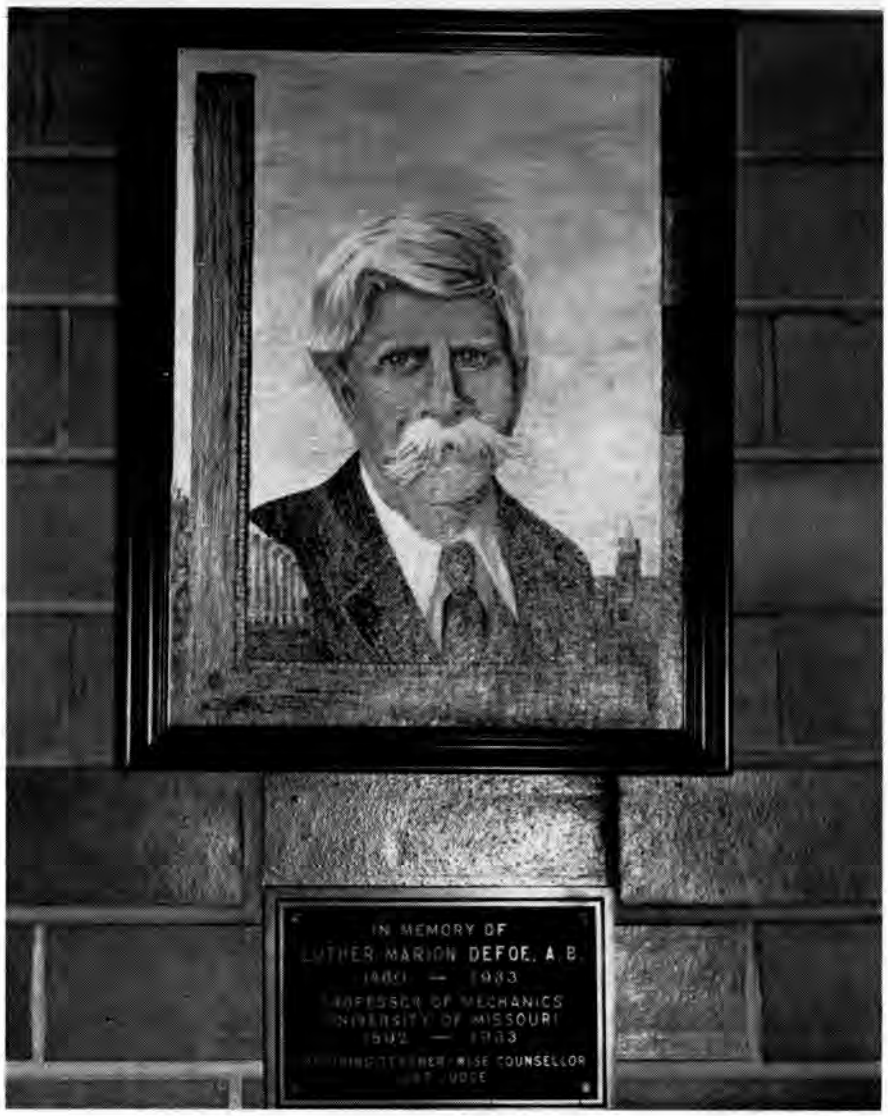
Huge clam-shaped vat "cooks" concrete supports of current-limiting reactors under high temperatures and pressures in a wet steam-curing process developed by G-E engineers. The reactors, used in electrical systems, absorb the jolting shocks of short circuits. The concrete supports cure faster in the "cooker" and are many times stronger than normally cured concrete.



An ascending helicopter, its rotor tips lit by new high intensity identification lamps, traces an unusual pattern in this time exposure. Midway in the ascent, a flash bulb was used to "freeze" the helicopter in its climb. Heavy traces of light at bottom resulted from plane's hovering before the ascent began. New blade-tip lamps, capable of withstanding centrifugal forces of 1000 g, or 1000 times the force of gravity, were jointly developed by Westinghouse lamp division and Kaman Aircraft Corporation. Kaman devised helicopter lighting identification system under contract with U. S. Navy Bureau of Aeronautics. Photo—courtesy of Westinghouse

"DADDY" DEFOE

By BOB McCANN, I.E., '57



An oil portrait of the late Luther Marion Defoe, beloved as "Daddy" Defoe by thousands of University of Missouri students during his half-century of service to the school, has been painted and given to the University by alumna Mrs. George C. Gundlach of Pass Christian, Mississippi. The oil portrait has been hung in the library of the College of Engineering.

"Daddy" Defoe was born near California, Missouri in 1860. He received his early education in the schools there and entered the University of Missouri as a student in 1881. That was the beginning of an association with the University which was uninterrupted, except for one or two brief periods, until his death in 1933.

He received a certificate in pedagogics from the University in 1886. He was awarded an A.B. degree in 1893 from Harvard University and later spent a year at Cambridge University, England, where he studied under Sir William Thompson, better known as Lord Kelvin.

Professor Defoe joined the Missouri faculty in 1892 as tutor in mathematics and was appointed assistant professor of mathematics in 1893, before his leave to complete his degree. He was made professor of mechanics in engineering in 1903, a chair which he held until his retirement in 1932 as professor emeritus.

In 1892, Professor Defoe married Cora Alice Eitzen of Washington, Missouri, an honor graduate of the University.

He was a member of many national professional societies and was elected to the Columbia City Council in 1908, 1910, and 1912.

"Daddy" Defoe was chairman of the disciplinary committee of the University from 1907 to 1925. It was during these years that he came to be an unofficial "Dean of Men" at the University and gained the respect and affection of all the students.

At the time of Professor Defoe's death, in April 1933, the late Walter Williams, then President of the University, praised his life, befitting the man who had come to be known as "Daddy" Defoe to literally thousands of students and alumni of the University.

Dr. Williams said, in part: "Here he came a student a half-century ago, a student poor in purse but rich in ability and ambition. Here he served as student assistant, as instructor, as assistant professor and professor, as tutor, all in the best tradition of a great teacher. Here he practiced the code of the gentleman as he preached it to the thousands of students who rejoice with us today because of the influence of his life upon their lives.

"He had no children to perpetuate his name, but there are thousands of former students who cherish his name in their heart of hearts and call him "Daddy". He held no doctor's degree. Men and women called him doctor affectionately because he was a master of the finest of fine arts — the art of healing and helping human lives.

"He knew books and the hearts of men. Books — his remarkable private library, thumbed with use, and his speech and conversation testified to his life of books. But he knew also the hearts of men, and turned aside oftentimes from the delights of the

(*Continued on page* 35)

Dave Johnson asks:

What's involved in production work at Du Pont?

DAVID L. JOHNSON, JR., expects to receive his B.S.Ch.E. from the University of Kansas in 1956. He is very active in campus affairs, president of Alpha Chi Sigma and a member of several honorary engineering fraternities. Dave is interested in learning more about production work in the chemical industry.

JAMES L. HAMILTON is one of the many young engineers who have been employed by Du Pont since the end of the war. After service in the Navy, Jim got his B.S.Ch.E. from the University of West Virginia in June 1948, and immediately joined Du Pont's Repauno Plant at Gibbstown, N. J. Today, he is Assistant Superintendent of the dimethyl terephthalate area at this plant.

Jim Hamilton answers:

Well, Dave, I've been doing production work at Du Pont for about seven years now, and I'm still getting involved in new things. That's what makes the work so interesting—new and challenging problems arise all the time.

To generalize, though, the duties are largely administrative. That's why effectiveness in working with others is one of the prime requirements. Teamwork is important in research and development work, for sure. But it's even more important in production, because you work each day with people having widely different skills and backgrounds.

A production supervisor needs a good understanding of engineering and scientific principles, too. He has to have that to get the best results from complicated equipment—but he doesn't necessarily need the specialized training that goes with research and development work. A real interest in engineering economics and administration is usually more helpful to him here than advanced technical training. The dollar sign's especially important in production work.

It all adds up to this, Dave. If you enjoy teamwork, and have a flair for large-scale, technical equipment, then you'll find production work mighty rewarding.

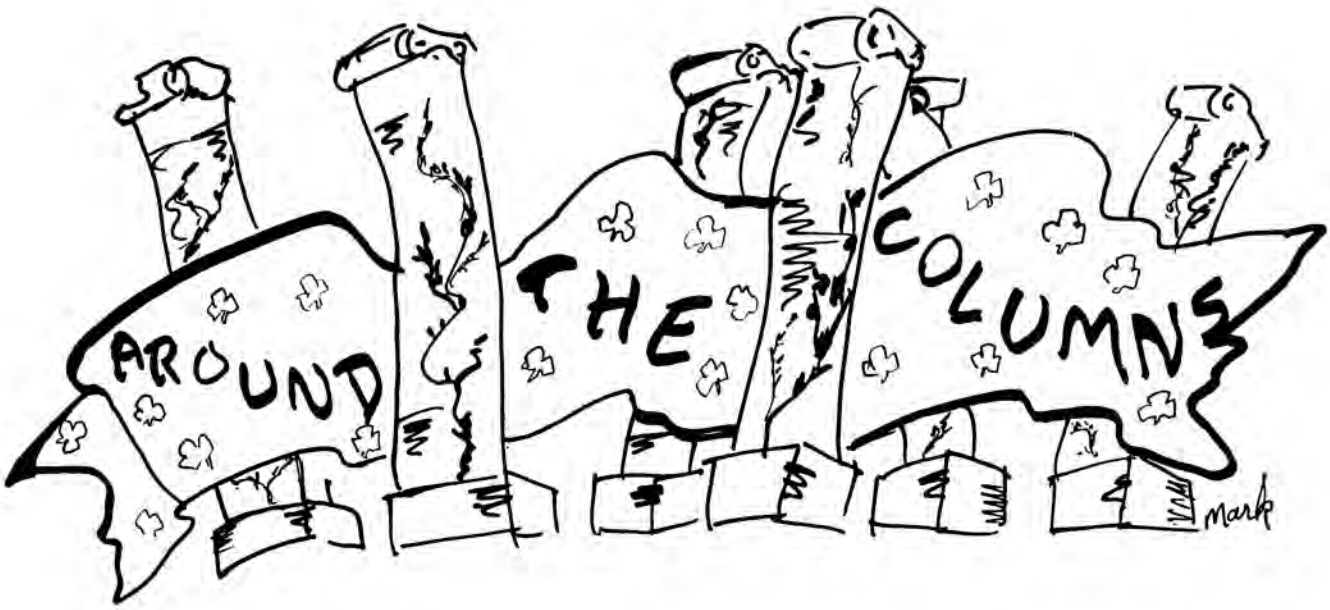
A MORE COMPLETE ANSWER to Dave Johnson's question about production work is given in "The Du Pont Company and the College Graduate." This booklet describes in detail the training, opportunities and responsibilities of engineers who take up this kind of work at Du Pont. Write for your free copy to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Delaware.

DU PONT

REG. U. S. PAT. OFF.

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

WATCH "DU PONT CAVALCADE THEATER" ON TV



By JERRY HERDAN, M.E. '57

It is an extreme honor and certainly cherished event when one receives his United States Citizenship. Professor Erik K. Henrikson and his wife recently received theirs at the U. S. Federal District Court House in Kansas City, Missouri. At the court house on Friday, September 30, Mr. and Mrs. Henrikson, along with about one hundred other persons representing twenty-two different nations took the impressive and solemn oath which ends the two and a half hour long citizenship proceeding. This does not mean that it takes only two and a half hours to become a citizen; Mr. and Mrs. Henrikson would readily explain that it took them almost six years.

Professor Henrikson is originally from Haslev (near Copenhagen), Denmark. He received his M. A. degree in Mechanical Engineering in Copenhagen. In 1947 Prof. Henrikson visited the United States for three months. In 1948, he and his wife returned to the U. S. to stay. The Henriksons have one son, Svend, who is working for his M.A. degree in Geology here. Svend is twenty-six years old and graduated from Rolla School of Mines and Metallurgy in 1953.

Prof. Henrikson has written many technical articles in Danish, German, and English. He has also written and edited several books. He is carrying on research here at the University on "measuring forces in metal cutting" and "developing improved methods of grinding cutting tools".

We missed this gal, unintentionally, in our last issue when we introduced the lady engineers to you. She is Miss Pat Donaldson from Maryville State College. Pat is a member of Pi Phi Sorority and is in the division of Civil Engineering. She has chosen engineering because her Mother and Father are engineers and she intends to go into business with them. Pat likes to swim, play tennis and watch football games.

Rumor has it that some of the boys in M.E. 351 are renting calculating machines to do those long thermal calculations. Again its only rumor, but we hear that the most modern machines available are of vintage 1930 or earlier; it takes quite a time just to figure what all those cranks are for! Which leads us to believe that one of the great inventions of our time has been overlooked — the "push button".

The Department of Electrical Engineering of the University of Missouri at Columbia, Missouri has announced the opening of power system analyzer service to electric utilities, engineering organizations, and other industries. It is expected that the analyzer board will be ready for use by February 1, 1956 for the following services:

1. Load flow and regulation studies.
2. Stability studies.
3. Short circuit and fault studies.

The installation of an A. C. network analyzer board has been made possible by contributions from industrial organizations operating in the state of Missouri.

The board will be available for service to any industrial concern approximately twenty weeks of the year. During the balance of the time it will be used by the contributor companies for system studies and by the University of Missouri for educational and research activities.

The A. C. network analyzer board is located on the ground floor in the Electrical Engineering Division of the Engineering Laboratories Building.

(Continued on page 24)

Viva La Femme!

In support of our acclamation we offer this pic of Miss Judy Rissler, a Junior in the Home Economics School at Missouri. She is nineteen years old, five feet five inches tall and weighs one hundred and nineteen pounds. Dietetics is her major field of study; she has maintained a high "S" grade average therein. Campus activities in which she participates are Missouri Workshop and Home Economics Club. Her major hobbies are art and singing. She is a member of Chi Omega Sorority.

it takes many engineering skills to create the top aircraft engines

McDonnell "Voodoo", *the most powerful jet fighter ever built in America.*

An aircraft powerplant is such a complex machine that its design and development require the greatest variety of engineering skills. Pratt & Whitney Aircraft's engineering team has consistently produced the world's best aircraft engines.

The best planes are always designed around the best engines. Eight of the most important new military planes are powered by Pratt & Whitney Aircraft J-57 turbojets. The first two jet transports in the United States will use J-57s. Further, no less than 76 percent of the world's commercial air transports are powered by other Pratt & Whitney Aircraft powerplants.

Such an enviable record can only be built on a policy which encourages, recognizes and rewards individual engineering achievement.

PRATT & WHITNEY AIRCRAFT

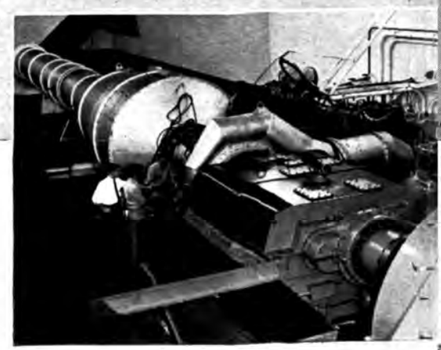
Division of United Aircraft Corporation

EAST HARTFORD 8, CONNECTICUT

World's foremost designer and builder of aircraft engines

J-57 POWERED AIRCRAFT

MILITARY	
F-100	F8U
F-101	A3D
F-102	B-52
F4D	KC-135
COMMERCIAL	
Boeing 707	
Douglas DC-8	



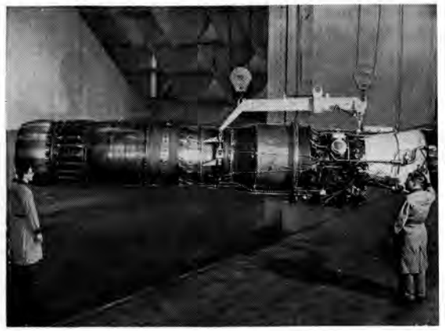
MECHANICAL ENGINEERS are concerned with many phases including experimental testing and development, mechanical design, stress and vibration analysis, combustion research, heat transfer and nuclear reactor development.

AERONAUTICAL ENGINEERS work on innumerable internal and external airflow problems concerned with design, development and testing of aircraft powerplants. Some who specialize in analytical engineering forecast engine-airplane combinations a decade in advance of design.

ELECTRICAL ENGINEERS directly contribute their specialized skills to the analysis and development of controls, systems and special instrumentation. An example is the "Plottomat" which automatically integrates and plots pressures, temperatures and air angles in performance testing.

CHEMICAL ENGINEERS, too, play an important role. They investigate the chemical aspects of heat-producing and heat-transferring materials. This includes the determination of phase and equilibrium diagrams and extensive analytical studies.

METALLURGISTS investigate and develop high temperature materials to provide greater strength at elevated temperatures and higher strength-weight ratios. Development of superior materials with greater corrosion resistance is of major importance, especially in nuclear reactors.



WORLD'S MOST POWERFUL production aircraft engine. This J-57 turbojet is in the 10,000-pound thrust class with considerably more power with afterburner.

NEW RECIPES

By CHARLENE KORANDO, Ch. E., '59

EDITOR'S NOTE — Many of our freshmen have had experience in industry before attending college. They have a good idea of what they want to do when they graduate. Miss Korando has had experience in the chemical field and is currently studying for an engineering degree in that field. The following article is based on information which she acquired while employed by the Ralston Purina Company in St. Louis.

The farm animals of today enjoy the benefits of 50 years of nutritional research. Today the feed manufacturers provide almost a dozen vitamins, 10 essential amino acids and over half a dozen minerals for a balanced diet.

Through the use of scientific research which has determined the nutritional requirements of the various animals and the use of by-products to provide these requirements, the modern feed industry can supply the farmers with economical and productive rations.

At the beginning of this century it took 13 pounds of feed to obtain a dozen eggs. Today the same yield can be obtained with less than 6½ pounds at a cost of 10% less per pound.

An examination of some of the specific ingredients used in the feeds will show why this is possible.

Among the first to benefit from these new developments were the poultry raisers since most of their ration needs are satisfied by manufactured feeds. Corn, which formerly supplied the carbohydrates and was therefore the source of energy in poultry diets, has been partially replaced by animal fats unfit for human consumption. These inedible fats became surplus when detergents replaced soaps in the American home. The caloric value of fats as a source of energy is 2½ times that of carbohydrates.

Carotene (plant form of Vitamin A) in poultry diets determines the color of the bills and feet of the birds and the color of the egg yolks. It was shown by experiment that the carotene content of eggs laid by hens fed alfalfa was much higher than that obtained from the eggs of animals fed carotene dissolved in oil. It has been suggested that alfalfa carries a factor which assists in the utilization of carotene.

It was discovered rather by accident that poultry fed scraps of meat grew faster than poultry fed entirely on grains and whatever they happened to scratch for themselves. Meat scrap and fish meal, by-products of the meat packing and fish processing industries, are used to supply some of the proteins in poultry diets.

These products contain the B vitamins of which Vitamin B-12 is apparently the most potent and therefore the most important and are collectively called the APF (animal protein factor) complex. University of Connecticut workers have reported that 7.5% of animal protein concentrates greatly improves the efficiency of the feed.

For swine and cattle feed, manufacturers have provided a series of supplements and concentrates to be fed along with local grain and pasture forage.

Plant proteins supplied by soybean meal, cottonseed meal, peanut meal and linseed meal which are by-products of the vegetable oil industry are deficient in amino acids, particularly methionine. The fermentation products of certain types of bacteria have been demonstrated to contain these missing APF products. With new and lower prices of artificially cultured feed grade methionine, it is possible to make the vegetable proteins comparable to animal proteins from an amino acid standpoint.

Now available in synthetic form is Vitamin A needed for maximum protein utilization during early growth. Commercial users will no longer be faced with investments of large sums of money for huge inventories of fish oils which are subject to deterioration on standing.

In addition to proteins and vitamins these supplements and concentrates provide the right amounts of the trace minerals. Iron, copper and cobalt are necessary to prevent anemia. Cobalt is also a part of the Vitamin B-12 molecule. Iron is a part of the red pigment molecule (hemoglobin) in blood. Copper is an essential element that catalyzes the formation of hemoglobin; without it hemoglobin building cannot take place. Iodine is necessary to the thyroid gland which controls the rate of metabolism. Manganese is needed for normal reproduction.

Scientific research carried out by government, university and industrial laboratories have made possible the ever-increasing production of animal products at rates greater than nature ever intended.

NOTE: *The Author gratefully acknowledges information supplied by T. J. Potts, Manager of the Analytical Laboratories, Ralston Purina Co.*

New On Faculty

By SHELTON EHRLICH, M.E. '57

A new year is beginning, accompanied by many new faces. One, in particular, belongs to our new chairman of the Industrial Engineering department. He is Dr. Eastman, currently from Georgia Tech. Dr. Eastman replaces George Elliot who has joined the staff of the Sandia Corporation.

Dr. Eastman was born in Dayton, Ohio and was raised in Springfield where his father was a county engineer. Upon receiving a B.A. degree in accounting (1940 Antioch College) he began his career with an aircraft parts manufacturer. When the second World War started, he joined the Army and rose to the rank of captain. He was discharged in 1946. By 1948 he had completed his work for an M.S. degree in Industrial Engineering at Ohio State. He continued further at Penn. State where he worked on his doctorate degree. In 1951, upon completing his thesis on engineering economy, he was awarded the first Ph.D. in Industrial Engineering ever given by Penn. State.

Dr. Eastman believes that engineering professors should work in industry during the summer. Following through on his theory, he has worked for many companies during the summer months. To mention a few: Standard Products Engineering Co., American Can Co., and Jeffery Manufacturing Co.

He is a registered engineer in the State of Georgia, a member of the American Material Handling Society, American Society of Engineering Educators and the American Institute of Industrial Engineers. He served in the capacity of business manager of the latter organization's publication "Industrial Engineer."

Dr. Eastman is married and has three children, the newest addition to the family being just seven weeks old. When he occasionally finds some free time, Dr. Eastman enjoys collecting stamps and swimming.

We wish to extend a warm and friendly welcome to Dr. Eastman, and hope that his stay here at Missouri will be a long and happy one.

AROUND THE COLUMNS

(*Continued from page* 18)

Adjacent to the operators room there are a conference room and an office and records room. All rooms are specially lighted and air conditioned. The board is of Westinghouse manufacture, operating on 440 cycle power. It is comprised of the following major components: An instrument and control desk, containing the master instruments with automatic scale selector to select correct current scales of these meters, circuit metering selector equipment, and remote controls of essential circuits to the M. G. set. A recording desk or plotting table with space for 400 circuits.

The A. C. network analyzer board will be operated under regulations and policies formulated by an advisory committee consisting of one representative appointed by each of the contributing companies and three representatives of the University. The latter members will be the Dean of the College of Engineering, the Chairman of the Electrical Engineering Department and the Supervisor of the analyzer. Professor J. C. Hogan, Associate Professor of Electrical Engineering, will act as supervisor of the analyzer program. Professor Hogan holds a Ph.D. degree from the University of Wisconsin and has been a member of the Electrical Engineering faculty since 1947. He has had considerable industrial experience and is thoroughly cognizant with the techniques involved in making analyzer board studies. Professor J. R. Tudor, Assistant Professor of Electrical Engineering, will act as associate supervisor. Professor Tudor holds an M.S. degree from this institution and has been on the department faculty since 1952. He has had several years practical experience in the power utility field during which time he assisted in making network analyzer board studies. In addition there will be available one or two graduate student assistants who will act as operating personnel.

Dr. Eastman

The service charge to non-contributing companies for the use of the board will be $125 per eight-hour day, starting at 8 a.m. on any day, except Saturdays, Sundays, and legal holidays. For any additional hours used in any day, and/or any hours used on Saturdays, Sundays, or legal holidays, the service charge is $20 per hour with a minimum of $40.

The objectives of the program are many. The location of an A. C. network analyzer board at the University of Missouri at Columbia, Missouri will provide a centrally-located engineering service to the Utilities operating within the state of Missouri. Moreover, it will be in a position to serve the many companies located in the mid-western area of the United States. In providing this service, the Department of Electrical Engineering expects to promote closer relationships between engineers in industry, members of the engineering faculty and students who are interested in power system 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. The interchange of ideas between practicing engineers, faculty and students will stimulate interest in the power field among students and will foster discussion of important problems which may be of mutual benefit to industry and the College of Engineering.

(*Continued on page* 28)

Apart, they're liquid... together, they're solid

—and this strange reaction helps make parts for your car

. . . your television set . . . and even your tableware

BY THEMSELVES, these two liquids flow as freely as water. Yet when poured together they quickly turn into a solid—harder than many metals.

THESE AMAZING LIQUIDS which become a solid, without applying heat or pressure, are man-made chemicals—one called a resin, the other a curing agent. The chemists have coined the name, *epoxy*, for the resulting plastic.

FROM YOUR KITCHEN to the automobile plant, you will find epoxies now at work. In the latest tableware, they seal knife blades in their handles, keeping them everlastingly tight.

Epoxies are being used to make huge dies to stamp out automobile parts, airplane wing sections, and other varied shapes. These dies can be made in little more than half the time it takes to make all-metal dies, and at substantial savings, too.

DELICATE PARTS for television, radio, and other electronic equipment are embedded in epoxies to protect them from moisture and vibration.

MANY INDUSTRIES now are looking to epoxies for help in making better things for you. Developing and producing epoxies—as well as long-familiar plastics—is one of the many important jobs of the people of Union Carbide.

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

UNION CARBIDE
AND CARBON CORPORATION

30 EAST 42ND STREET UCC NEW YORK 17, N. Y.

In Canada: UNION CARBIDE CANADA LIMITED

UCC's Trade-marked Products include

BAKELITE, VINYLITE, and KRENE Plastics · PYROFAX Gas · PREST-O-LITE Acetylene · EVEREADY Flashlights and Batteries · SYNTHETIC ORGANIC CHEMICALS · LINDE Silicones · PRESTONE Anti-Freeze · LINDE Oxygen · ACHESON Electrodes · Dynel Textile Fibers · ELECTROMET Alloys and Metals · HAYNES STELLITE Alloys · UNION Carbide · NATIONAL Carbons

Dean Croft congratulates Max Richardson

First Westinghouse Achievement Scholarship Awarded at Missouri

Max C. Richardson, a junior in the College of Engineering at the University of Missouri, was awarded the Westinghouse Achievement Scholarship at a meeting of the Engineers Club Tuesday evening, Sept. 20, in the Memorial Student Union.

The award, the first of five similar awards to be given by the Westinghouse Educational Foundation, is valued at $500.

Mr. Richardson, who has a 3.59 grade average in chemical engineering, was chosen by a faculty committee on the basis of achievement and demonstrated leadership. Candidates for the award were selected from juniors in the electrical, mechanical and chemical fields of engineering.

Concerning Centennials, Celebrations, and Alumni

You may have heard it before, but it bears repeating. This is our Centennial year and we are really planning to celebrate. The activities will center about St. Pat's week. We're hoping that our alumni will be well represented. Just as the Engineer's Club is the focal point for all undergraduate activities, so is the Alumni Association the focal point for graduate activities. Alumni who wish to join this association should renew their membership as soon as possible. The dues are two dollars per year and should be mailed to E. J. Vredenburg, Secretary of the Alumni Association, College of Engineering, Columbia, Missouri. Shamrock subscription is included in this fee.

A TRIBUTE TO MIZZOU

By SHELTON EHRLICH, M.E., '57

Every one of us has been confronted at one time or another with the query, "How does the University of Missouri rate as an engineering school?" The attempt to answer this raises another question, How do you rate a school and in this particular situation, an engineering school?

In rating schools you could use several approaches. You could investigate the physical facilities of the campus and judge the school on the capital investment. If this approach did not seem fair, you might tabulate the degrees of the instructors and compare schools on the number or percentage of Ph.D's on the staff. Another approach to the answer would be to see what proportion of the graduates of the particular school you are investigating were successful engineers. To me it seems that the only fair criterion for judging is the latter. If we accept this presumption, then we are immediately faced with another dilemma: where do you find a list of successful engineers?

A yearly publication entitled "Who's Who in Engineering" shows a list of successful engineers. A study of the 1954 edition of this publication was made by Charles J. Baer, Assistant to the Dean, University of Kansas, School of Engineering and Architecture, Lawrence, Kansas. This study is basically divided into two parts, a listing of schools by total of alumni included in the publication and a listing by proportion of included alumni to total alumni. Although Missouri ranks thirty-eighth in the listing of total alumni included, it ranks fifth in the listing by proportion. In other words, your chances of making "Who's Who in Engineering" are almost twice as good if you graduate from the University of Missouri than if you would graduate from M.I.T.

We need no longer fear the question, "How does M.U. rate as an engineering school?" We can now go forth armed with statistics which prove that "Old Mizzou" is "best."

AROUND THE COLUMNS

(*Continued from page* 24)

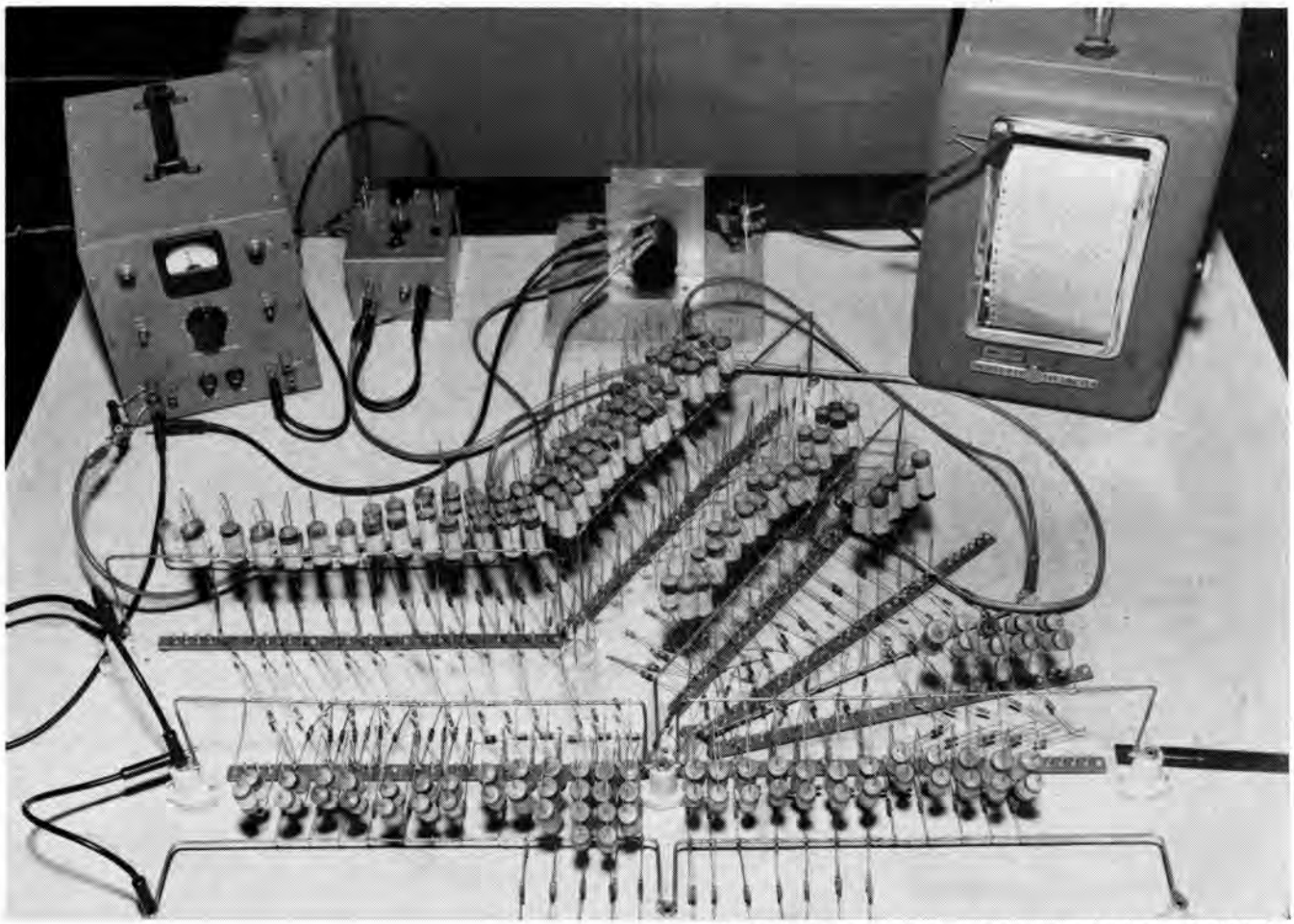
Three professors of electrical engineering at the University of Missouri attended the National Electronics Conference Oct. 3, 4, and 5, in Chicago. Attending the three-day conference were Dr. C. M. Wallis, chairman of the department of electrical engineering; Dr. Donald L. Waidelich, and Dr. G. V. Lago. The conference was sponsored by the Institute of Radio Engineers and the American Institute of Electrical Engineers.

Dr. Lago read a paper on "A Synthesis Procedure for Sampled Data Systems," and Dr. Waidelich presented a paper entitled "Design of Optimum Phase-Shift Oscillators."

Dean Huber O. Croft has announced that the Board of Curators accepted an offer of $6,657 and an additional $7,500 from the U.S. Army Corps to continue a grant for research by the Department of Civil Engineering. Dr. Adrian Pauw, associate professor of civil engineering, will conduct the project entitled "Basic Research in Force Relaxation Methods". The grant will expire Aug. 31, 1956.

On Wednesday evening, September 28, the Engineer Wives' Club met for the first time this year. The meeting was held at the now remodeled Read Hall. Election of officers was held. The new officers are: Vice-president, Mrs. E. Lee Ward; Secretary, Mrs. Bob Haist; Treasurer, Mrs. Bruce Jorden. Chairman of committees are: Social chairman, Mrs. Jim Glass; Reporter and Property, Mrs. J. T. Battenberg; Membership, Mrs. James Musgrave; and Historian, Mrs. Jack Harrison.

Antidisestablishmentarianism: we can spell it, but what does it mean?



This analogue computer, a pioneer in this age of "thinking machines", was developed by Standard Oil scientists.

New Electronic "Engineer" Solves Tough Refinery Problem

THE MEN who design modern oil refineries need specific information about temperature distributions in different parts of pressure vessels. Such information, essential to safety and efficient operation, is often extremely difficult to obtain by conventional mathematical methods.

Scientists at Standard Oil's Whiting laboratories recently developed and built an electrical analogue capable of simulating specific conditions within a refinery unit still in the design stage. Using this device, they could determine in advance the temperature distribution in the joint between two pressure vessels having a common head. Thus they were able to duplicate in 20 seconds the heat stress picture within the unit during an 8 hour start-up to shut-down period.

Creative scientific thinking made possible this constructive achievement by engineers who have chosen to build their careers at Standard Oil.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

AUTOMATION

(*Continued from page* 10)

documentation was convincing and the assembly line spread rapidly, became the basis of our system of mass production.

But it is a mistake to think of this as automation, though it was an essential step in that direction. For the assembly line led naturally to the product approach, not just for assembly but for all the preliminary operations. As machines became more specialized, it was possible to make them increasingly automatic in operation.

The Early Transfer Machine

Next came the combining of two or more operations on a single machine bed. It is hard to identify just when this first happened, but the first true transfer machine appears to have been the one built at the Morris automobile plant in Coventry, England, in 1924. This machine was 181 ft. long, 11 ft. 4 in. high, and 11 ft. wide. It weighed more than 300 tons and produced finished cylinder blocks from rough castings, removing about 40 lb. of metal. There were 53 operation stages and 81 electric motors with a combined rating of 267 hp. It was actually a collection of standard machines attached to a continuous bed with a continuous table mounting the fixtures and jigs and a common control shaft to time the motion of all the heads. Cycle time on the machine was 4 min., with duplex lines handling blocks alternately for boring and other operations requiring more than 4 min.

A few years later, in 1929, Graham-Paige Motors installed a system for operations in their cylinder department which included automatic jigs and fixtures with transfer bars to move work from machine to machine in which all the basic elements of a modern transfer machine were present.

By this time we had begun to realize that there was little point in cutting machining time from 90 sec. to 70 sec. if it took 13 min. to load the work into the machine and 2 hr. to get hold of the crane to move it on to the next machine. Materials handling was recognized at last as the essential element it was.

Now we begin to see instances of all these developments being tied together efficiently into the automatic production of a metal component. A. O. Smith did it first in 1920 with auto frames and somewhat later Budd Wheel did it with car wheels. There were many such isolated cases over the years, I am sure, but we are handicapped in tracking them down because they were considered to be so specialized as to be of little interest to others. Automation had not yet emerged as a principle, though it certainly existed as a fact.

What Is Automation?

Let us pause to take a look at this suddenly popular, often misunderstood word "automation." The word itself is now the simplest thing in the whole complex picture, for the lexicographers have already traced the history of it, and written a definition for it.

The word was coined by D. S. Harder of Ford Motor Company in 1947. Someone had asked for means of handling parts in process without the delays caused by the human element. "What we need," said Harder, "is more automation." It is possible that other people had coined the same word before, but this time it stuck. The name was applied to a special task force at Ford assigned to mechanize the loading and unloading of new equipment. The initial emphasis was on presses. The "iron hand" to feed presses had already been developed at Fisher Body, and this and other devices were adapted to a whole series of press operations.

The word automation first appeared in print in *American Machinist* for October 21, 1948. LeGrand at that time defined it as ". . . the art of applying mechanical devices to manipulate workpieces into and out of equipment, turn parts between operations, remove scrap and to perform these tasks in timed sequence with the production equipment so that the line can be wholly or partially under pushbutton control at strategic stations."

The editors of Merriam-Webster's International Dictionary plan now to define the word in their next edition thus: "automation, n, 1. The act or technique of making a manufacturing process fully automatic. By this technique parts are moved into and out of machines without being handled by human operators. 2. The state of being automatic. 3. Automatic operation, as of a machine."

Harder has since said, and I think that most will agree, that automation is more than this, that it is "a philosophy of manufacturing" and the original definition must be broadened to include design of parts, methods for their manufacture, and production-tool control systems. Alspach has defined automation simply and concisely as "continuous automatic production."

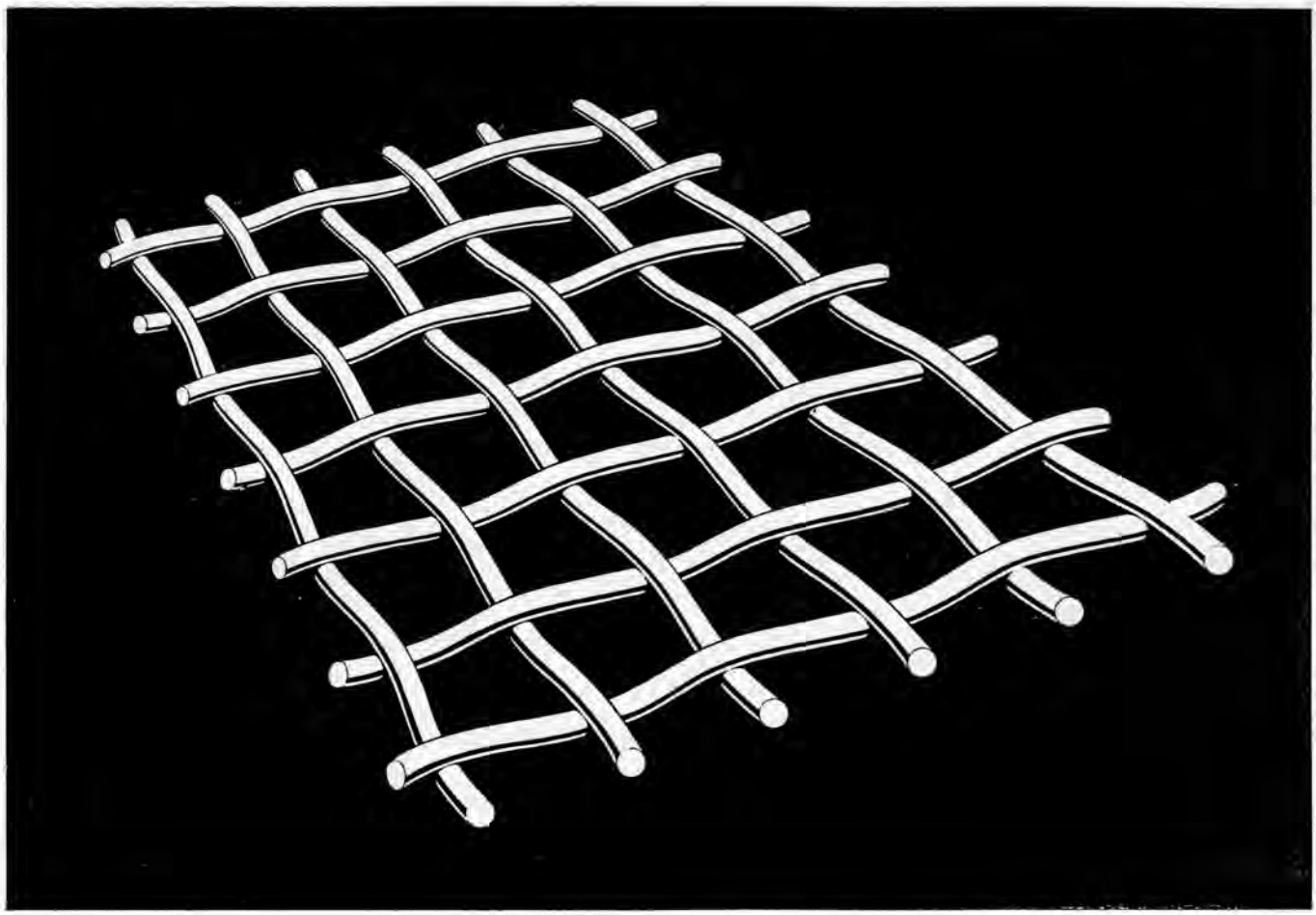
High-Speed Machining

Credit also should be given to the development of high-speed machining for the impetus it has given to automation. At about the time that Ford first was working on the automation of presses, and before it had been applied to metal-cutting operations, several hardy souls in widely scattered shops began to experiment with cutting speeds much higher than those conventionally recommended. Drawing on these experiences, and the work of researchers here and abroad, Tangerman wrote a series of articles in 1948, 1949, and 1950 that started a controversy of considerable proportions, that made "high-speed machining" a popular term, that stimulated several research projects, leading to the concept of optimum machining rates and that appears to have caused a rather common shift to speeds well above the accepted handbook values when tools and equipment permit. It followed naturally that the shorter machining times made the same old loading time rather ridiculous and pushed the development of automation to redress the balance.

Automatic Machine Control

Now we have to go back a century and a half to find the origin of automatic machine control, back to 1801 and the Frenchman, Joseph Marie Jacquard, and his pattern loom controlled by punched-cards linked together in a chain. The Jacquard loom is still used today, in countless variations, to produce rugs, tapestries, lace, and embroidery.

(*Continued on page* 32)



AUTOMATION

(*Continued from page* 30)

Punched tape found many other applications. Most of you can remember the player piano. In 1887, Talbert Lanston invented the monotype, first produced in 1897, in which a punched tape govern the casting and assembly of the type.

Automatic control first came to the metalworking machine, however, with the cam. Perhaps the key was the turret lathe, developed in 1854, and transformed into an automatic machine in 1876 by Christopher M. Spencer. The importance of the blank cam cylinder with flat strips adjustable for different jobs was overlooked by his patent attorney. Thus he secured no rights on the device that made automatic bar and chucking machines possible, and is still used today. The automatic screw machine was developed at Brown & Sharpe during the Civil War. The multiple-spindle automatic at White Sewing Machine in Cleveland.

These developments were paralleled by the development of contouring machines with tracer control working first mechanically, then electrically, and hydraulically.

Automatic Size Control

An early example of automatic size control was developed by Bryand in 1931. Contact between a carbon washer, adjacent to the wheel and a carbon sizing ring mounted in the chuck backed off the feed when the desired size had been reached.

Now let us look at a couple of typical examples of how these advances were combined. Consider a typical shop with a line of drill presses. There are 13 drill presses in a line. Holes are drilled in steering-gear housings, with the work progressing from one machine to the next and stored on tables between. This was considered an efficient arrangement by rather recent standards. These 13 drill presses were replaced by an indexing machine that takes less floor space, insures higher accuracy (because of better fixturing), and provides a rather obvious saving.

That is typical of one large area of automation—the combining of operations into a single machine. Another area is to combine machines into a line. Here a circle of five punch presses forms rear-axle vanzos. Presses are fed by a rotating spider. One man operates the entire rig and the hazard associated with many press operations is virtually eliminated.

Selected Sequency Loading

One point in the Ford engine block line represents an important principle of automation that must not be overlooked when automation is extended to a large sequence of operations. The principle of "selective sequence loading" briefly stated, is as follows: Blocks come from two boring machines, A and B, and are fed to two face-milling machines H and J. One machine can be down for tool changes or maintenance without completely stopping production.

Even with such an approach, much of our present automation is limited to high volume and inflexible design. Engineers are seeking to restore the wide flexibility of the Spencer cam to such automated setups.

Tape Controls

Most of the effort in this direction is toward tape or some form of numerical control. An early example was the Arma lathe developed on the player-piano system about 1948. Then Cunningham produced noncircular gears commercially on a shaper controlled by film.

Recently tape developments have come so fast I cannot record them all. We have had the magnetic-tape record-playback control in which the control records machine movements while the operator makes one part, then playback of the tape duplicates the motions.

A basically different approach is the positioning device in which the table of a turret punch press is located and the turret is rotated from punched instructions on cards by a digital computer that translates co-ordinates and diameter into instructions for a Selsyn system. An earlier system employed a computer to count scribed lines on engraved control bars.

A similar application is in the positioning of a riveting machine by punched film. The same approach has

(*Continued on page* 34)

AUTOMATION

(*Continued from page* 32)

also been applied to press brakes. The aim of all these is to free automation from the tyranny of the need for high volume with fixed design.

There is, finally, the experimental setup at the Massachusetts Institute of Technology, where a milling machine is under complete control through servomechanisms of a digital analog computer receiving its instructions from punched tape. This machine, not in itself compact or economical enough for the average plant, is producing valuable research data which point the way for commercial application of numerical control in metalworking. Already this machine, in special cases, has proved an economical production tool. A complete description of this work has been prepared by Stocker and Emerson.

Keeping Tools Sharp

We have the automated production setup, and the means for making it flexible where necessary. There remains a major problem: the dull tool. With grinders, the automatic dressing attachment and various pneumatic and electrical gaging devices provided the solution some time ago. The solution of the problem for cutting tools is more recent.

Tool-Control Board

One approach is the tool-control board. A spare set of tools is preset in holders. Tests show the safe number of parts each tool can produce. The control board counts for each tool and stops the machine when one of the tools reaches its limit. The control lights indicate the tool to be replaced and the operator can replace it with the preset equivalent rather quickly.

Next step obviously is to have a toolholder that resets the tool automatically as it wears and replaces it when regrinding is needed. Several machines that accomplish this have been under development recently and the first ones are just now going into production in metalworking plants.

In the self-resetting lathe air gaging of the part controls the form tools. One set of tools is advanced six times, 0.0005 in. each time to compensate for tool wear, then the turret rotates to bring a fresh, preset pair of tools into position. After ten turret positions, the machine stops for installation of a new tool turret.

Assembly Machines

We are hearing a good deal about assembly now. The electrical manufacturers have assembly machines. Other metalworking industries have, or are developing them. An assembly machine can be a very complicated looking device, but in fact is likely to be a large collection of individually simple mechanical movements with pneumatic or electronic checking devices in a closed circuit to catch and eject the defective assemblies.

On this matter of assembly, here is an interesting description: "A new field for special machines seems to be opening up in the attention being paid to the automatic assembling of small parts. . . . Some of the more intricate mechanisms contain several hoppers into which different parts are dumped as required. These parts are sorted automatically so as to be right end up when they get into the assembly fixture. In some cases such parts as springs are made by the assembly machine itself . . . should defective parts get into the machines they are automatically rejected into a separate box". Except for the reference to small parts, that could have been written yesterday. But it wasn't. It was published March 12, 1925.

Conclusion

It has been my aim to summarize briefly the development of automation in the metalworking industries, and to show how it has gradually evolved through a much longer period than is generally recognized. Whenever I could, I have given credit to the man or organization in key spots along the way. To the many others whose contributions have been overlooked, I can only say that I am sorry, that present research methods, which are far from automatic, made it impossible to search out every step, nor did time permit the inclusion of all that I did find.

There is considerable dispute now about whether automation is a good word or a bad word, or even a word. I think we must all agree that it is a word. If its meaning is unclear, that is largely because the principles and the application of the concept are not fully established.

Automation can be a good, convenient word for engineers, and for laymen too—if we can lay the ghost that it is a concept that is new and revolutionary to industry, and new and dangerous to labor. Hoping not to add to the surfeit of definitions we already have, I would like to say that automation is a fact. We can hide neither from the word nor the concept

(*Continued on next page*)

SHAMROCK SEZ

By LEROY ANDERSON

Ye olde Shamrock staff has been searching for a reason why ivy doesn't grow on the columns any more. In September of 1953 the long lamented Missouri "Student" carried an article that tried to explain "Why Ivy Doesn't Grow On the Sixth Column." It said that six former presidents of Mizzou were buried under the columns, one to the customer. Five of them were God-fearing and the sixth was an atheist: Naturally ivy wouldn't grow over an atheist. This was a good theory but what has happened to the ivy on the other five columns? Maybe the other five presidents found out that we have an Ag school and have lost their religion. This may have happened but we have a different theory: Waldo came to Columbia and couldn't find a big enough fire plug.

Another matter which has puzzled us has to do with higher mathematics. Anyone who has successfully passed first semester calculus is familiar with the concept of displacement, or the motion of a point in space. They would know that the function represents distance traveled, the first derivative represents the velocity and the second derivative represents the acceleration at a given displacement. What they wouldn't know is the meaning of the third derivative. For years this has been a closely guarded secret among the faculty, but recently one of their number let it slip and we are now able to tell you that the third derivative is "jerk."

Engineers are supposed to have great mechanical aptitude. They are always inventing labor saving devices yet they never seem to get around to inventing any for their own use. To save future engineering students from having to buy all those old fashioned instruments for Engineering drawing someone should try their luck at developing an all around drafting tool that will do precision work and produce black lines. No wonder the lines weren't black, we just found out that the damn lead is grey.

If you bothered to look at the cover you'll notice a new style-more picture, less border. As a starter it features a picture of a smokestack. This picture is of special interest to the C.E.'s and is a good geometrical pattern for all of us to appreciate, but frankly we think most of us are more interested in that part of geometry that has to do with curves instead of straight lines. To satisfy those of the majority, next month's cover will be a real curvy gal. (Don't bet your Cadillac on it though).

Bill Marshall receiving award on behalf of the Shamrock

SHAMROCK WINS AWARD

The *Missouri Shamrock* received the first place award for the best student written article at the annual ECMA convention in Lincoln, Nebraska, October 6, 7 and 8. The award winning article was "Archimedes Principle" by Jack Harvey. It appeared in the December 1954 issue of the *Shamrock*. Our editor at that time was Tom Bolner. This award bears out our feeling that Tom did an excellent job as editor and that Missouri writers can write!

Representing Missouri at the ECMA convention were Bill Marshall and Jerry Herdan.

NEWSTUFF

(*Continued from page* 15)

steels and a method for manufacturing flue-dust sinter.

Continuing the disclosure of the results of his studies on nickel-free stainless steel, Dr. Carney concluded, "Further work is necessary to establish more carefully the corrosion, welding and high-temperature properties of these high-nitrogen steels.

"It is also necessary to solve several rolling and finishing problems. It is expected, however, that these problems will be resolved in the near future. If so, the way may be opened to a further marked increase in stainless steel production and application."

AUTOMATION

(*Continued from pake* 34)

for which it stands. But I think we can say without twisting the intent of Tocqueville, who said it first, in this concept of automation we "recognize the general and systematic idea upon which a great people direct all their concerns."

DADDY DEFOE

(*Continued from page* 16)

library to give of his time to men in doubt or distress or difficulty. He was a great teacher, an educator in a high sense, drawing out from the students in his classes an intellectual curiosity which led them into interested study and made what they studied a part of their own intellectual possessions.

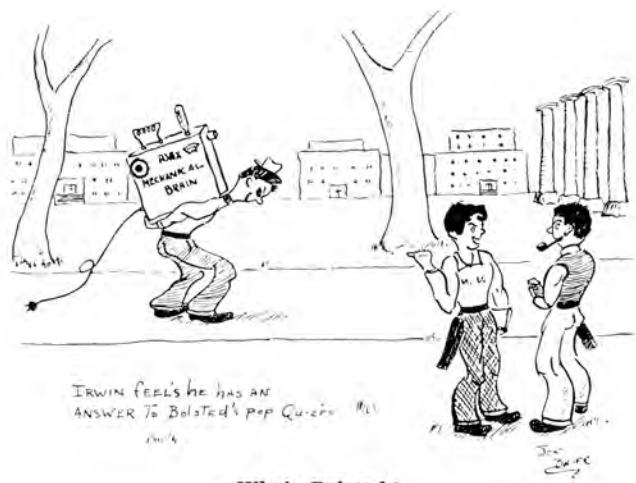
"It is given to few men to leave such impress upon his day and generation — and right wisely did he employ the gift that was his."

On October 19, 1940, the University dedicated a new residence hall for men and named it Luther Marion Defoe Hall.

OLDSTUFF

"Time flies" and as it does mass collects—In this case the mass is a mess of old plates in the Sham office. Partly out of curiosity, partly due to an inequity of papyrus and erudite hieroglyphics, we decided to give the past its due. The captions are of the present.

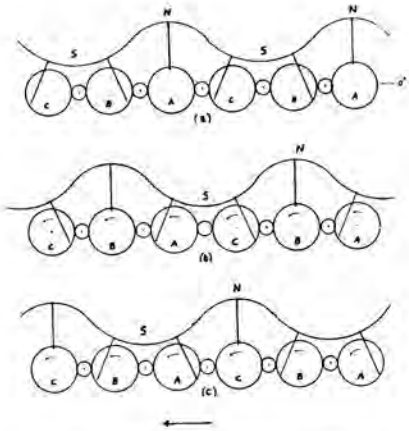
Prohibition Trousers—A fifth in each sock.



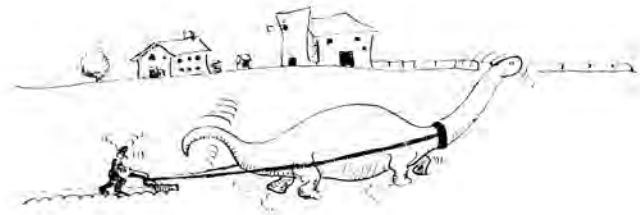
Who's Bolsted?

On the tonsils

Why drive? It's cheaper to ride a bus.

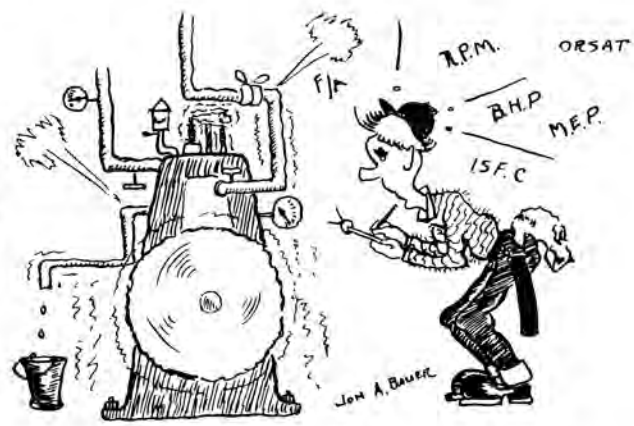


This is a technical magazine



Hi Ho, Bronty!

The Equipment Looks Familiar



Erin Go Bragh . . .
Er'n Go Braw . . .
Ern Ga Braa . . .
Ergabr!

BULLARNEY

By DUNK

Nothing works out right. In a town where you can park as long as you want to, you don't want to.

♣

Frosh (from back of room). "Are you sure the answer to the third question is in the book?"

Prof: "Certainly."

Frosh: Well, I can't find it."

♣

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 ChE was experimenting with new formulas for beer. He labored on his various theories for over a year, and when finally hitting upon what he thought was a revolutionary process, he sent the formula to a laboratory to be analyzed.

The reply came back, "Your horse has diabetes."

♣

What's the difference between a sewing machine and a girl running for a bus?

A sewing machine has only one bobbin.

♣

Her lips quivered as they approached mine. My whole frame trembled as I looked into her eyes. Her body shook with intensity as our lips met, and my chin vibrated and my body shuddered as I held her, pulsating, close to me.

The moral. "Never kiss them in a car with the engine running."

♣

CE: "What would you say if I stole a kiss?"

She: "What would you say to a guy who had a chance to steal an automobile but only took the windshield wiper?"

♣

The Deans who think our jokes are rough
Would quickly change their views,
If they'd compare the ones we print
With the ones we're scared to use.

♣

Overheard in a parked car near the "Hink": "Slow down Columbus, you've discovered enough for tonight."

♣

Give an athlete an inch and he'll take a foot — but let him take it. Who wants athlete's foot?

♣

A sweet old lady, always eager to help the needy, spied a particularly sad looking old man standing on a street corner. She walked over to him, pressed a dollar into his hand and said, "Chin up."

The next day, on the same corner, the sad old man shuffled up to the lady and slipped ten dollars into her hand.

"Nice picking," he said in a low voice. "Chin Up paid nine to one."

♣

The grave digger was completing his last grave for the day, his mind on other things. Suddenly he found he'd dug so deep he couldn't get out. It was nightfall before his cries for help attracted the attention of a drunken passerby.

"Get me out of here," pleaded the digger. "I'm cold."

The drunk pondered a moment, then began shoveling frantically. "No wonder you're cold," he muttered, "you haven't got any dirt on you."

♣

One thing about baldness — it's neat.

♣

An engineer wandered in at 3 a.m. after a glorious evening. In a few minutes a series of unearthly squawks howled out of the radio.

His wife looked into the room and discovered him frantically twisting the dial back and forth.

"For heavens sake, what in the world are you doing?" she exclaimed.

"G'way. G'way. Don't bother me," he yelled. "Somebody's locked in the safe and I've forgotten the combination.

♣

What was that explosion on Si's farm?

He fed a chick some "Lay or Bust" feed, and it turned out to be a rooster.

♣

Try reading the rest of the magazine — it's good too!

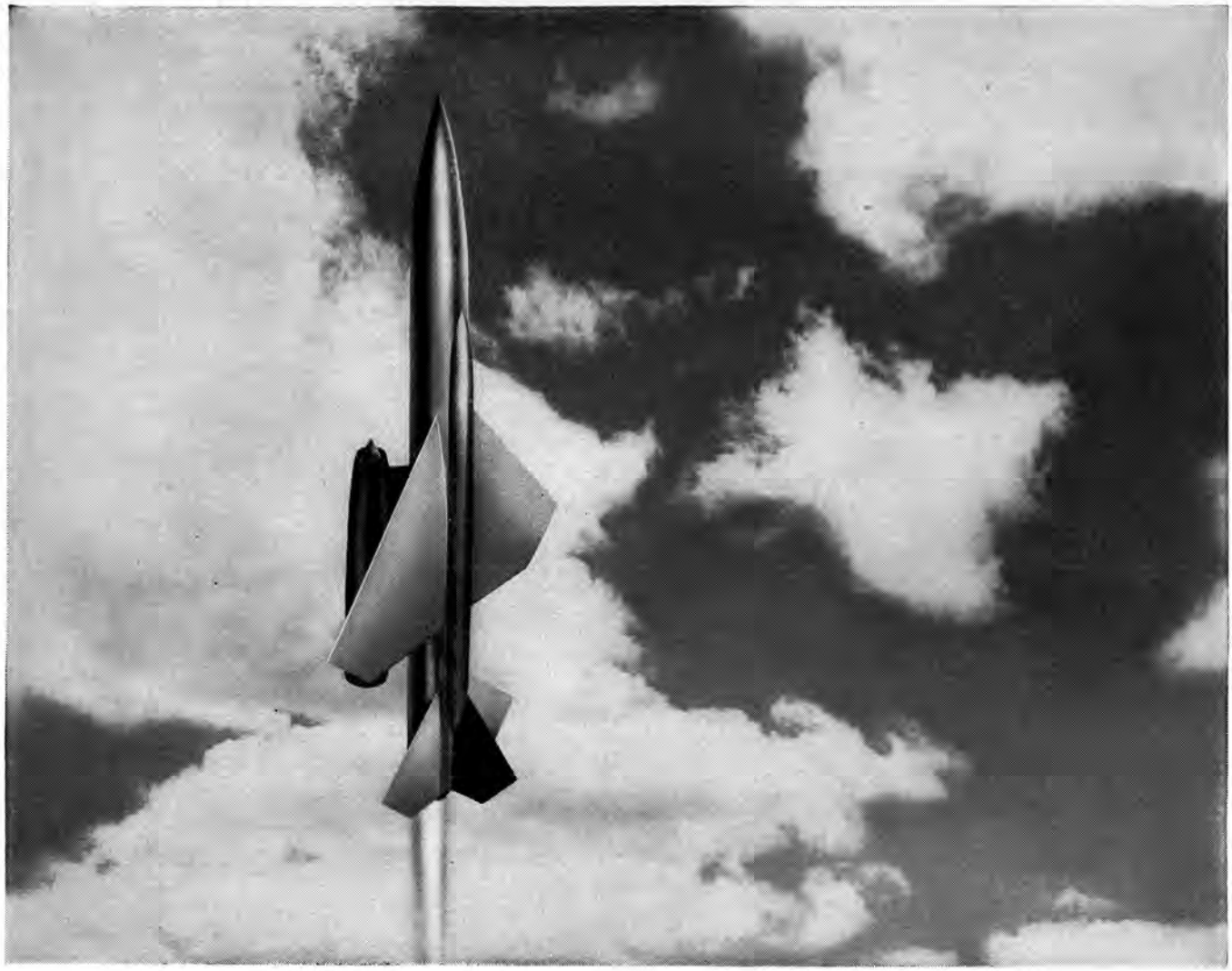
♣

"But how can you sell hair tonic if you have no hair?"

"What's wrong with that?; I know a guy who sells brassieres."

♣

Said the old maid to the burglar: Sure I have money. Don't just stand there — frisk me!"



$ $ NOW HEAR THIS $ $

The SHAMROCK will pay $5.00 for any student written article which conforms to the following specifications:

1. The article must consist of no less than 180 lines of typewritten material; 68 to 70 characters to the line. Double spaced typewritten manuscript preferred but any legible substitute will definitely be considered.

2. Author must give complete identification of any reference material used.

3. Author must be an undergraduate student at the University of Missouri. This offer is not restricted to Engineering students; any Missouri student is eligible.

4. Article must be accepted and published in the SHAMROCK.

We will consider an article on any topic.

In the Arma Visual Computer, a single control selects the desired chart from as many as 700 photo slides. Each slide contains punched code holes which automatically tune in the corresponding Omni Bearing Distance station. The image of the plane is governed by a combination of the radio signals and the plane's gyro instruments.

Photography teams with electronics and adds new certainty to flight

Now a visual computer pictures a plane's precise position and heading on projected photos of aeronautical maps.

Arma Division, American Bosch Arma Corp., working with the Air Navigation Development Board and C.A.A., has developed a valuable new aid in air navigation using photography.

With it the pilot, high above the weather, flicks a switch and before him appears a map of the area he's over. On the screen a tiny shadow of a plane moves and shows exactly where he is, where he's heading and whether he's on course.

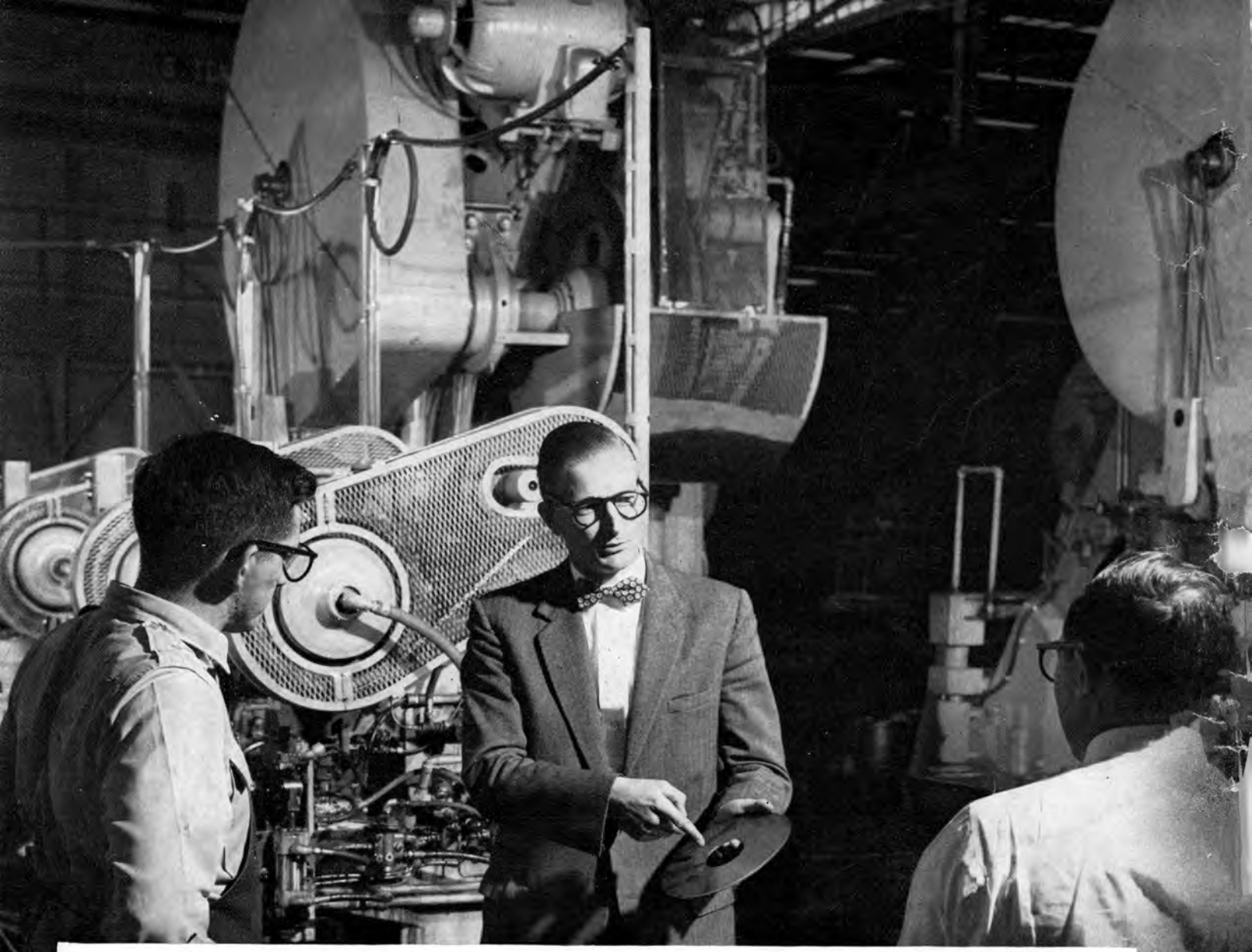
This spells added certainty. Even more! It can mean savings in time and money, too. For the flight can proceed by plan rather than by dog-legs on the beams.

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

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

This is why graduates in the physical sciences and in engineering find photography an important tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. If you are interested in these opportunities, write to Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company, Rochester 4, N. Y.



MISSOURI

SHAMROCK

DECEMBER 1955

Season's Greetings

FEATURES

Manufacture of Plate Glass
Day of the Interview
Detective in Chips & Stresses

Robert T. Blake, Class of '49
speaks from experience when he says,

"At U.S. Steel, the opportunities are unlimited."

Bob Blake had his first experience in steel mills working there during summer vacations from college. After receiving his B.S. degree in Electrical Engineering, he became an operating trainee in U.S. Steel's Irvin Works. During his training program, his background and versatility were used by the Training Division to develop a training program for Electrical Maintenance employees. By the end of 1951, Mr. Blake had become a Foreman with experience in both Cold Reduction Maintenance and the Galvanizing Department.

Effort is made to have young engineers obtain varied experience before devoting themselves to one field. Mr. Blake feels that, "An engineering graduate has practically no ceiling provided he has the right attitude and is willing."

Promoted again in 1954, Mr. Blake is now Foreman—Electric Shop in Central Maintenance. Supervising a crew of 40 men, he is responsible for electrical construction work, maintenance and crane wiring. Mr. Blake feels he is in "an interesting and challenging field of work." He has found that "U.S. Steel is a highly desirable employer in this most basic of all industries."

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

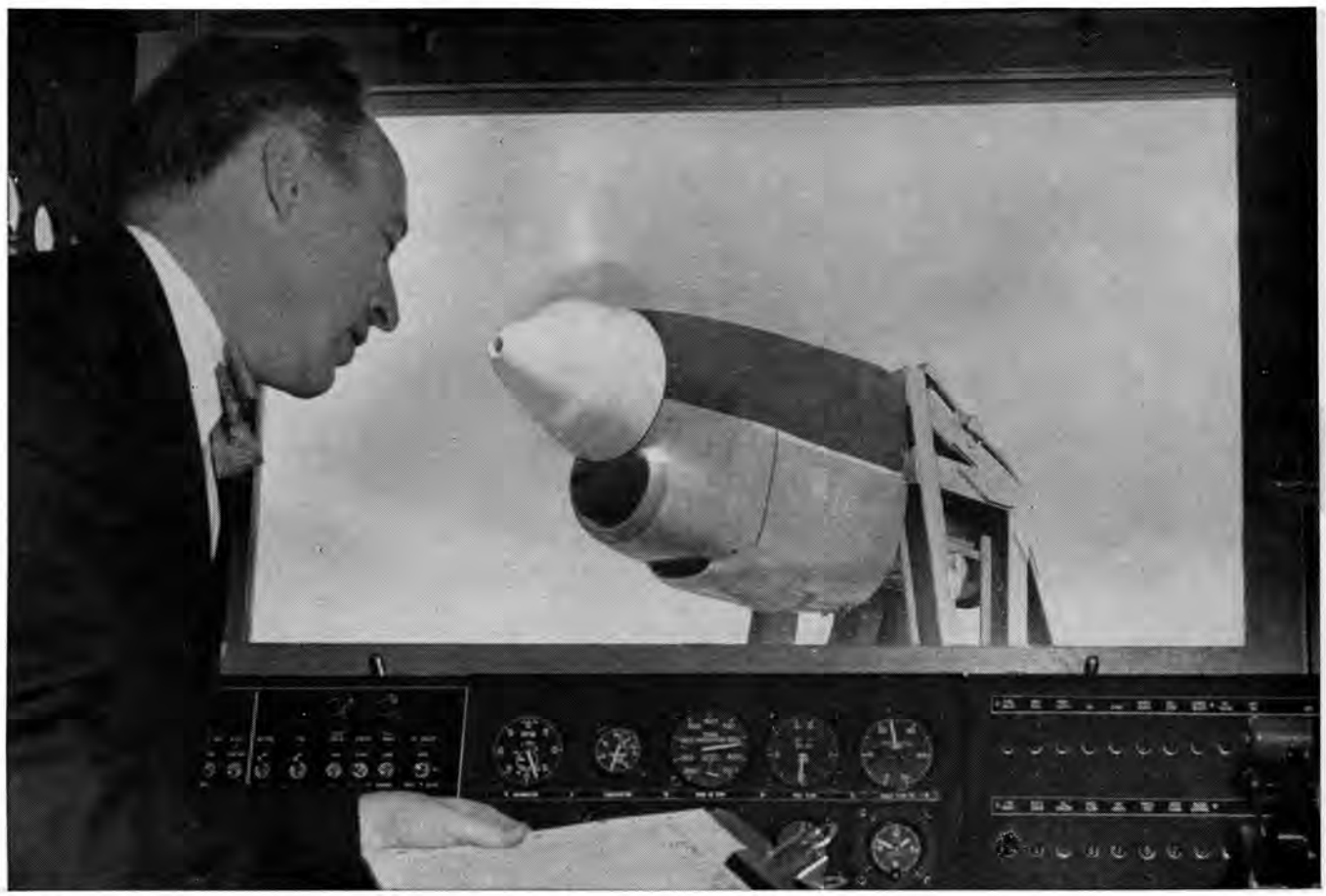
SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

USS

UNITED STATES STEEL

AMERICAN BRIDGE . . AMERICAN STEEL & WIRE and CYCLONE FENCE . . COLUMBIA-GENEVA STEEL . . CONSOLIDATED WESTERN STEEL . . GERRARD STEEL STRAPPING . . NATIONAL TUBE
OIL WELL SUPPLY . . TENNESSEE COAL & IRON . . UNITED STATES STEEL PRODUCTS . . UNITED STATES STEEL SUPPLY . *Divisions of* UNITED STATES STEEL CORPORATION, PITTSBURGH
UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY

16 TIMES "AROUND THE WORLD" AND NEVER OFF THE GROUND!



WHAT KIND of double talk is that—"16 Times Around the World, and Never Off the Ground?"

It's like this. With Allison's entry into the commercial airline field, there is a need for flight data on turbo-prop engines before they are put into regularly scheduled commercial service. In the absence of actual data, Allison is running a 1000-hour test schedule with a Model 501 turbo-prop engine mounted on an outdoor test rig.

In reality, 1000 hours of flying time represents about 16 times around the earth, is the equivalent of about 4 months of normal, commercial airline usage.

For this test, actual airline operating schedules are used. This means that the engine is run through complete cycles of starting, ground idle, take-off, climb, cruise and descent for landing, and the cycle is repeated continuously 'round the clock as the schedule simulates trips of from 250 to 2500 mile blocks.

One of the young engineers who has been working on the project from the start is Donal J. Nolan, shown above at the test instrument control panel. Don is assistant chief, installation engineering at Allison. After his graduation in '42 from Case Institute of Technology, he came to General Motors in 1943 with a degree in ME.

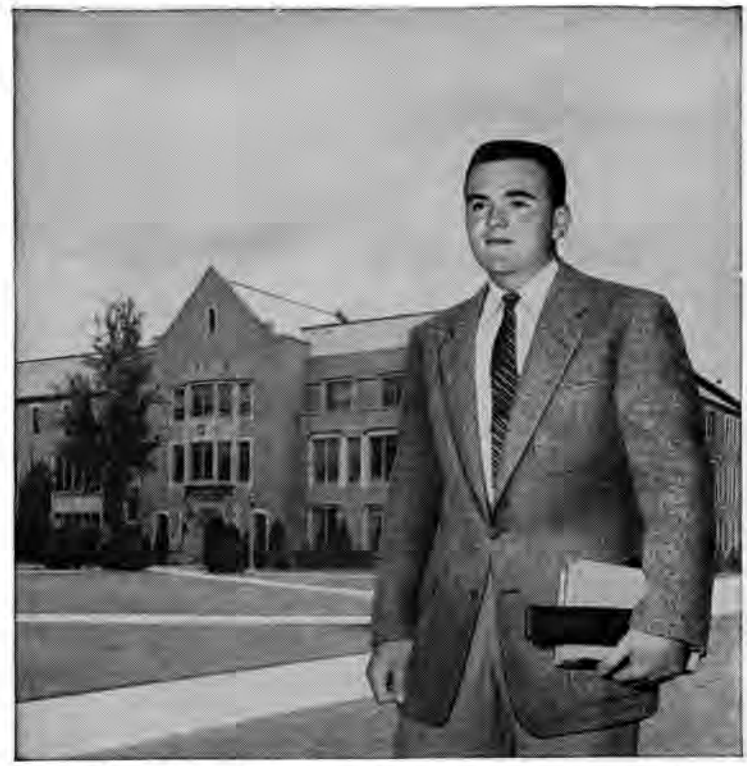
Commercial acceptance of the Allison turbo-prop engine started with the purchase of a quantity of Allison-powered Lockheed Electras by American Airlines. This initial purchase, plus plans of other leading airlines to adopt the Electra, opens a new chapter in the growth and development of Allison Division of General Motors Corporation. Already a leader in the design, development and production of turbo-jet and turbo-prop engines for military use, Allison is underway with a long-term engineering expansion program covering advanced military and commercial engine installations. This $75,000,000 program, providing for newest engineering and research facilities, intensifies the *immediate* need for engineers.

Opportunity for young graduate engineers is unlimited at Allison. Arrange now for an early interview with our representatives on your campus, or write now for information about the possibilities of YOUR engineering career at Allison: R. G. GREENWOOD, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

ALLISON
TURBO-PROP ENGINES
American built for the new era in air travel

John Kennedy asks:

How much travel is there in technical sales work?



JOHN T. KENNEDY is working toward his B.S. degree in chemical engineering from Notre Dame University in June 1957. He's a member of the student branch of A.I.Ch.E. and is active in the Young Christian Students and in the Chicago Club. Because John feels one should make employment plans early, he's starting his investigations during his junior year.

A. HICKS LAWRENCE, JR., earned his B.E. degree from Yale in June 1940 and joined Du Pont in the following month as an analytical chemist. He progressed steadily at various plants, from line foreman to shift supervisor to senior supervisor. In 1949 he applied his technical training to sales work. Today Mr. Lawrence is a sales manager in the "Kinetic" Division of Du Pont's Organic Chemicals Department.

A. Hicks Lawrence answers:

Well, John, as the *Old Man of the Sea* told Sinbad the Sailor, "The quantity of travel varies with the specific situation encountered." Of course, you'll never be shipwrecked or encounter the other travel problems that Sinbad did, but a man shouldn't seriously consider a career in sales work unless he really enjoys travel. Most of our sales personnel do just that, because the work itself provides so many rewards and satisfactions. It's not unusual for a representative to be away from home base 30 to 60 per cent of the time.

You see, John, for a good salesman, every trip means meeting new people, new situations, and new challenges. Every one of these offers a chance to display individual initiative. Perhaps the customer will need technical advice on applying our product to a specific item he's developing. The Du Pont salesman may choose to use his own experience and "trouble-shoot" on the spot. On the other hand, he may refer the problem to "home base," where he knows he'll be backed up by a strong technical organization. This knowledge naturally stimulates a salesman and heightens his interest in his work. He knows that he never travels alone.

WANT TO KNOW MORE about technical sales at Du Pont? Send for "The Du Pont Company and the College Graduate." This booklet contains a section on sales work and also gives many interesting details about the technical staff and laboratory facilities which stand behind a salesman. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington 98, Delaware.

DU PONT

REG. U. S. PAT. OFF.

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

WATCH "DU PONT CAVALCADE THEATER" ON TV

On the cover—This month the cover is dedicated to a subject which is uppermost in the minds of many of the seniors. In just a few months they will graduate and begin to command a tremendous salary (we hope). Needless to say, a large income must be spent somehow. What better way than buying a sleek, new convertible?

—*drawing by Frank Eggers*

MISSOURI SHAMROCK

VOL. XXII DECEMBER, 1955 NO. 3

CONTENTS

FEATURES:

DEPARTMENTS:

MEMBER
ENGINEERING COLLEGE MAGAZINES
ASSOCIATED

Chairman, Merk Hobson, University of Nebraska
Publisher's Representative, Littell-Murray-Barnhill, Inc., 101 Park Avenue, New York 17, New York, and 605 Michigan Avenue, Chicago, Ill.

Published monthly except June, July, August, September, by Board of Publications of Engineers Club, University of Missouri. Office of Publication: Room 233 Engineering Building, University of Missouri, Columbia, Missouri. Entered as second class matter at the post office at Columbia, Missouri under the act of March 3, 1879. Printed by The Missouri Farmer, Columbia, Missouri. Single copies 25 cents; subscriptions, $1.50 per year, $2.50 for 2 yrs.

ENGINEERS:

How 2 Years at Sylvania can equal 4 elsewhere

You're in at the beginning of major advances in the fast-moving electrical-electronic industry, when you work at Sylvania...a leader in electronics, television and radio, communications and radar, lighting, electronic components, powdered metals, atomic reactor fuels, advanced weapons systems and other rapidly-advancing fields.

Every year important developments come out of the company's 16 research and engineering laboratories—such recent achievements as Sylvania's stacked tube, the pill-sized germanium transistors, travelling wave tubes, television circuitry, and many others.

When you join Sylvania you are not plunged into narrow specialization. You work in different groups—survey many activities—and weigh a number of possibilities before deciding upon your field of concentration. The horizons are unlimited

It is easy to see how a young engineer or scientist can find 2 years at Sylvania equal to 4 at a more static organization—in professional development, responsibility, salary.

This is a young man's company. The average age of department heads is only 45. Sylvania's steady expansion into new fields provides continual opportunities for *young men of talent.*

Whatever your interests—research, development, design, production, administration—there are many opportunities for you at Sylvania's 43 manufacturing plants and 16 laboratories.

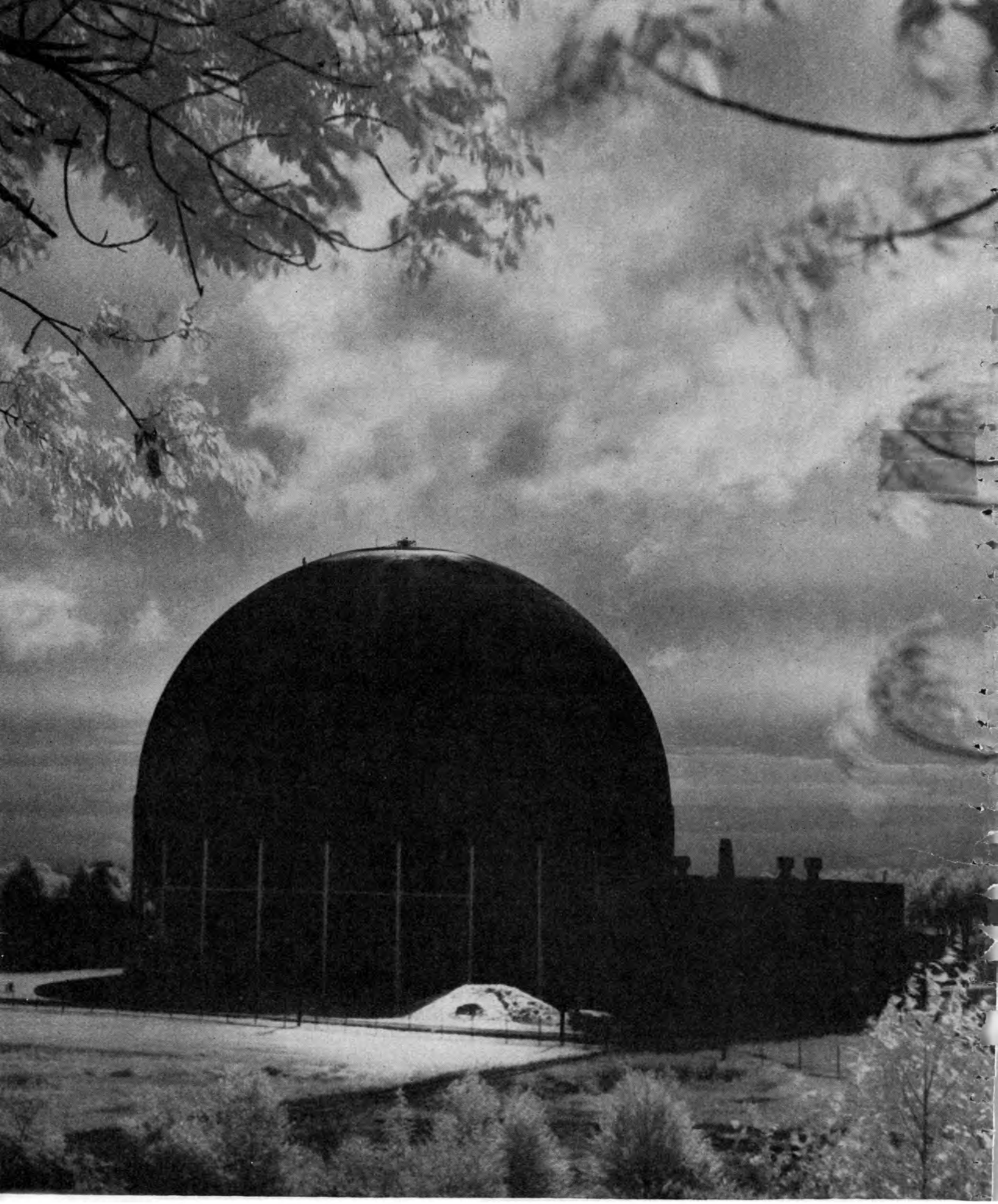
We invite you to make an appointment, through your College Placement Office, to discuss a Career at Sylvania with our representative. Write our Supervisor of Technical Employment for the comprehensive booklet, "Today and Tomorrow with Sylvania."

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.

1740 Broadway, New York 19, N. Y.

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY



ATOMIC AGE — Like the colossal remains of an ancient civilization, this steel sphere dominates the countryside around West Milton, N. Y. Here the General Electric Co. produced the world's first commercial atomic electric power for use in homes and industries. Inside 200-foot diameter ball is prototype reactor for Navy submarine "Seawolf." Excess power from the reactor was used to turn a G-E turbine-generator.

Unions: For Engineers?

Recently we have received some literature on the subject of unions for engineers. Apparently quite a bit of this type of material is being mailed to colleges in the hopes of swaying the student of engineering in favor of engineering unions. One letter in particular was quite interesting to us; it was an excellent example of techniques used in all sorts of organizing campaigns. At one point it said ". . . over 40,000 of the country's engineers and scientists currently enjoy the economic and professional advantages of collective bargaining."

This is the old "jump on the bandwagon, everybody's doing it" technique. Unfortunately, the letter failed to state just what are the advantages of collective bargaining **for engineers.** The writer of the letter signed it "Fraternally yours . . .", and after his name listed his college, year of graduation and three Greek letters, apparently a social fraternity to which he belonged. In the body of the letter, it was stated that many of the officers of this particular union were former fraternity men. The letter further stated that "it is planned to mail material at regular intervals to the various social fraternities." This all adds up to another well worn organizing technique—identifying yourself with your audience.

We are somewhat curious as to what the logic is in choosing a social fraternity as the prime target for union literature. Most of the social fraternities have a pretty good sampling of students from every branch of learning. Material mailed to them will reach a relatively small segment of the engineering enrollment. This is unfortunate, inasmuch as the union literature is one of the most convincing arguments in favor of **not** joining an engineering union.

One thing which is usually lacking in union literature but is much in evidence in union contracts is the word "seniority". This single word represents one of the most significant and destructive concepts in our society. It is a poor substitute for initiative, ability and hard work.

In many industrial organizations, management has resorted to incentive payments for union workers who no longer have any competitive spirit; it is interesting to speculate on how they would contrive to "induce" a competitive spirit in the unionized engineer.

America is currently in the grip of a shortage of Engineers. The shortage, according to Ass't. Sec'y. of Defense Donald Quarles constitutes "potentially a greater threat to national security than any aggressor weapons known." (November 1955 TIME magazine.) The surest way to make this shortage more acute, and to jeopardize American freedoms, is to eliminate the "American system" of competition in the professions and to unionize the Engineers.

P.D.G.

The Manufacture of Plate Glass

By AL McGLOTHLIN, M.E., '56

An engineer in industry spends a good deal of time writing reports to supervisors, employers and customers. Because this phase of engineering is sc important many companies require a report from their summer students during or upon the termination of their assignments.

The following article describing the glass making process was taken from a report submitted to Pittsburgh Plate Glass Company by the writer. Certain confidential information regarding constituents, melting processes, speeds, feeds and temperature have been deleted out of respect for company security.

The glass industry, like all other specialized process industries, has a language all its own as this report will illustrate. As we trace the progress of the sand from the mine through the various processes to the finished product, we will become familiar with this new terminology.

The Mine

Shortly after the Civil War in the late 1860's the sand under Buck Knob Hill, just south of Crystal City, Missouri, was discovered to be pure enough to be used commercially in the manufacture of glass. The mine was first worked in approximately 1873. Availability of raw material is one of the important factors considered in the location of an industrial plant. The shipping of huge quantities of a heavy material like sand is quite costly for even short distances. Another reason for locating a plant near this mine is the high purity of the sand (99.8% SiO_2) which makes refining processes unnecessary for even the finest glass products. Constant surveying of this mine is unnecessary due to a strata which makes a discolored line at the same level near the top and throughout the length of the sand deposit.

The mine consists of many miles of tunneling under Buck Knob. The columns are on 80′ centers and are 40′ by 50′ square. A 30 ft. layer is removed from the center of the vein. A 12 ft. layer is left on the ceiling and a 20 to 25 ft. layer is left underneath to decrease the possibility of using impure sand. The solid sand weighs 160 lbs. per cu. ft.

Faces 30′ by 40′ are blasted to loosen the sand from the solid rock form. The dynamite for each face is packed into 60 holes 16′ to 18′ deep, 2½″ in diameter. The holes are drilled by a Markroy Drill Rig, a semi-automatic machine which is one of the very recent improvements at the mine. The machine, powered completely by compressed air which is piped into it from a central compressor station located outside the mine, includes both propulsion and drilling equipment. Water runs through the bit to wash the sand out of the hole.

A power shovel loading one of the diesel trucks in the sand mine. The ceiling, wall and floor is composed of 99.8% pure silica sand.

The initial blast is set off at the center of the pattern. Successive blasts in an ever widening radius crumble the sand into very small particles, with a few exceptions of large rocks which are broken by sledge.

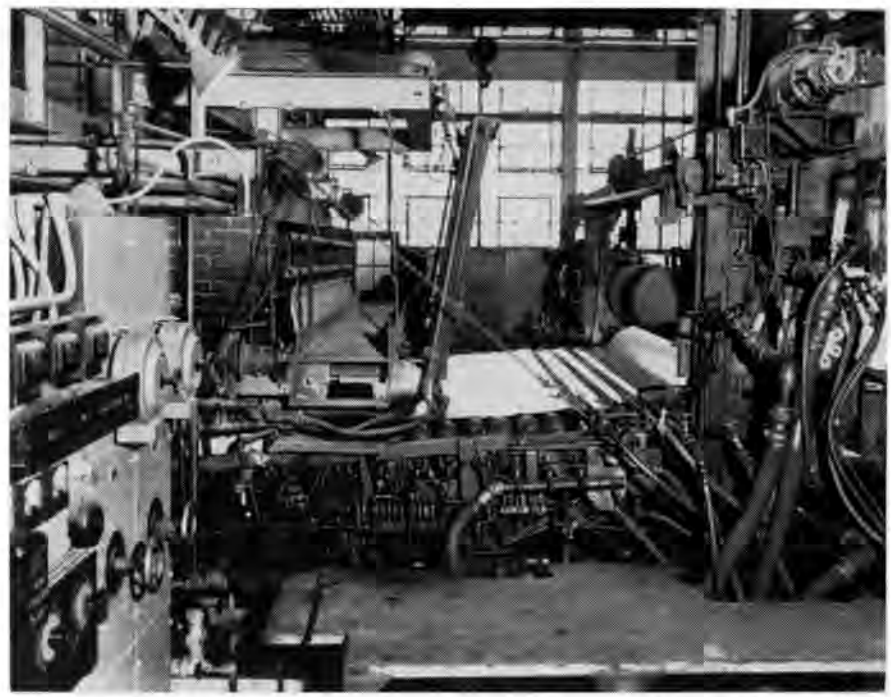
After the sand is blasted loose it is picked up by two large power shovels working simultaneously, loaded onto three diesel trucks hauling 10 tons each, and taken to the head of the mine which is called the tipple.

At the tipple the sand is dumped down a trough into a rolling screen (shaped like a barrel) and mixed with water. The water and rolling motion break up the softer lumps. The sand and water then drop down to the bottom of an inverted belt conveyor, which drops the mixture through a screen that retains the larger lumps of sand. The fines are then pumped into the valve house. The lumps that are screened out, go up a conveyor and into a crusher which drops the sand from the lumps back onto the screen.

From the valve house some of the sand is pumped to the Grinding and Polishing Department and the rest is pumped into the settling tanks, where the water runs off. The pumps used to pump this mixture are rubber lined and of the centrifugal force type.

Compressible rubber is used in the construction of most of the valves because of the great abrasive power of the mixture when a valve is only partly open and is allowing some flow. Two settling tanks catch the mixture on alternating days. It is then moved to a secondary settling tank by a large crane equipped with a 1½ cubic yard clam shovel. When the specified settling time has elapsed, the crane moves the sand over a hopper which deposits it on a conveyor.

The conveyor takes the sand up into the drying room, where it is put into a barrel shaped drier 6⅔ ft. in diameter and 55 ft. long. The inside of the drier is baffled causing the sand to be dropped through the flame shooting from a natural gas nozzle as the drier rotates. From the drier the sand goes up into a storage tank, where it can be dropped as needed into railroad cars and hauled to the Batch House.



That limp looking sheet is a ribbon of glass being rolled to thickness. It is passing from the tanks on the right to the annealing lehr on the left.

The Batch House

At the Batch House the raw materials are weighed and blended into homogeneous mixtures. The automatic scales are adjusted so that the hand breaks the beam from a photoelectric cell, which in turn stops the ingredients from flowing onto the scales when the proper amount is reached. The main ingredients are: —sand, limestone, dolomite, salt-cake, soda ash, coal, rouge (Fe_2O_3), and cullet.

The weighed ingredients are conveyed to the mixer where they are thoroughly blended. The mixture is dumped into small batch hoppers which travel to the tanks by crane.

The Tanks

The Crystal City Plant has two tanks, one of which makes solex while the other makes clear glass. Solex, green tinted glass, is designed to absorb heat. Checkers utilize exhaust gasses to preheat the air used in the tank. Large natural gas burners on each side of the main tank reverse every 10 minutes, thus pulling hot air from the checker on the opposite side and allowing the checker on the first side to heat as in an open-hearth steel furnace. Since the flame from the burners shoot in over the mixture to melt it, the bottom of the tank is cooler than the top. The mixture is melted and brought up to temperature before it passes the first three burners. As the glass passes on down through the tank, it is slowly cooled by water running through U-shaped pipes which protrude into the tank from each side. As the glass comes out it is rolled into a sheet by a knurled roll.

After leaving the tanks the glass enters the lehr for annealing. In the lehr the temperature is allowed to drop slowly as the ribbon of glass passed through. Immediately at the end of the lehr an automatic measuring device starts a cutter across and the glass is separated into sheets. The cutter moves with the ribbon so that the cut will be perpendicular to the edge of the glass. The glass must be cooled before it reaches the grinding and polishing department so that the plaster will not set too quickly. This is accomplished by spraying the glass with water.

If a crack appears in the glass at this point it is stopped by placing a hot brick at the back end of it and melting the glass again. Once each day a sample is taken into the laboratory to be ground and polished and to have the transmittance checked. A sample is also taken every two hours to check the thickness which has to be adjusted manually.

Grinding and Polishing

As the plates are received at the Grinding and Polishing Unit they are placed on large, flat, cast iron table cars by an overhead crane equipped with a vacuum rack. The flat surface of the table car is covered with a layer of fast drying plaster of Paris. The glass is laid flat, rolled down and the excess plaster scraped off by this machine.

The table cars then move under grinders turned by large electric motors. The large, disc-shaped grinders have cast iron runner bars which come in contact with the glass. A sand and water mixture used as the abrasive in grinding comes down through the center of the grinders at the rate of 5 to 20 gallons per minute. The pressure allowed in the grinders and polishers is controlled automatically by electricity. As the glass moves along, the size of the sand decreases from 259 microns to 66 microns. The last few grinders use alundum (Al_2O_3) as the abrasive instead of sand. The abrasives are re-

(*Continued on page* 26)

Amid the dawning hours the eternal quest for "five minutes more sleep" can no longer be pursued, and with a revenging sweep of the hand Tom Lafferre silences his alarm clock. Tom then realizes that today is the day of the interview and with a 7:40 class there is no time to waste.

The Day Of The Interview

By JERRY HERDAN, M.E., '57

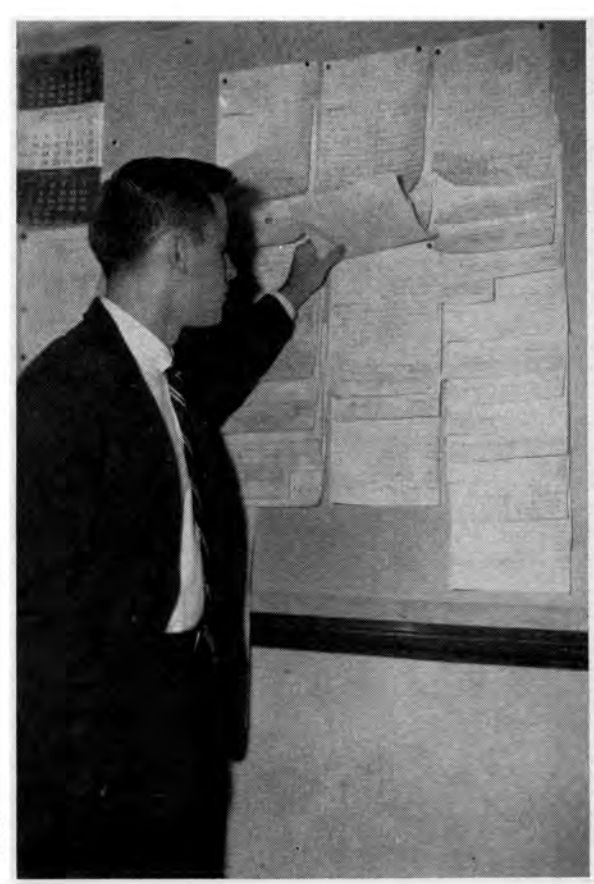
When a man reaches the status of senior in the College of Engineering he has learned a lot of things that are not mentioned in textbooks. He can shave in his sleep without drawing blood. He can prepare instant coffee, put a Windsor knot in his tie and don his trousers simultaneously. All of the actions necessary to complete the transition from an unconscious lump of humanity to a bright up and coming young man ready for business can be accomplished in the short space of twelve minutes.

These achievements (plus some incidental formal education) make him a hot item on the labor market. Companies from far distant places send interviewers to talk to him and perhaps employ him. This creates a special problem in his life for he must be prepared to make a good impression on his prospective employer. He must look sharp and have the right answers; if he really wants to make an impression he should have some good questions, too. In addition to a successful interview he must have a successful day in his normal class activities. This may lead to such incongruous situations as a student appearing for a lab session in a dark blue suit; he'll get a bit of kidding but it is all accepted as a part of this devious process we call education.

I donno' who ya are, but those whiskers have gotta' go!

In the kitchen, Tom hastily prepares instant coffee. While the coffee is dissolving, the tie will get a hasty knot put into it. Tomorrow, he'll get up ten minutes earlier and have regular coffee.

As assistant instructor in M.E. 310, Tom stands out in contrast to the atmosphere of the laboratory and its surroundings. A suit in the Engineering laboratories is almost unheard of.

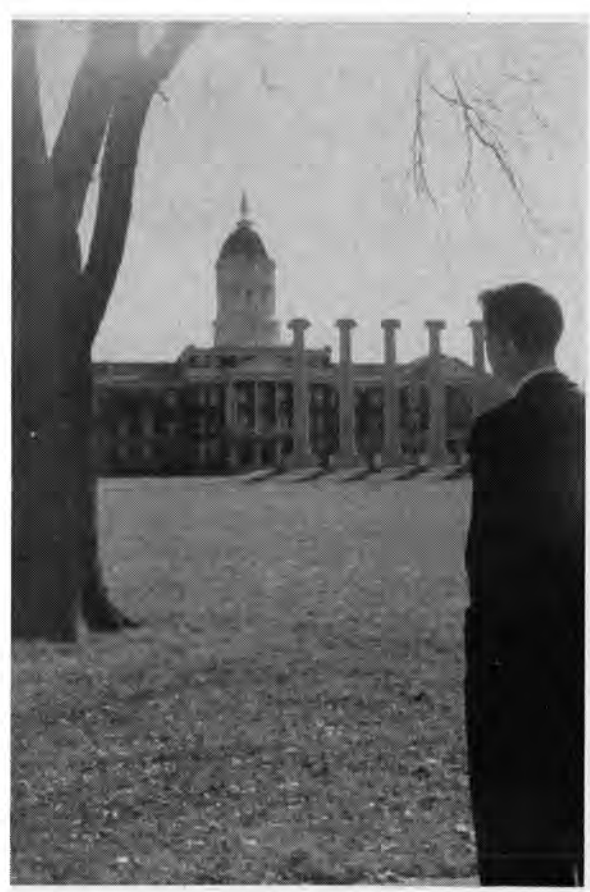


Five minutes before interview time; nothing to do but fidget through future interview notices.

(*Continued on next page*)

Interview . . .

The Interview. In a few short minutes the company representative must decide whether Tom will fit into the organization. Tom, in turn, must try to obtain enough information to decide whether he would want to work for this particular company.



It's a big decision.

"If I were back in high school . . ."

"Dear Bill,

"It was great hearing that you plan to study engineering too. I imagine you know the tremendous demand right now for engineers — twice as many jobs as there are graduates—and the high beginning salaries—36% higher than in 1949.

"Just look in the want ads of the paper, Bill, to see the terrific opportunities and future of an engineer. Why, there are over 30 phases of engineering in industry alone. And do you realize the interesting work of today's engineer? He does everything from rocket design and electronics, to food processing and production.

"But start preparing to be an engineer *now,* while you are still in high school. This is *most* important, Bill. If I were back in high school, I would take all the algebra, geometry, physics and chemistry I possibly could. You need a *background* in those subjects *before* you start your college training, if you really want to be an engineer.

"Go in and talk to your counselor, first chance you have, and ask him about the preparatory courses you will need for engineering. And urge Dick and Ralph and those other fellows who want to be engineers to go in with you. Your counselor can set up your programs and give you some excellent information on engineering.

"By preparing now, Bill, you will have the foundation you *need* to study college engineering. And after college graduation you'll be prepared for one of the most interesting, most rewarding careers today.

Your brother, Bob"

SPENCER CHEMICAL COMPANY, 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) • Cylinder Ammonia.

SPENCER®

America's growing name in chemicals

Detective In Chips And Stresses

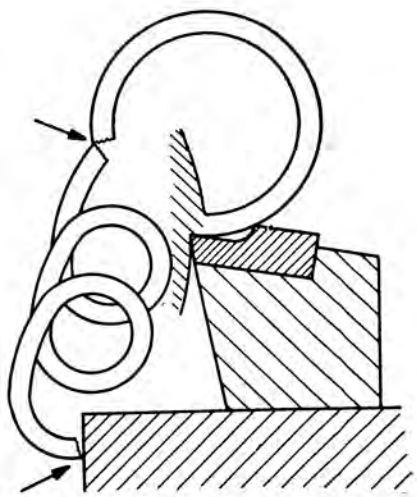
By PROFESSOR ERIK K. HENRIKSEN
University of Missouri

In the days when High Speed Steel was the most common material for metal cutting tools there was no chip problem. The quantity and volume of chips produced was never more than the operator could handle conveniently. Furthermore, under these cutting conditions the chips ordinarily curl up and have a natural brittleness, so that they break fairly easily. In fact, the operator has to be quite careful if he, for fun, wants to "nurse" a good long chip.

The arrival on the scene of the Sintered Carbide tools, (dating approximately from the beginning of the 30's) has changed this fortunate and comfortable situation. With the high cutting speeds (from three to ten times the cutting speed employed with High Speed Steel tools) the chip formation changes its character, the chip loses its natural curl and internal cracks; it becomes tough and straight and with fast and powerful machines the chip will either bundle itself up in a "bird's nest" or shoot out against the operator, causing trouble and even danger. Just imagine a thin strip of steel, almost hardened, with an edge like a razor blade, or a fine-toothed saw, shooting out from the tool at a rate of maybe 10 feet per second, and hot, too!

The remedy to this calamity is the chip breaker, a small step or groove, ground into the tool along with the cutting edge, forcing the chip into a tight curl, and thereby controlling its flow. In addition (and hence the name chip breaker) it directs the chip flow towards some solid surface (work piece, tool post, etc.) so that the chip breaks off in shorter or longer pieces, usually of a surprising uniformity.

Experimental and research work on this problem can be traced back to the early 30's, although it does not seem possible to say *who* really invented the chip breaker. Maybe it appeared, or developed at several places simultaneously, borne out of a common need. However, a table of chip breaker width in relation to feed was published by The Carboloy Company and received very wide publicity; in fact, when I came across the problem after the end of the war, I found that same table published in tool catalogs from America, Belgium, England, France, Germany and Sweden, usually without any reference to its origin. It had apparently become "public" property! Incidentally, the reproduction of this table was sometimes rather erroneous with important details lacking.



The remedy: chip is curled by chip breaker and breaks when it meets an obstacle.

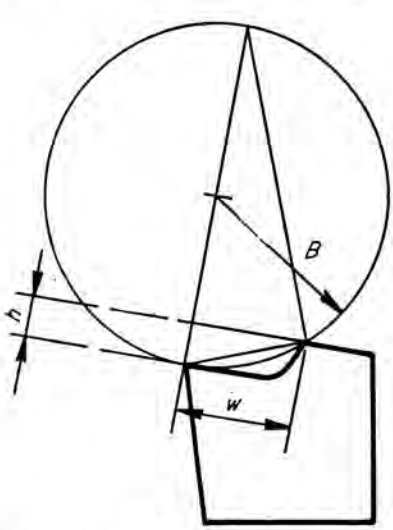
The trouble: A half mile of chips.

This was the situation when a friend of mine in the Machine Tool business asked me to give him some help with a demonstration of his Sintered Carbide tools in the Copenhagen plant of Burmeister & Wain. The job was that of turning cam

The result: Broken chips of uniform shape and size.

shafts in a Fischer Rigid Lathe (Starrdrehbank), a real chip eater, and the problem was to curl and break the chip. The data in the available table failed to solve it, so we had to go back to the good old method of "cut and try". In time a satisfactory solution was found, but I found my curiosity challenged by the obvious failure of the available information, and I started tests in the Machine Tool Laboratory of the Royal Danish Technical University.

It should be remembered that the table gave only data for chip breaker *width* in relation to feed. It seemed to me as if the problem was at least two-dimensional; not only the width (w), but also the height (h) of the chip breaker should be considered (Fig. 4), and we made chip breaker tools with varying width *or* height,



Cross section of chip breaker tool, showing principle dimensions of chip breaker, width w and height h. Also showing chip flow circle with radius B.

and studied their effect. To begin with, the outlook was extremely blurred. With each chip breaker, no matter what its dimensions were (with the exception of a few very extreme cases) it was found possible to get perfect chip breaking within a certain range of feeds; but this effective range would vary from one material to another, and also vary with speed and other cutting conditions. Our findings might confirm the data from the common table in some cases, but would, on the other hand, be contradictory to it in other cases.

A strange coincidence led us on the track. There were two chip breakers that always gave equal performance. If the one of them would break the chip, the other one would do the same; if the one would fail, the other one would also fail, and the general performance of the two chip breakers was practically identical, no matter what cutting conditions were, as long as they were identical for the two. The two chip breakers were different in width, and different in height, but it was an obvious conclusion that, despite the differences in their basic dimensions, they must have one deciding factor in common. The question was: just what is this deciding factor or dimension?

One day I tried to draw them in large scale on transparent paper, put one tracing on top of the other, and draw a curve through the two chip breakers; a few trials brought out that if the curve was chosen as a circle it would satisfy the geometry of the two chip breakers.

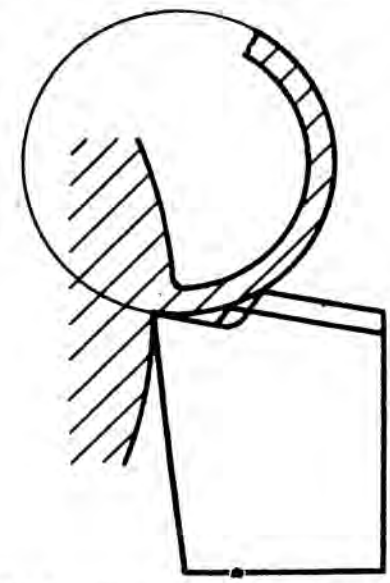
This is almost the end of the story.

Subsequent tests confirmed this general theory and brought out a parabola-like relationship between the feed and the radius in the circle, which then was referred to as the Chip Flow Circle. From here on the rest is "elementary, my dear Watson, elementary". The geometrical analysis is simple; the relationship (the Copenhagen Formula) between the fundamental dimensions is:

$$B = \frac{w^2}{2h} + \frac{h}{2}$$

The Copenhagen parabola was also confirmed by a long series of tests sponsored by the National Machine Tool Builders' Association, at Cornell University (the Cornell data), and revised straight-line tables (the Missouri tables) now permit a simpler and clearer presentation of experimental data for practical use. It is also possible to apply the same principle of the Chip Flow Circle to the clamped chip breaker, now so common in the metal-cutting industry.

Any progress in chip breaker technique is of extreme importance for the economy of industrial operations. There are roughly 1½ million machine tools in use in the U.S.A. today, each of them (except the grind-



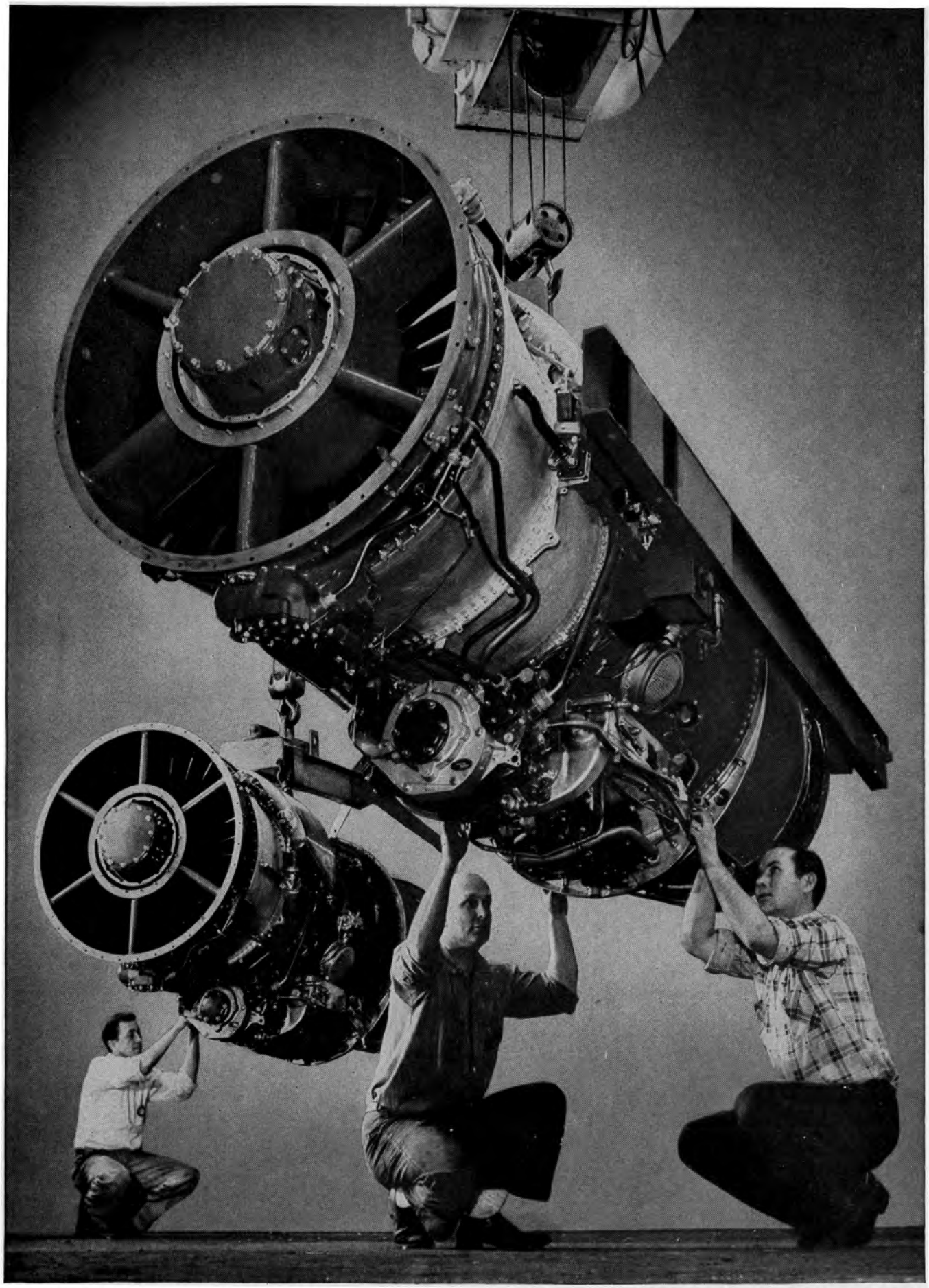
The key to the solution: Two chip breakers of different width and different height but with the same chip flow circle radius show identical chip breaking performance.

ers) employing one or several cutting tools. The import of diamond material *for chip breaker grinding only*, is estimated at a figure of between 30 million and 50 million dollars a year. The Russian heavy industry is constantly working on chip breaker developments along various lines, as evidenced by frequent publications appearing in their technical magazines.

—o—

Stresses are invisible and their existence can only be revealed by the observation of their effects. While stresses from outer loads can be computed (if you know how!), residual stresses can only be determined by experimental methods, mostly of a destructive nature. Most of these methods consist in machining the test piece, removing one layer at a time and keeping track of the subsequent deformation. This was essentially the method I used in the investigation of residual stresses in a 6 ft. long casting

(Continued on page 20)



The J-57, in the 10,000-pound thrust class, is the most powerful turbojet engine now in production. A new generation of U.S. air power has been designed around this mighty new Pratt & Whitney Aircraft engine.

North American's F-100 Super Sabre, fastest Air Force jet fighter, is powered by Pratt & Whitney Aircraft's J-57 engine.

First all-jet heavy U. S. Air Force bombers are the huge Boeing B-52s, powered by eight J-57s mounted in pairs.

The Douglas F4D Skyray, fastest Navy jet fighter, will be powered with the big J-57 engine.

The Douglas A3D, the Navy's most powerful carrier-based attack airplane, has two J-57 engines.

Blazing the Way for a New Generation of Air Power

The most powerful turbojet engine in production is blazing the way for a whole new generation of American aircraft.

That engine is Pratt & Whitney Aircraft's J-57, the first turbojet to achieve an official rating in the 10,000-pound thrust class.

But the J-57 provides far more than extreme high thrust. Its unique Pratt & Whitney Aircraft design, achieved after years of intensive research and engineering, offers as well the low specific fuel consumption so vital to jet-powered bombers and future transports, plus the additional important factor of fast acceleration.

The importance of the J-57 in America's air power program is clearly shown by the fact that it is the power plant for three of the new "century series" fighters for the U. S. Air Force—North American's F-100, McDonnell's F-101 and Convair's F-102—as well as Boeing's B-52 heavy bomber. The Navy, too, has chosen the J-57 for its most powerful attack aircraft, the Douglas A3D, the Douglas F4D fighter and for the Chance Vought F8U day fighter. And the J-57 will power the Boeing 707 jet transport.

The J-57 is fully justifying the long years and intensive effort required for its development, providing pace-setting performance for a new generation of American aircraft.

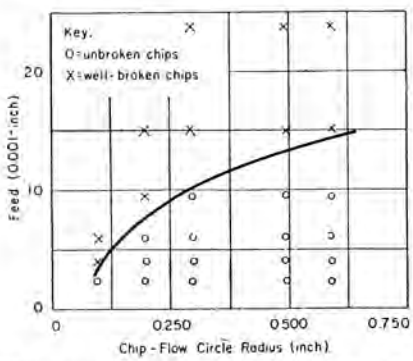
Engineering graduates who can see the challenge in this new generation, might well consider a career with the world's foremost designer and builder of aircraft engines.

PRATT & WHITNEY AIRCRAFT
DIVISION OF UNITED AIRCRAFT CORPORATION
EAST HARTFORD 8, CONNECTICUT

DETECTIVE IN CHIPS AND STRESSES

(Continued from page 17)

back in 1933; the piece was put on a planer and one thin layer at a time was planed off; between cuts the change in curvature was measured and the residual stresses computed from these measurements. It was obvious to me that in order to be strictly correct any such method must assume



The Copenhagen Parabola. Chip breaking depends on radius in the chip flow circle as well as on feed. A characteristic parabola — like curve separates areas between unbroken chips and well-broken chips.

that no new and foreign stresses are introduced into the work piece material by the cutting process itself (the same would, of course, apply to such metal removal methods as chemical etching, etc.), and I found it advisable to check this possibility a little further.

A search in the literature gave, surprisingly enough, an almost negative result. Several authors stated that at least heavy cuts with dull tools might create stresses, some authors mentioned as a possibility that stresses might be produced by a machining operation, but no quantitative data were given, in fact not even such a simple, qualitative indication as to whether these stresses would be tensile or compressive.

At the start of this investigation we had focused our attention on the pressure between the tool and the work, and we expected that if any machining stresses should occur, they would be compressive stresses. Since no quantitative data were available it was decided to "give it a try", and a friend of mine in a Copenhagen foundry supplied a piece of cast iron of rectangular shape and suitable dimensions. This piece was then machined to size, but showed a large accumulation of blowholes. It was necessary to get another casting, which would take a few days, and we decided to use the waiting time for testing a piece of low carbon steel, if not for any other reason then at least for trying out our experimental technique.

The test piece of steel was machined to size and stress relieved in a furnace. A planing cut was taken on the one side. Since the piece was supposed to be stress free, it should stay straight after machining, if no "new" machining stresses were introduced. If any warpage or curvature should occur, this would indicate the presence of "new" machining stresses.

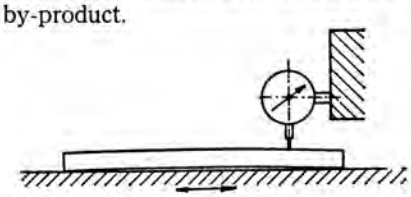
It so happened that I was in a meeting when my assistant, Mr. E. Hvalso Petersen, made the first curvature measurement, and I still remember his answer, as I came back to the laboratory and asked if the test had given any result.

Experimental planing operation for investigation of residual stresses in 6 ft. long casting.

"I don't understand it, it looks as if we get tensile stresses", was his first comment.

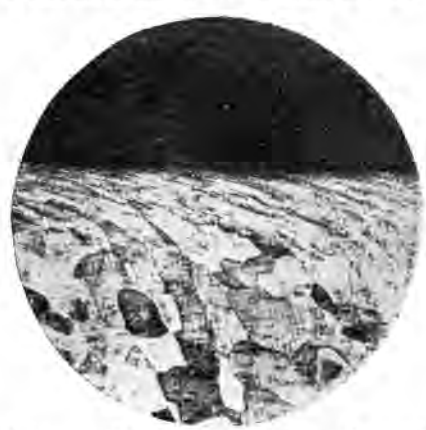
This was entirely against our expectations, and our first reaction was to check for any possible sources of error, such as incomplete stress relief, cold draft in the furnace during the cooling period (we sealed all leaks with wet asbestos), a counter-check on the mathematical analysis of the stress, etc.; everything we could think of; but all repeated tests showed the same result. We finally had to accept it as a new fact, that machining of mild steel builds up a surface layer of tensile stresses.

An explanation was sought after and found in the microstructure of the surface layer and the chip. The grains just below the surface are distorted in the direction of the motion of the tool, and similar distortions, in the opposite direction, are found in the chip. It looks as if the grains are pulled or dragged along with the tool edge before the final separation takes place, and it seems clear enough that such a violent deformation (which occurs even with perfectly sharp tools) must leave considerable stresses as a by-product.



Deflection measurement by means of dial indicator.

Having thus dispersed our legitimate doubt about the origin and nature of tensile machining stresses and the mechanism of their formation, our interest was directed towards a study of their behavior and their relationship with cutting conditions. It was found that the stresses are ordinarily concentrated in a thin layer only, and hence reach a very high intensity, up to 50,000 to 100,000 psi. The stress pattern is two dimensional (at least, if not three dimensional) with the ma-



Micrograph showing distortion of metal in a machined surface — magnified 120 times.

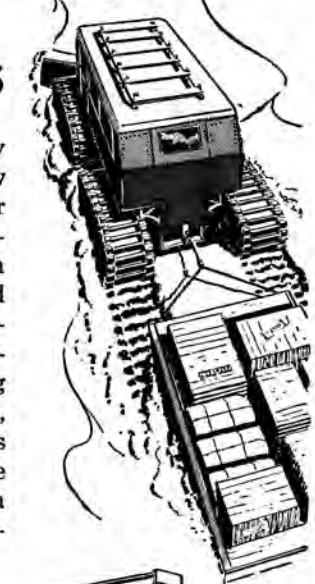
jor component in the direction of the cut; the stress depends on material, dimensions of the cut, cutting speed and tool angles. Softer materials take on higher stresses, heavier cuts create greater stress, higher cutting speeds give lower stress; for a straight tool the highest stresses appear with a small or even negative rake angle; and the stress decreases steadily with

(Continued on page 25)

CREATIVE ENGINEERING

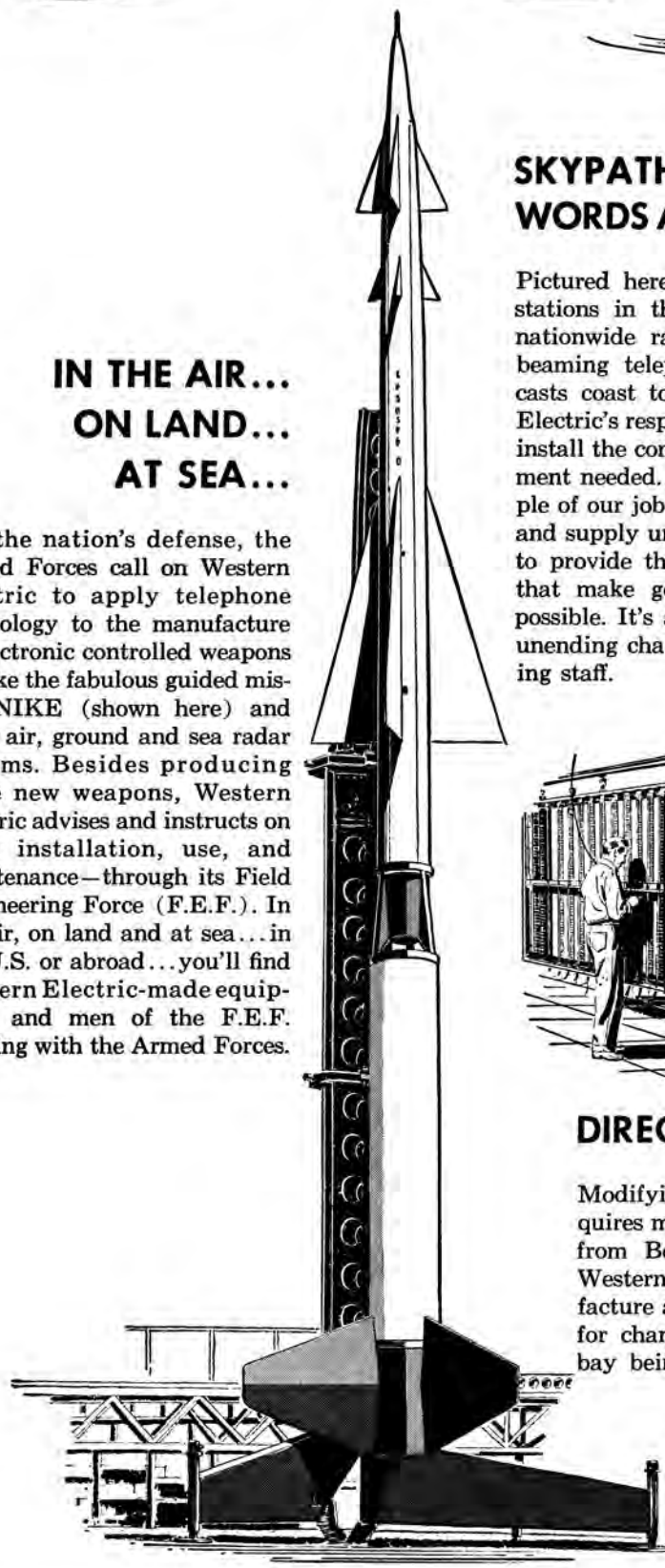
SKYPATH FOR WORDS AND PICTURES

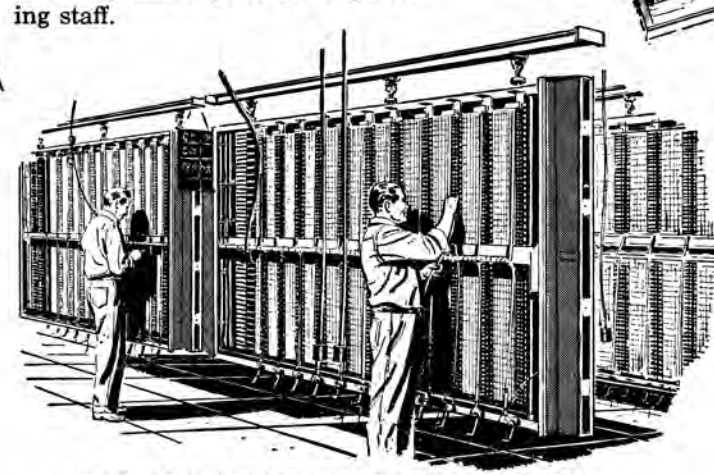
Pictured here is one of the many stations in the Bell System's new nationwide radio relay system for beaming telephone calls and telecasts coast to coast. It is Western Electric's responsibility to make and install the complex electronic equipment needed. This is another example of our job, as the manufacturing and supply unit of the Bell System, to provide the thousands of things that make good telephone service possible. It's a job that presents an unending challenge to our engineering staff.



IN THE AIR... ON LAND... AT SEA...

For the nation's defense, the Armed Forces call on Western Electric to apply telephone technology to the manufacture of electronic controlled weapons . . . like the fabulous guided missile NIKE (shown here) and other air, ground and sea radar systems. Besides producing these new weapons, Western Electric advises and instructs on their installation, use, and maintenance—through its Field Engineering Force (F.E.F.). In the air, on land and at sea... in the U.S. or abroad... you'll find Western Electric-made equipment and men of the F.E.F. working with the Armed Forces.





DIRECT DISTANCE DIALING

Modifying telephone systems for nation-wide dialing requires months of make-ready. Working with technical men from Bell Laboratories and Bell telephone companies, Western Electric engineers develop and plan the manufacture and installation of the intricate equipment needed for change-overs. Shown here is an automatic switching bay being manufactured in one of Western's 16 plants.

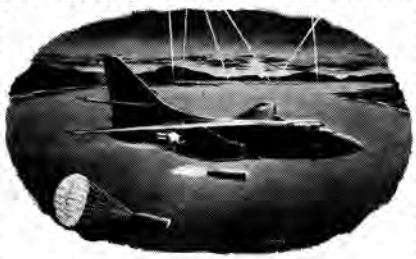
Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

F4D, "SKYRAY"— only carrier plane to hold official world's speed record

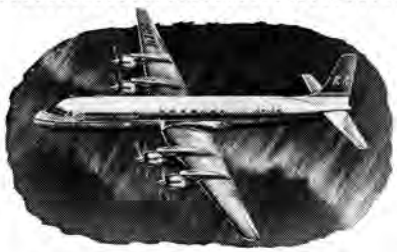
A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier

RB-66 — speedy, versatile jet bomber



A3D, "SKYWARRIOR"— largest carrier-based bomber

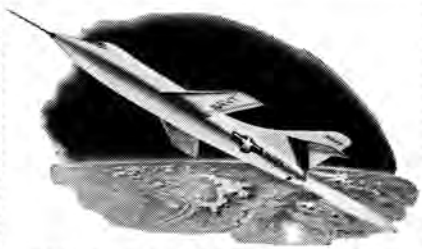
C-124, "GLOBEMASTER"— world's largest production transport



DC-7 "SEVEN SEAS"— America's finest, fastest airliner

Engineers: join this winning team!

"NIKE"— supersonic missile selected to protect our cities



D558-2, "SKYROCKET"— first airplane to fly twice the speed of sound

At DOUGLAS you'll be joining a company in which the three top executive officers are engineers... you'll be associated with men who have designed the key airplanes and missiles on the American scene today! Nothing increases an engineer's ability faster than working with other engineers of top calibre.

Not only is Douglas the largest manufacturer of commercial aircraft in the world, but it also produces outstanding aircraft and missiles for *every* branch of the armed services! This diversity, besides giving you job security, provides unequalled opportunity for the engineer with an eye to the future.

Challenging opportunities now exist in the following fields:

Mechanical design
Structural design
Power plant installation design
Weapons delivery
Aerodynamics
Thermodynamics
Electronic computers
Systems analysis
Aircraft air conditioning
Hydraulics
Stress analysis
Servo mechanisms
Acoustics
Electronics
Mechanical test
Structural test
Flight test
Process engineering
Missiles

DOUGLAS
First in Aviation

Brochures and employment applications are available at your college placement office.

For further information relative to employment opportunities at the Santa Monica, El Segundo and Long Beach, California divisions and the Tulsa, Oklahoma division, write today to:

DOUGLAS AIRCRAFT COMPANY, INC.

C. C. LaVene, Employment Manager... Engineering General Office
3000 Ocean Park Blvd.... Santa Monica, California

By JERRY HERDAN, M.E., '57

We have received information about the A. F. Davis—American Welding Society Welding Award Program which we think offers an excellent opportunity to some enterprising student (with a nimble pen hand) to make a little money. Accordingly, we are passing along the rules and regulations of this program, as taken from their announcement.

CONDITIONS OF THE A. F. DAVIS UNDERGRADUATE WELDING AWARD PROGRAM

PURPOSE—To encourage and stimulate interest in welding through the preparation of articles on the subject of welding by undergraduate students, and dissemination of such information through undergraduate publications (papers and magazines).

AWARDS—$200.00 to the Author of the best paper; $200.00 to the Publication; $150.00 to the Author of the second best paper; $150.00 to the Publication. A suitable certificate will be given to each author and publication receiving awards. In case of joint authorship, the author award shall be given jointly; however, certificates will be issued to each author.

SUBJECT—Subject matter of the paper may be on any phase of any type of welding or its application to design and construction.

ELIGIBILITY—Any undergraduate of any college or university, in the United States, its possessions, or Canada, is eligible. The papers must be published in an undergraduate publication between April 1, 1955 and June 1, 1956, however, the manuscripts must be accepted for publication between April 1, 1955 and April 1, 1956. Six copies of the publication must be received at the office of the American Welding Society, 33 West 39th Street, New York 18, N. Y., before 5 p.m., June 10, 1956, marked to the attention of the Chairman of the Educational Committee.

JUDGING—The judging group shall be selected by the Educational Committee of the American Welding Society. Judging shall be based on originality of subject, originality and clarity of presentation and thoroughness with which subject is presented. Decision of the judges will be final.

ANNOUNCEMENT—The persons and publications to receive awards will be notified by mail on July 25, 1956. An announcement of the award winners will be made in the next regular issue of the Welding Journal and the awards will be presented at the Annual Meeting of the American Welding Society.

NAME—Awards will be known as "A. F. Davis Undergraduate Welding Awards."

The A. F. Davis Undergraduate Welding Award is named for its donor, A. F. Davis, vice president and secretary of the Lincoln Electric Co., Cleveland, O.

Another award which should interest the Industrial Engineering students is offered by the American Society of Tool Engineers. Information about this can be obtained from members of the I.E. faculty.

Pi Tau Sigma had its fall initiation banquet November 21. Featured speaker of the evening was Dr. Walter Keller of the Geology Department. Dr. Ralph Burton of the Mechanical Engineering Department was initiated as an Honorary Initiate. The undergraduate initiates were John W. Allen, James R. Darden, Robert G. Ely, Rudolph Freitag, Ronald Haynes, Dickson Krebs, John Lewallen, Don Samuels, Ben Callaway, Edward E. Duke, Earl R. Fink, Ivan L. Haston, Bob King, Norman Leigh, Lee Lowry, Jim Wilhelm, John L. Wray.

(*Continued on next page*)

New On Faculty

By SHELTON EHRLICH, M.E., '57

Professor Harry L. Beach is the newest addition to our drafting department. He comes to us with a long and experienced background which makes him well qualified for the position.

He began his college career at Worchester Poly Tech in Worchester, Massachusetts. Here he received his B.S. in Mechanical Engineering in 1924. In 1945 he earned a B.S. in Vocational Education. By 1950 he had completed work on his M.S. in Education and had also done some work on his doctorate at the University of Connecticut. Between 1924 and 1945 Professor Beach was well occupied with various jobs. He taught vocational education in Connecticut, worked for the New Departure Division of General Motors Corporation as

Harry L. Beach

an engineer and at a later period as its training director. He also did work for the General Motors Institute at Flint, Michigan. At Hillyer College in Hartford, Connecticut he was head of the drafting department and the visual aid department.

He was born in Bristol, Connecticut. His father was a dentist and his mother rounded out a talented family as a professional organist. Professor Beach's major hobby is photography. He still has in his possession the first print he ever made. This was done in 1913 using blue print paper. He has used photography not only as an avocation but also as a vocation, teaching it to adult classes.

Professor Beach has two daughters, one of whom is married. His younger daughter is now enrolled at the University as a freshman in the School of Education.

We wish to welcome Professor Beach and his daughter to Missouri and we hope that their stay will be a long and happy one.

AROUND THE COLUMNS

(*Continued from page* 23)

This month's cover has a rather interesting background. It started out as an elaborate "doodle" in Frank Eggers' notebook. When the Editor saw it he thought it had possibilities and asked Frank to make a formal drawing of it. Then Mr. Petrakis at the printers saw it and started talking about it in terms intelligible only to one experienced in the printing business. To be honest as we write this we're not quite sure what the cover will look like!

Three engineers were presented outstanding military awards during drill ceremonies November 15, 1955 by Col. Wesley P. Warner, Professor of Air Science. The students were John J. Lewellan of Sheldon, Missouri, David L. Oshiek of Jennings, Missouri, and Dail F. Stone of Bucklin, Missouri. This award was made for outstanding leadership in drill, summer camp, campus activities, and scholastic achievement.

You've probably noticed the Picture Story in this issue. It deals with the "Day of The Interview." While it treats the subject in a rather light manner, interviewing is no menial event in an engineer's life. The interview of today is the method by which the vast majority of graduating engineers get "lined-up" with a company. Since the interview is the "point-of-contact" with a potential employer, it should be of the best quality that you can make it. Practice is one of the best ways of increasing your I.Q. or "interview quotient." Sophomores and Juniors are duly urged to interview—if not particularly for a summer job at least for the experience. Most companies are glad to see you and there's always a chance that they have something of interest to offer you.

P. J. Zilles has been appointed sales manager of the newly-created air cleaning products department of the Sturtevant Division, Westinghouse Electric Corporation, Hyde Park, Mass. The new department is responsible for the engineering, manufacturing and sales of all Sturtevant air cleaning products including the Precipitron. Mr. Zilles, a graduate engineer of the University of Missouri, joined the Westinghouse student training course in 1925. During his years with the company, he has received broad sales and sales training experience in many locations throughout the country. He served as a captain with the U. S. Army during World War II.

Charles Kircher, E.E., '55, who is now in the USAF, came by M. U. on his way to New York, where he will leave for a 2 year stay in Europe. He has just completed a 5 weeks school on communications at Wright Patterson AFB.

Among the many Homecoming visitors we noticed Bill Stracke, an M.E. grad. of 1955. Bill is with the Bailey Meter Co. of Cleveland, Ohio. He's in the Patent Department and is taking law courses in the evenings at Cleveland Marshall Law School. Seen at the game were Don Bussick, Jerry Lammers, Bill Burkstaller, and Bill Weber. Ralph Niehaus was observed back at his favorite spot on campus —the Engin. Bldg. sidewalk. He had gathered the usual large crowd.

DETECTIVE IN CHIPS AND STRESSES

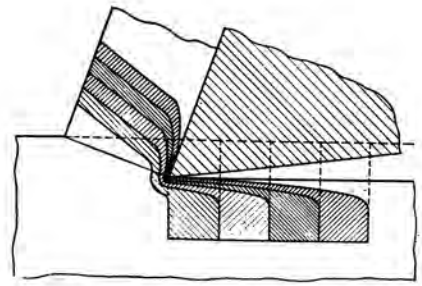
(Continued from page 20)

larger and larger rake angles, but for an ordinary side-cutting tool there is a rake angle at approximately 18 degrees, where the stress is at a minimum.

No particularly exciting results were encountered so far, with the more conventional materials. Cast iron showed compression stresses (actually what we had expected at the very beginning), and so did Austenitic High Manganese Steel. But with stainless steel the picture changed again.

"I don't understand it; there must be something wrong; it looks as if there are no stresses", said my assistant, when he had made the first tests on Ferritic stainless steel (14% chromium). There was nothing wrong, it was only that these steels develop remarkably low stresses, in fact, only a small fraction of the stresses found in equivalent carbon steels.

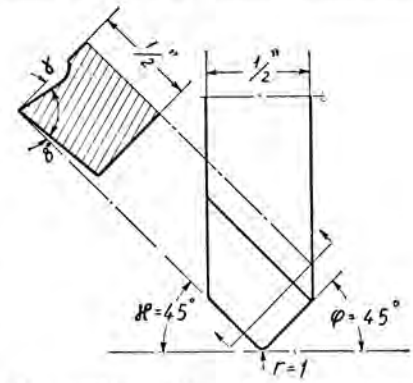
If we found remarkably low stress



Schematic presentation of metal distortion in machining.

value in the Ferritic steels, we certainly got it the other way around when we turned our attention to the Austenitic stainless steels of the 18/8 type. These steels behaved differently from every other material tested before.

Normally we would find that a stress pattern could be repeated, if only we would take a cut deep enough to go below the stressed layer in the old surface. Not so with the 18/8 steel. Second cut showed higher stresses than the first cut did; the third cut showed still higher stresses, and so there was a continuous build-up of stresses, which we explained as an effect of the tool working in a layer that was already hardened to a considerable depth from the previous operation. Such a build-up could, presumably,



Side-cutting tool used in machining stress experiments.

not go on forever; it seemed conceivable that it must level off sooner or later and reach some stationary value, so we continued cutting in search of such a stationary maximum stress value. Our expectations were not entirely disappointed; after a number of cuts the stress would level off, but when we continued cutting, then the calcu-

(Continued on page 30)

THE MANUFACTURE OF PLATE GLASS

(*Continued from page* 11)

turned to the grading building after they are used, to be graded and used again. Fifteen tons of sand per hour has to be replaced.

Manufacture of Plate Glass

After grinding, the plates go through a group of polishers which use rouge (ferric Oxide particles of 2-3 microns) as an abrasive. The faces of the polishers are made of a fine grade felt. On each large disk of the polishers are a number of small ones which rotate individually as the large disk turns. The sheet of glass is turned over by a large vacuum rack, replaced on the table by the same process as before, and run through another line of grinders and polishers. The tables have to be washed and thoroughly cleaned before the glass is placed down each time.

Since the grinders and polishers of each line are in the same section, it is necessary that the tables traverse

Some of the giant grinders used to produce the high quality surface on plate glass. The glass passes under the rotating grinders at a uniform velocity.

the building twice. The table cars travel on a track and are pulled by an endless chain. The table cars are moved from track to track by a transfer car especially fitted with tracks that allow the table cars to roll onto them.

The Wareroom

After leaving Grinding and Polishing, the glass is conveyed through a wash of both sulfuric acid and water and from there to a tilting frame where the glass is stacked on large "A" frames by cranes with vacuum racks and moved to the inspection booth where the glass is placed, one plate at a time, onto the booth which has a lighting system behind it to show up any defects. On this basis the inspectors specify the sizes into which each plate is to be cut. The cranes then move the plates of glass to the cutting tables where they are cut to size. After cutting, the glass goes onto smaller A-frames and is taken by fork lift trucks to storage or on to another department for further processing.

Bending Department

From the cutting room the glass may go to a number of departments, one of which is the Bending Department. Here the glass is shaped for such things as the wrap around windshield for automobiles and many other bent glass products.

The glass comes to this department in rectangular plates of approximately the right size. Here the glass is cut then bent in lehrs to the right shape. The glass is put on overhead chain conveyors when it comes from the lehr and is taken to the Laminating Department.

Laminating Department

Laminating is a process by which two plates of glass are put together with a plastic filler which forms a strong bond between them making shatter-proof safety glass. There are three main laminating lines: the wrap around windshield, the conventional curved windshield and the side light. The wrap around windshield line, while similar to the others, is largest and most complicated. As the bent glass comes across the building on the conveyor it is cooled somewhat by air, and as it nears the laminating lines it passes through a refrigerated area. The pairs are put on a special conveyor which raises one so that the plastic can be inserted between them. On the other lines the pairs are separated manually. After placing the plastic between them, the pairs are fitted back together and heated. They are then rolled by nipper rolls to start the bond. The excess plastic is taken off with power brushes.

The pairs have by then been thoroughly bonded, but are still not completely transparent. The laminated windshields are then put into Autoclave racks equipped with spacers to keep them separated and lowered into the autoclave, a large tank of oil which is heated under pressure to render the windshields transparent. The rack is then taken out and sent through an automatic washer, after which the windshield is removed and packed for shipping. Since the windshield is covered on all edges, it does not have to be edged as the side lights do.

The side lights which are run through approximately the same process are in addition put on the edging line conveyor. As they go along this line they are inspected and edged. They are then transferred to the packing line, where they are inspected and packed.

There is also a reclamation line, where the broken or cracked laminated sections may be cut by a double headed cutter into smaller ventilators, etc. The scrap from laminating cannot be used as cullet because of the plastic in it.

Tempering

Glass to be used for automobile side lights and back lights may be tempered. This process pre-stresses the glass, causing it to be strong and hard. Three men could stand on a rear light with no damage. However, a soft tap on the edge will shatter the glass into small pieces the size of grains of corn.

The rectangular sized glass is taken from the Wareroom to the cutting room of the Tempering Department where it is trimmed to the right shape and size. It is then put on molds and sent through lehrs to be heated. After it has been brought up to temperature, it is quenched by blowing com-

(*Continued on page* 28)

THE MANUFACTURE OF PLATE GLASS

(*Continued from page* 26)

pressed air across it. After this, it is inspected in front of Polarized light, which shows the stress pattern, and packed for shipping. Small ventilators and side lights are treated in the same manner, except that they are hung by clamps on the corners.

Subsidiary Phases

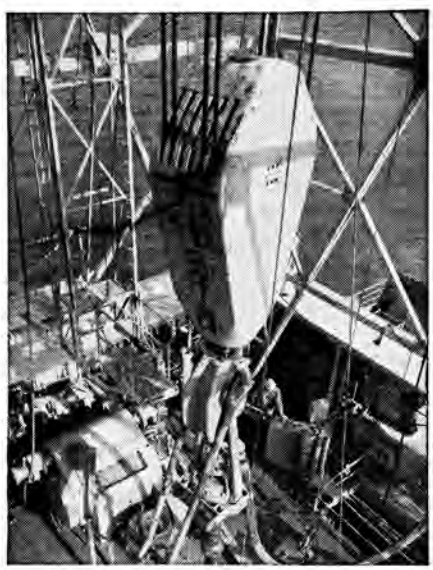
There are a number of very well equipped machine shops located at the plant for maintenance work and for developing new ideas. There is one large machine shop and small ones for almost all departments. The electric motors are rewound and the tank rollers turned, etc.

The waterworks is also an essential part of the Company. All of the drinking water used by the large plant and the surrounding town is pumped from one large well and processed at the plant.

The heat for the plant and the D.C. electric current is produced by six boilers (three gas fired and three coal fired). The A.C. electrical current is purchased from the Union Electric Company.

Summer jobs such as this are mutually beneficial to students and employers. Students can learn about the different companies, the type of jobs they offer and the qualifications for the jobs. Employers can become acquainted with students and their possibilities for filling available positions.

Another page for **YOUR BEARING NOTEBOOK**



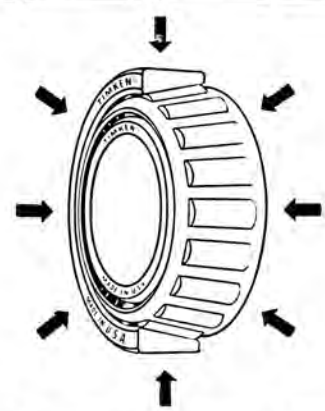
How to tackle heavy thrust loads in a 400-ton traveling block

Fleet angles set up a thrust problem on this oil rig traveling block. Engineers solved it by mounting the sheaves on Timken® tapered roller bearings. They keep the sheaves in positive alignment regardless of the fleet angle or line load, give the 400-ton capacity block maximum stability.

Timken bearings are designed to roll true, and precision-made to live up to their design. As a result, sheaves rotate freely and easily, even with a full weight of drill string, reducing line slippage and wear.

The taper in TIMKEN® bearings lets them take radial and thrust loads in any combination

Timken bearings are tapered to take thrust loads as well as radial loads, or any combination. And Timken bearings can handle heavy loads because (1) they have full line contact between rollers and races. And (2) the rollers and races have shock-resistant cores under hard, wear-resistant surfaces.



Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This is Timken". The Timken Roller Bearing Company, Canton 6, O.

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

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

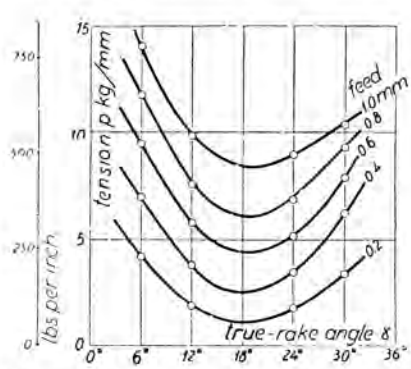
DETECTIVE IN CHIPS AND STRESSES

(Continued from page 30)

lated stress would slightly decrease again. This last observation might have been quite disturbing, but it must be remembered that we have been talking about *calculated* stresses, based on the assumption that the stress is concentrated in a layer that can be considered infinitely thin.

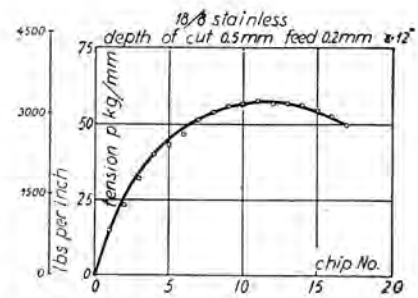
Our observations showed clearly that this simplifying assumption, which was entirely permissible in our numerous experiments with Carbon steel, would no longer be valid with stainless steel. The stressed layer is no longer infinitely thin; on the contrary, it has a finite thickness which cannot be ignored in the stress computation, and when this factor is taken properly into account we found it possible to use the decreasing branch of our build-up stress curve for a determination not only of a corrected value for the resulting stress but also the depth below the surface where it is located.

The first study of machining stresses grew out of my suspicion of



The machining stress shows a minimum value at approximately 18 degrees rake angle on the tool.

a possible source of error in the conventional experimental investigation of residual stresses in general; but soon it matured into an independent research project which went on through a number of years. Machining stress has been taken up at various places, also in Russia some years ago (where, incidentally, they misinterpreted one of my early publications). Machining stresses have been correlated with other residual stresses, and I have had cases where the results of the conventional residual stress investigation were meaningless if they were not corrected for machining stresses. There is probably a connection between the machining stresses and the forces on the back side of the tool (the pressure between the tool and the work plus its accompanying frictional force—a factor which has been largely ignored, even in present day research) and



The build-up of machining stresses in austenitic stainless steel. The maximum stresses in the stainless steel are 4-5 times greater than the corresponding stresses in plain carbon steel.

through this there should be a way open for a correctional study of the cutting forces in general.

The science of today is the practice of tomorrow.

The metal working industry is now feeling the pinch of the machining stresses. A number of work-hardening materials are now being used extensively in aircraft engine manufacture and these materials are extremely sensitive to machining stresses, like the 18/8 stainless. The result is that flat discs and wheels, as used in turbines, may warp severely, if for some reason, the machining stresses on the two sides of the disc are out of balance with each other. The phenomenon is known as "cupping". The difficulties thus encountered have given the impetus to new research in the field, and, in severe cases, it has even been found necessary to design special machinery for simultaneous machining of the two opposite sides of the disc in order to maintain equilibrium of the machining stresses.

Acknowledgement: Various illustrations to this article are borrowed from The Tool Engineer, Technical Aids for Small Business, and University of Missouri Engineering Reprint Series No. 12

CONSTRUCTION— Tremendous rotary kilns, like these, typify Allis-Chalmers role in the cement industry.

Join the company that serves 3 GROWTH INDUSTRIES

Match your engineering talents to the future needs of the construction, power and manufacturing industries. These are growing needs—for the population is climbing at the amazing rate of 50,000 people every *week!*

Many billions of dollars for highway *construction* alone are called for by the President in the next ten years. Allis-Chalmers builds equipment used in making cement, aggregate and steel as well as earth movers and graders.

Electric *power generation* will double in ten years. A-C builds the machines that make electricity.

Manufacturing output must increase $3.5 billion by this time next year. Allis-Chalmers builds motors, control, drives and many other types of equipment for this industry.

MANUFACTURING—A-C aids high speed production and helps improve quality with dielectric sand core dryers like the one above.

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.

POWER GENERATION—Growing use for power means growing demand for A-C steam turbines, transformers, and other equipment.

ALLIS-CHALMERS

A-4685

BULLARNEY

By DUNK

Little Audry, mad as hell,
Pushed her sister in the well.
Said her mother, drawing water,
"Gee, it's hard to raise a daughter."

♣

I used to eat Wheaties for breakfast every morning. I'd split open the top of the package with a bread knife, sprinkle a quantity of the cereal in an ordinary oatmeal dish, pour in just enough cream, and coat the mixture with some plain white sugar. It wasn't so bad when grasping the edge of the bed to pull myself out mornings I'd tear it to bits under me. I didn't mind particularly when the steering wheel of my car crumpled under my hands and we turned over three times into the ditch. I thought it was a good joke when I banged the door of my fraternity house and it fell to the ground. But when I tried to kiss the only girl I ever loved and broke her neck, I went back to Grapenuts.

♣

Interviewee: "I'm Gladys Zell."

Interviewer: "I'm happy too. Have a seat."

♣

The young lady eyed her escort with disapproval. "That's the fourth time you've gone back for more punch, Albert," she said coldly. "Doesn't it embarrass you at all?"

"Why should it?" the young man shrugged. "I keep telling them I'm getting it for you."

♣

A man walked into a restaurant and left the door open. A big fat man called out: "Shut the door! Were you brought up in a barn?"

The man closed the door, sat down and began to cry. At this the fat man looked uncomfortable and went over to the sorrowful one. Said he, "I'm sorry, I didn't intend to hurt your feelings."

"I'm not crying because you hurt my feelings," was the reply, "but the fact is, I was brought up in a barn and every time I hear a jackass braying it makes me homesick."

♣

I serve one purpose in this school
On which no man can frown.
I quietly sit in every class,
And keep the average down.

♣

The collection department of a credit firm tried a new method on a slow-paying account.

"Dear Mrs. Smith," the letter began, "what would all your neighbors think if we came to your town and repossessed your car?"

In time the letter came back with message scrawled at the bottom. "I have asked my neighbors about this matter," it said, "and they think it would be a lousy trick."

♣

Doctor: "Your husband must have rest and quiet. Here's a sleeping powder."

Wife: "When do I give it to him?"

Doctor: "Don't give it to him—take it yourself."

♣

Ch.E.: "Are you troubled with improper thoughts?"

Date: "Why no, I rather enjoy them."

♣

The bored youth turned to his partner at a dinner party. "Who is that strange-looking man over there, who stares at me so much?"

"Oh, that's Professor Jenkins," she replied brightly, "You know, the famous expert on insanity."

♣

She: "Stop!"

He: "I won't!"

She: "Well, at least I resisted."

♣

Then there was the near-sighted snake who eloped with a rope.

Old prof: I feel like a two-year-old this morning.

Young lab student: Horse, child—or egg?

♣

The horse and mule live 30 years
And nothing know of wines and beers;
The goat and sheep at 20 die
And never taste of Scotch and Rye.
The cow drinks water by the ton
And at 18 is nearly done.
The dog at 15 cashes in
Without the aid of rum and gin;
The cat in milk and water soaks
And then in 12 short years it croaks.
The modest sober bone dry hen
Lays eggs for you, then dies at 10.
All animals are strictly dry,
The sinless live and swiftly die.
But sinful, ginful, rum-soaked men
Survive for three score years and ten.
And some of us, the mighty few,
Stay pickled 'til we're 92.

♣

A farmer was phoning a veterinarian. "Say, Doc," he said, "I've got a sick cat. He just lays around licking his paws and doesn't have any appetite. What shall I do for him?"

"Give him a pint of castor oil," said the vet.

Somewhat dubious, the farmer forced the cat to take a pint of castor oil. A couple of days later he met the vet in town.

"How's your sick calf?" inquired the vet.

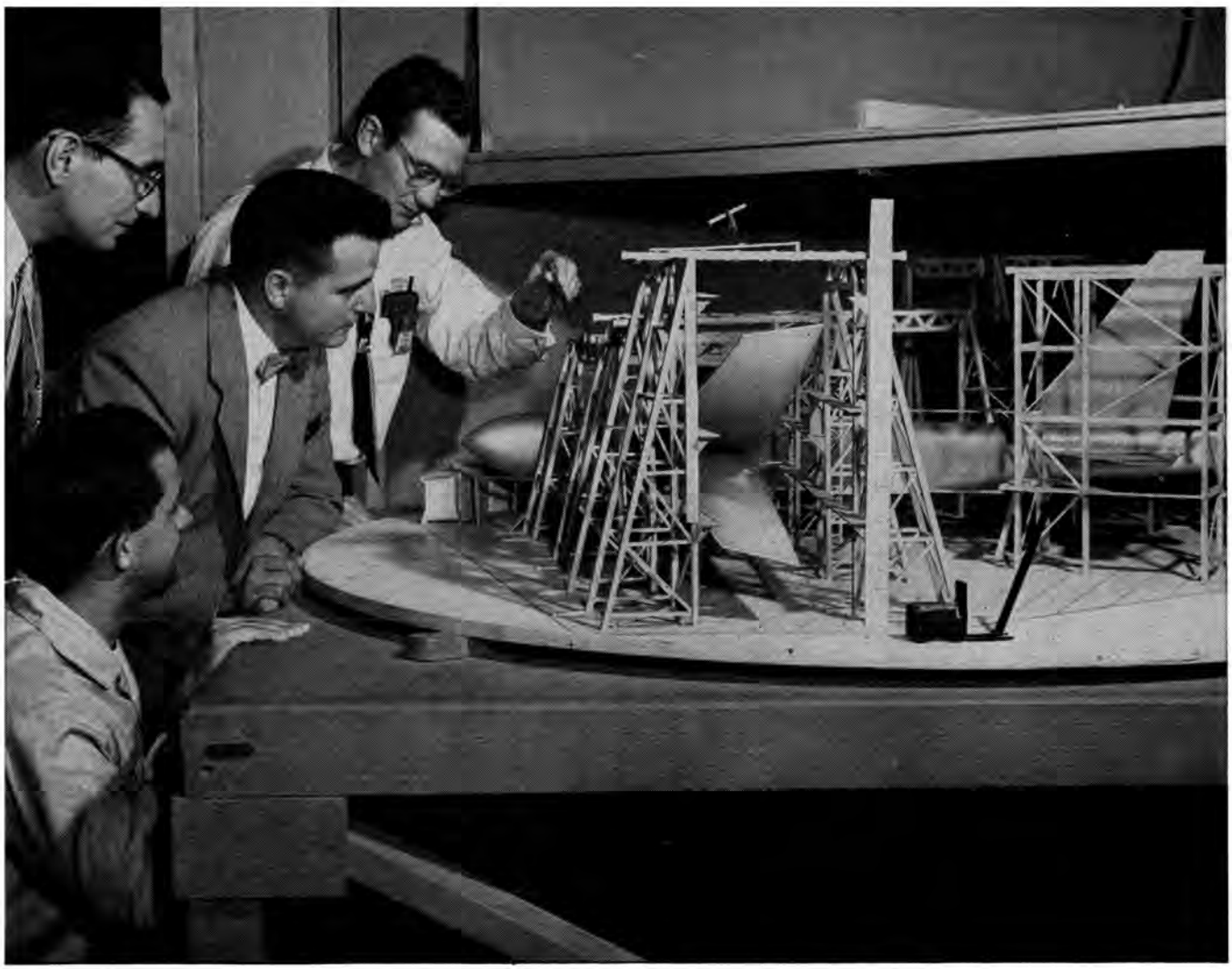
"Sick calf! That was a sick cat I had.

"Migawd, did you give him the pint of castor oil?"

"Sure did."

"Well, what did he do?" asked the vet.

"Last time I seen him," said the farmer, "he was going over the hill with five other cats. Two were digging, two were covering up, and one was scouting for new territory."



Boeing engineers work with stimulating associates

Many engineering skills are represented in this picture. Mechanical, civil, electrical and aeronautical engineers—in almost equal proportion—work closely together in planning and conducting the structural test of airplanes such as the B-52. This stimulating contact among experts in every field is typical of Boeing projects. It makes a good engineer even better, and helps his professional growth.

In no other industry does the engineer have the opportunity to evaluate so completely—through destruction testing—the structural integrity of such a large and complex product. It is a "classical" challenge for mechanical and civil engineers. It tests the instrumentation ingenuity of electrical engineers and gives aeronautical engineers an opportunity to proof check designs by translating theoretical air loads into practical test loads.

Many immediate problems and "years ahead" projects involving these same skills and their infinite variations are under way at Boeing. The application of rocket, ram-jet and nuclear power to current and future aircraft and missiles is typical of projects in active study. Applied research in developing materials and components to withstand the tremendous heat and stress of flight at supersonic speeds offers even further opportunities to express engineering talent.

More than twice as many engineers are with Boeing now than at the peak of World War II—evidence of the company's solid growth. This outstanding group of engineers has been responsible for such aviation landmarks as the 707 Stratoliner jet transport and its KC-135 military tanker version, the Bomarc IM-99 guided missile, the global B-52 jet bomber and the B-47 jet bomber, present backbone of Strategic Air Command.

Graduates of top engineering schools all over the country come to Boeing. If you, too, want breadth of contacts, job variety and professional growth, it will pay you to investigate Boeing. There is always room for additional creative engineers on Boeing's research, design and production teams.

For further Boeing career information consult your Placement Office or write the Boeing plant nearest you:

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

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

BOEING

Aviation leadership since 1916

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.

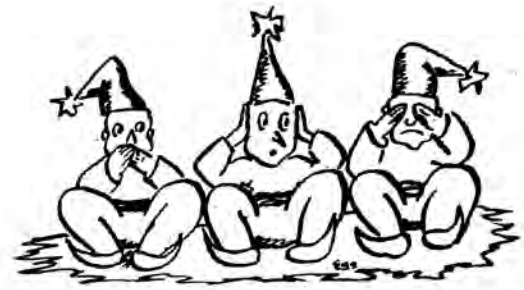
Standard Oil Company

STANDARD

910 South Michigan Avenue, Chicago 80, Illinois

SHAMROCK SEZ

LEROY ANDERSON, M.E., '57



By the law of averages the Missouri football team should win as many games as it loses. That did not come to pass this last season. Out of ten games we were able to drink to victory only once. All of the other games resulted in a "drown our losses" session. The law of averages says that we should win half of our games but this is the University of Missouri and we should win far more than half!

This is no "rah—rah, noble University" article but it's hard to listen to your friends at Cape Girardeau State talk about this past season. IT IS TIME FOR A CHANGE!

How is this change to come about? We could start a recruiting program that compares with the U. S. Army's or Maryland's, but that would defeat the purpose of college football. We have an answer that is in keeping with the ideals of amateur sports; we'll use our heads.

It's about time we started playing this game called football scientifically.

Lord Kelvin said that if you can express a problem in numbers you are really beginning to solve it; we'll do that to football. Here are a few samples of what we mean.

The yard markers should have the coefficient of static friction for that part of the field on them. Then the quarterback would know whether he should call for a long end run or go to the air. The backfield men should be numbered according to the following formula: the product of their weight and their time on the 100 yard dash over the cubic inches of oxygen consumed in running 100 yards. (A slight correction factor would be introduced for quarterbacks by multiplying the above number by the square root of their I.Q.). The linemen should be numbered by taking the product of their weight times the moment of inertia about the belt buckle. Into every player's number should be incorporated Anderson's coefficient.

This coefficient varies between 1.5 and 0. This constant is determined by strapping a blood pressure machine to the player on the night of a date with his best gal. Average values for the Anderson coefficient:

	peroxide blonde	red head	blonde	brunette
Hot	1.5	1.3	1.25	1.2
Warm	1.4	*	1.0	.9999
Cool	1	*	.8	$\pi/4$
Cold	*	*	.3	.1
Homely	*	*	.001	0

*No such animal.

To take care of defense the viscosity of the opposing line has to be figured. An apt formula might be: amount of water consumed in, say for instance, Lawrence in a day divided by the square inches of sole area on the lineman.

Now you might say, all this is well and good but much too complicated to use, or in other words too many figures. The answer is a slide rule. This slide rule would measure wind velocity and direction, and relative humidity. You are probably saying to yourself, this would be a great thing but it's impossible. It is not impossible and how it is done will be explained now.

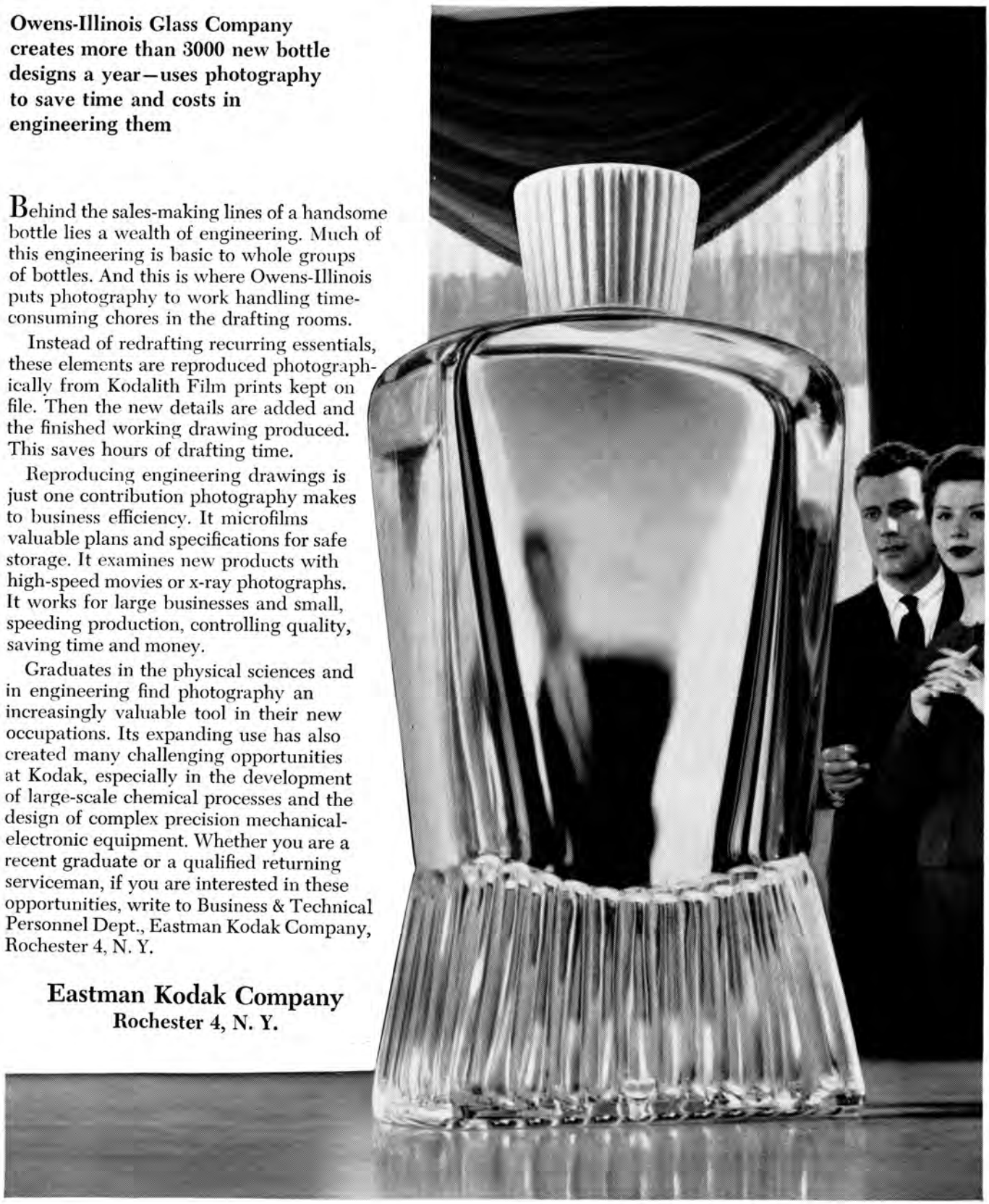
All the quarterback has to do is to put the viscosity of foe on "D" scale, put the minutes remaining on "C" scale and divide. This gives the number of the player who will carry the ball. On "A" and "K" scales would automatically be the numbers of the linemen that would open the hole for the ball carrier.

You might say that this would make your offense too rigid. The opposition would carry a slide rule just like yours and be able to tell exactly what you are going to do. That is where you're wrong. This slide rule would be made of sponge rubber to allow for unexpected plays. By the time the quarterback wrings it to measure relative humidity and throws it into the air to measure the wind velocity and direction a few times the plays would become harder for the opposition to predict. Just think how it would make the games more unpredictable. By the end of the game nobody would know what to expect. You might see the tackle snapping the ball to the guard who throws a jump pass to the center while your quarterback blocks out your fullback. You may see the halfback throw a 40 yard lateral to the homecoming queen who punts. We may not win but we would be colorful.

Glass turns salesman

–as photography speeds bottle design

Owens-Illinois Glass Company creates more than 3000 new bottle designs a year—uses photography to save time and costs in engineering them



Behind the sales-making lines of a handsome bottle lies a wealth of engineering. Much of this engineering is basic to whole groups of bottles. And this is where Owens-Illinois puts photography to work handling time-consuming chores in the drafting rooms.

Instead of redrafting recurring essentials, these elements are reproduced photographically from Kodalith Film prints kept on file. Then the new details are added and the finished working drawing produced. This saves hours of drafting time.

Reproducing engineering drawings is just one contribution photography makes to business efficiency. It microfilms valuable plans and specifications for safe storage. It examines new products with high-speed movies or x-ray photographs. It works for large businesses and small, speeding production, controlling quality, saving time and money.

Graduates in the physical sciences and in engineering find photography an increasingly valuable tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. Whether you are a recent graduate or a qualified returning serviceman, if you are interested in these opportunities, write to Business & Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company
Rochester 4, N. Y.

MISSOURI

SHAMROCK

JANUARY 1956

FEATURES:

Award Winning Tau Beta Pi Essay

Build a Vacuum Tube Tesla Coil

25c

Edward J. Stolic, class of '48
speaks from experience when he says . . .

"With U. S. Steel, my future holds interest, challenge and reward."

From his graduation in 1948 with a B.S. degree in Mechanical Engineering, until November of that year, Edward Stolic worked as an operating trainee in the Irvin Works of United States Steel. Following his discharge from the Army in 1950, he returned to work at U.S. Steel. In just 18 months, Mr. Stolic reached a management position as Engineer-Lubrication.

By mid-year 1953, Mr. Stolic was promoted to Foreman-Instrument Repair and Sub-Station. In a recent interview he said: "Opportunities for rapid advancement are almost limitless in U.S. Steel." At 27, Mr. Stolic is supervising a force of 30 men in mechanical and electrical tests as well as instrument repair and maintenance of gas generators, compressors and water purification units. He feels that, "The engineer finds many places to apply the knowledge he garnered in school." The men under Edward Stolic are called on to trouble shoot in any part of the mill. This calls for a wide variety of talents and leads Mr. Stolic to say: "The steel industry has expanded greatly, and with it the need for good men."

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

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

UNITED STATES STEEL

AMERICAN BRIDGE . . AMERICAN STEEL & WIRE and CYCLONE FENCE . . COLUMBIA-GENEVA STEEL . . CONSOLIDATED WESTERN STEEL . . GERRARD STEEL STRAPPING . . NATIONAL TUBE
OIL WELL SUPPLY . . TENNESSEE COAL & IRON . . UNITED STATES STEEL PRODUCTS . . UNITED STATES STEEL SUPPLY . . *Divisions of* UNITED STATES STEEL CORPORATION, PITTSBURGH
UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY

6-02

Boeing engineers are insiders on top-secret work

Engineers are doing vital work on significant new developments at Boeing. For example, the Boeing BOMARC IM-99 pilotless interceptor. Its predecessor, the Boeing GAPA, is shown here, because photographs of BOMARC are highly classified. BOMARC is a supersonic long-range missile that spearheads an entirely new weapons system. It is a key weapon in America's defense planning.

BOMARC, as well as other "years ahead" Boeing projects, which cannot be discussed here, are complex challenges to all kinds of engineers. These men find real creative interest in the problems of very high speed flight: heat, compressibility, vibration, rocket, jet and nuclear power, miniaturization, electronic control, and others. Their goal is to design structures and components that will "weigh nothing and take no space," yet withstand extreme velocities and altitudes.

The prestige of Boeing engineers is second to none. They have created such recent aviation milestones as the B-52 global jet bomber, the 707 jet transport, and the B-47. There are superb facilities at Boeing: the multi-million-dollar new Flight Test Center, the world's most versatile privately-owned wind tunnel, the latest electronic computers, and much more.

Boeing engineers enjoy exceptional opportunities for career stability and growth. There are more than twice as many engineers with the firm now as at the peak of World War II. Living is pleasant in the progressive, comfortable-size communities of Seattle and Wichita.

There is room for top engineering talent on Boeing research, design and production teams. If you feel that you belong with aviation's leader, it will pay you to investigate the advantages of a career with Boeing.

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

R. J. B. HOFFMAN, Administrative Engineer
Boeing Airplane Company, Wichita, Kansas

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

BOEING

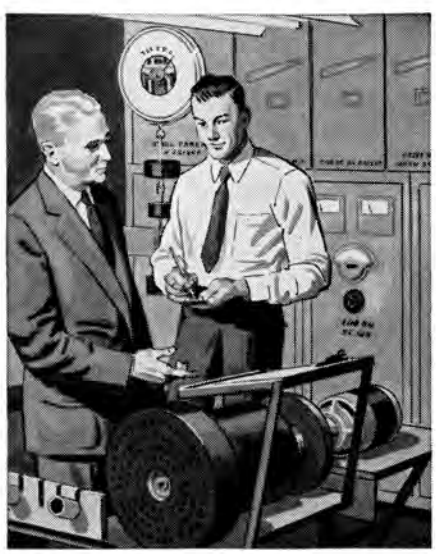
Aviation leadership since 1916

SEATTLE, WASHINGTON WICHITA, KANSAS

Here's what happens when you take a job with DELCO PRODUCTS

1 When you take a job with Delco Products, you start a career with General Motors—with a division known throughout the world as a leading manufacturer of electric motors, hydraulic shock absorbers, and many other products.

2 You enter into a well-organized training program—a program specifically designed to take full advantage of your particular interests and abilities. You don't just "go back to school." Instead, you *learn* by *doing*, with top-flight supervision.



3 As a trainee you get into every conceivable phase of Delco's engineering operations — engineering laboratory, plant engineering, drafting, sales, processing, standards, quality control. Additional assignments are often made in related departments for broader experience.

4 Training completed, you'll be given a specific departmental assignment. Progress can be made in product development, technical staff operations, sales, or in manufacturing supervision—according to your interests and capacity for future development.

5 With Delco's policy of promotion from within, your opportunities for advancement are virtually unlimited. Not every trainee becomes a supervisor, but some go much farther. Many General Motors top executives today are "graduates" of Delco Products Division.

If this opportunity interests you, sign up for the GM interview on your campus and ask for referral to Delco Products. For booklet detailing Delco's engineering activities, write to:

E. J. Bentley, Supervisor, Graduate Training
Delco Products Division, GMC
Dayton 1, Ohio

DELCO PRODUCTS

DELCO DAYTON OHIO

GM GENERAL MOTORS

Division
General Motors
Corporation
Dayton, Ohio

George Lincoln asks:

What do metallurgists do in a chemical company?

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

CHARLES I. SMITH, JR. received his B.S. Ch.E. from V.P.I. in 1943, served in the Navy as an engineer officer, and joined Du Pont's Engineering Department in 1946. Since then he has advanced steadily through a number of interesting assignments at various Du Pont plants. Today Charlie Smith is technical superintendent of Du Pont's Newport, Delaware, Plant, Pigments Department.

Charlie Smith answers:

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

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

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

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

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

DU PONT

REG. U. S. PAT. OFF.

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

WATCH "DU PONT CAVALCADE THEATER" ON TV

On the cover—Is it possible to depict the feeling of inadequacy which descends upon a student during finals week?

—photo by Jerry Herdan
—William C. Boteler, Jr.
by William C. Boteler, Sr.

MISSOURI
SHAMROCK

VOL. XXII JANUARY, 1956 NO. 4

CONTENTS

FEATURES:

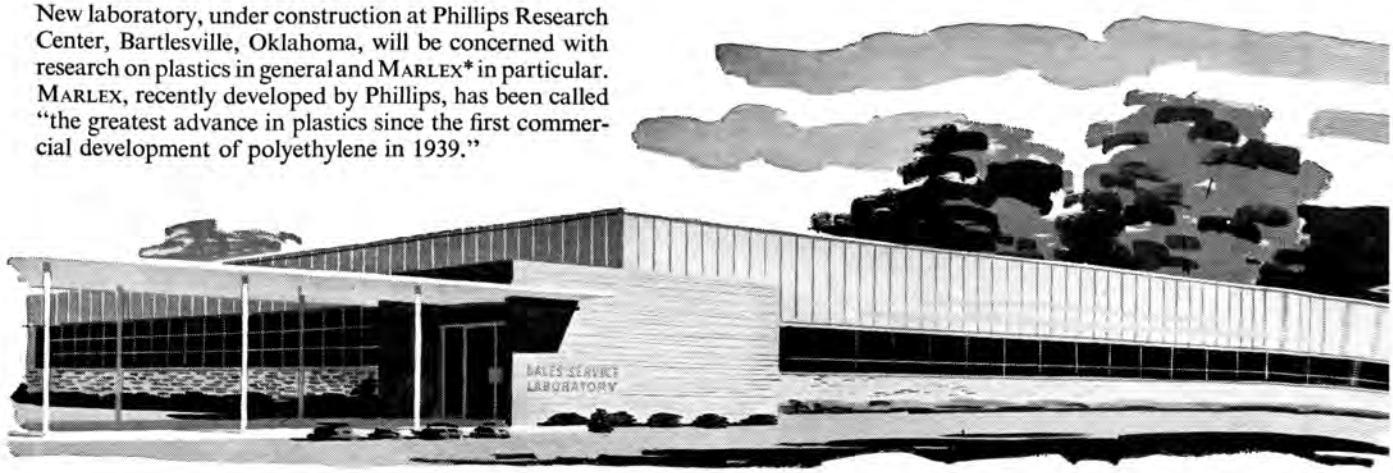
DEPARTMENTS:

MEMBER
ENGINEERING COLLEGE MAGAZINES
ASSOCIATED

Chairman, Merk Hobson, University of Nebraska
Publisher's Representative, Littell-Murray-Barnhill, Inc., 101 Park Avenue, New York 17, New York, and 605 Michigan Avenue, Chicago, Ill.

Published monthly except June, July, August, September, by Board of Publications of Engineers Club, University of Missouri. Office of Publication: Room 233 Engineering Building, University of Missouri, Columbia, Missouri. Entered as second class matter at the post office at Columbia, Missouri under the act of March 3, 1879. Printed by The Missouri Farmer, Columbia, Missouri. Single copies 25 cents; subscriptions, $1.50 per year, $2.50 for 2 yrs.

New laboratory, under construction at Phillips Research Center, Bartlesville, Oklahoma, will be concerned with research on plastics in general and MARLEX* in particular. MARLEX, recently developed by Phillips, has been called "the greatest advance in plastics since the first commercial development of polyethylene in 1939."



Opportunities in Petrochemistry

Petroleum hydrocarbons are playing an increasingly important role in our national economy, providing the raw materials for the manufacture of plastics, chemical fertilizers, carbon black, rubber and various intermediate products. Phillips Petroleum Company, by virtue of its huge reserves of raw materials and its long-continuing program of research, has achieved a position of leadership in the petrochemical field. To the technical graduate Phillips is able to offer exceptionally interesting opportunities in scientific research, or in its practical applications in the business world. For further information write to our Employee Relations Department.

**A trademark for Phillips family of olefin polymers.*

Phillips 66

PHILLIPS PETROLEUM COMPANY, Bartlesville, Oklahoma

Choose your job carefully...

see the

Westinghouse

Man With The Facts

Let's face it. Graduate students in engineering and scientific fields are fortunate. You can be choosy in picking the company where you will start your career.

But be careful. Get complete information on each company before making your decision.

The Westinghouse Man With The Facts has the complete story on Westinghouse and the jobs and opportunities it offers.

Discuss with him our complete training program that bridges the gap between college and business . . . helps you start your career right. Ask about our Graduate Study Program, at Company cost.

Westinghouse offers you unusual opportunities. Its $300 million expansion program creates new jobs and speeds up advancement. Our activity in new fields like atomic power . . . solid state devices . . . director systems . . . aircraft armament . . . missile guidance . . . provides interesting and rewarding work . . . with a future.

Ask your Placement Officer to make a date with the Westinghouse Man With The Facts. Send now for the two fact-filled booklets listed below. G-10294

Write for these two booklets: *Continued Education in Westinghouse* (describing our Graduate Study Program) and *Finding Your Place in Industry*.

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

YOU CAN BE **SURE**...IF IT'S

Westinghouse

Hughes-equipped T-29 "flying laboratory" for systems evaluation.

Flight evaluation of advanced interceptor electronic system uses unique approach.

T-29 "INTERCEPTOR"

THE DEVELOPMENT OF AIRBORNE ELECTRONIC SYSTEMS REQUIRES THOROUGH FLIGHT EVALUATION OF BREADBOARD AND PROTOTYPE EQUIPMENT PRIOR TO FINAL DESIGN. AT HUGHES, SYSTEMS FOR INTERCEPTORS ARE FIRST TESTED IN "FLYING LABORATORIES" IN WHICH THE EQUIPMENT IS READILY ACCESSIBLE TO SYSTEMS TEST ENGINEERS

One interesting problem recently confronting Hughes engineers was that of evaluating the requirements imposed upon the pilot of a high-speed one-man interceptor. This arose in the development of a new integrated electronic system to control several phases of an all-weather interceptor's flight. Because of the great importance of providing the pilot with the optimum design and arrangement of displays and controls, it became necessary to determine accurately the pilot's work load during flight, and the human factors that affect his ability to carry out his task.

The solution was to install a complete mock-up of the actual interceptor cockpit in a large T-29 aircraft in which a breadboard model of the system was being tested. From this cockpit a test pilot can simultaneously operate the electronic system and fly the T-29, performing all the functions of an interceptor pilot. Systems test engineers and psychologists analyze his problems and his performance, and adapt the cockpit design to the natural abilities of the human pilot. The result will be a much better "fit" of pilot and electronic system prior to final flight testing in the tactical interceptor.

SYSTEMS ENGINEERS

Required are engineers with a basic interest in the system concept, who have the ability to develop new evaluation techniques and conduct highly controlled tests. They should be able to resolve complex circuitry problems, and have sufficient resourcefulness and follow-through to carry a difficult program to its ultimate goal.

Convair F-102 all-weather interceptor, Hughes-equipped.

Scientific Staff Relations

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

Editorial

Is Money Enough?

A great deal has been written about the desperate situation of our educational system. The factors most often discussed are the obsolete buildings and the underpaid instructors. The solution is always the same. They must have more money.

While we certainly agree that the educational system should have more money we seriously question whether this is the complete solution to the problem.

The tools and techniques of most of man's activities have undergone a complete transformation in the last one hundred years. Consider our system of transportation. In 1856 the horse was about the best form of transportation available. The railroads and the steamship were just getting well started. One hundred miles was a good day's travel. Now we have at our command automobiles which can carry us seven hundred miles or more in a day.

Has the process of education shown a similar advance? While the "storehouse" of knowledge has certainly been enlarged, the technique of teaching has not shown any significant change. It is not hard to visualize an 1856 classroom; a piece of chalk, a blackboard, a textbook and some chairs. This may equally apply to a 1956 classroom. With little variation it might apply to a Roman or a Greek classroom!

Education needs new concepts of teaching or application of old concepts. The idea of using motion pictures to deliver a classroom lecture is not a new one. Why has it failed to appear as a major teaching technique? Probably because of the expense of preparing necessary films and perhaps because the educator fears that he will be displaced by such a device.

Many opportunities are completely neglected. Engineers, for example, are constantly belabored for their lack of a well rounded education; their need for the so-called humanistic social subjects. Now let us consider what happens to an engineering student at Missouri. He sits in a classroom and listens to a lecture about bridges, generators, or perhaps turbines. Then he walks out into a hall decorated with pictures of (you guessed it) bridges, generators and turbines!

Why not have reproductions of great paintings on the walls? We have courses in this University giving two hours credit for a study of these artworks; we could acquire about a half hour's credit while waiting for the next class!

Educators are noted for their research studies into far flung subjects — it is to be hoped that someday they will do a little research in the subject of education. Then, perhaps, we will get something *more* than our money's worth.

P.D.G.

Tau Beta Pi Essay

The Closed Shop Union

By BURTON ENGLE, E. E., '57

Editor's note—One of the pledge requirements of Tau Beta Pi, national honorary engineering fraternity, is an essay of a non-technical nature. This year, honors go to the E.E. department for the winning essay by Mr. Engle.

Most of the union leaders favor the closed shop, and most of the employers oppose it. For the labor organizer who is content to take a short-time view of his mission, the closed shop is a gift from Heaven. It solves the problem of finance and insures a full treasury, which can be used to keep the employer from breaking his contract with the union. It eliminates the necessity of recruiting and the toilsome business of keeping the union sold to the employees. It enables the officials to enforce union discipline and regularity, since a man expelled from the organization is automatically removed from his job.

In trying to sell the closed shop to employers and to the public, labor leaders have relied, mainly, on two general arguments. The first is that all workers benefit from the gains obtained through unionism, therefore all should support the unions through membership and dues payment. If they are not willing to render this support voluntarily they should be compelled to do so. This is no more unfair, it is asserted, than the requirement that all citizens support the government and help pay its expenses, through taxation, since the benefits of government are shared by all.

The argument has two weak points. First, there are grave doubts as to the part that unions have played in raising the wages and improving the working conditions of labor. Second, the thesis is based on the false analogy between a government and a private organization. A government by its very nature has the right to tax for its support all who live under its jurisdiction. That is one of the things that make it a government. A private organization does not have this right. To grant it would be to upset some of the fundamental doctrines of the American political and economic system. The union argument, if it proves anything, proves too much. If every worker who is supposed to benefit from the activities of unionism should be required to join a union, every business man should be compelled to join the United States Chamber of Commerce, and surely every beneficiary of Christian civilization should be forced to join a church.

The second general argument advanced by labor leaders in favor of the closed shop deals with supposed advantages to the employer's business. Under a closed shop agreement, it is claimed, factional strife is eliminated, and the management is not subjected to conflicting claims from rival organizations. To a limited extent this may be true, although the records of the National Labor Relations Board include numerous cases in which closed shop contracts have been ignored and rival organizations have built up sufficient strength to contest the claims of the unions that were supposed to have been installed permanently.

Moreover, jurisdictional disputes between unions by no means are confined to open shop industries. Even if it be conceded that, in some cases, a closed shop contract has brought a degree of stability in labor relations, it is proper to ask whether the price has not been more than the result was worth. The effect upon employee morale and loyalty of enforced conformity to a single organizational pattern is likely to cost the employer more than all he may ever hope to gain through recognition of a labor monopoly.

This tottering argument is sometimes shored up by the further claim that, under a closed shop agreement, the union executives can maintain factory discipline, restrain overzealous local leaders, oust racketeers, and prevent wildcat strikes. Here again the most effective rebuttal is an appeal to the records. The history of closed shop unionism does not indicate that these claims are true in any general sense, although isolated cases perhaps can be cited in support of one or more of them. Certainly the most devoted advocate of the closed shop would not contend that outlaw strikes and racketeering have been confined to open shop industries.

A related argument concerns quality of workmanship. A closed shop union, it is claimed, can set standards for membership which will insure skill, efficiency and character among the working force. Again the argument does violence to the facts. Theoretically, a union that has a monopoly of labor should be able to do all that is claimed for it in maintaining standards of workmanship, but in most industries these results have not been apparent. On the contrary, through

(*Continued on page* 30)

...more than a week-end problem!

America's millions of Saturday night baths. Drop in the bucket compared to the billions of gallons of water used daily in homes and industries.

That's why college men who elect the challenging field of Sanitary Engineering have important work ahead. Supplying and distributing enough water to meet ever-increasing demands in the face of world shortages, is a continuing and crucial problem.

Cast iron pipe . . . the dependable, long-lived pipe . . . is used for water mains by practically every city in America—large or small. In over 70 American public utilities cast iron pipe has served for a century or more. No other pipe has served so long . . . and so well.

CAST IRON PIPE RESEARCH ASSOCIATION

Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

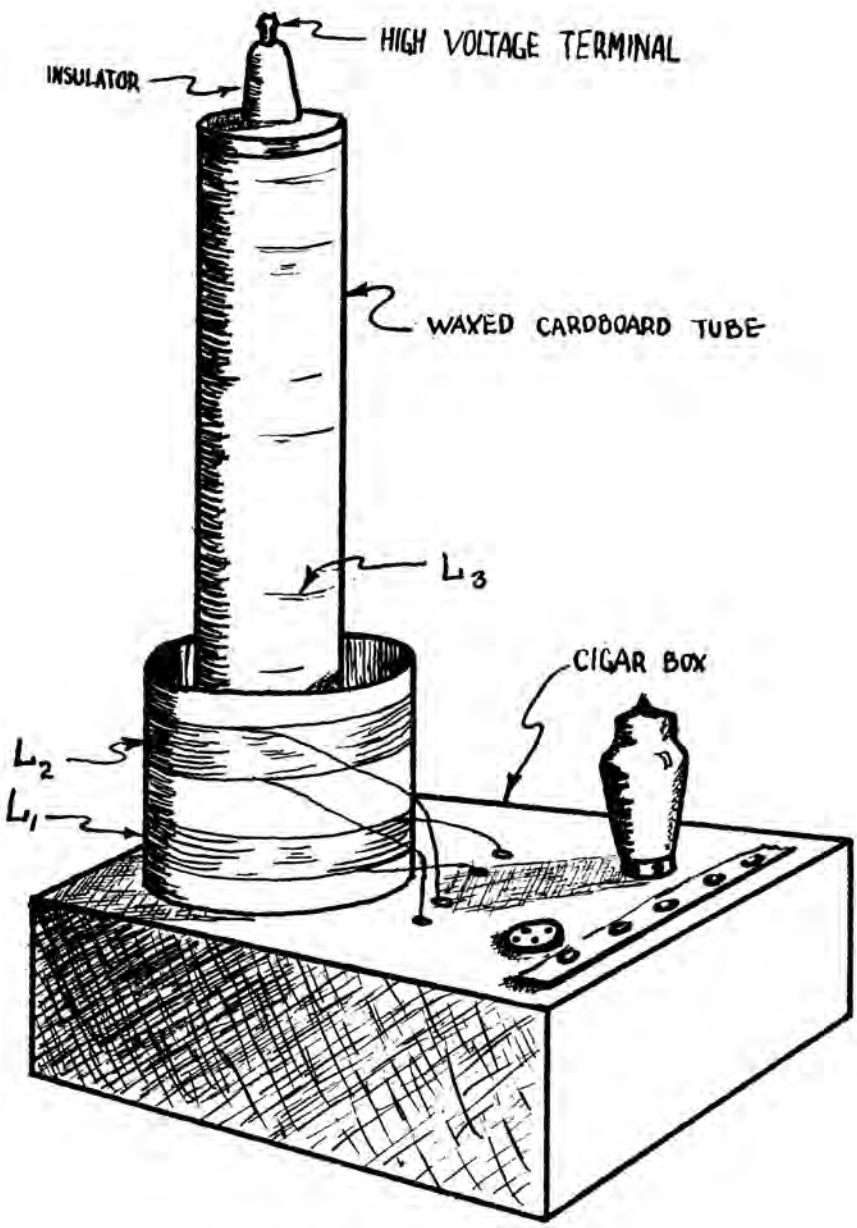
®

CAST IRON

CAST IRON PIPE SERVES FOR CENTURIES

VACUUM TUBE TELSA COIL

By ROGER RICHESSON, E.E. '56



General Arrangement of Telsa Coil

One night, more than a half century ago, a young man by the name of Nikola Tesla gave a demonstration of his new invention, the now famous Tesla coil. On that night there opened a wide, new field to the scientific experimenter. This field was high-frequency high-voltage alternating-current, a veritable fairyland of crackling brush discharges, beautiful gaseous glows, and energy that wires cannot confine.

By following the instructions in this article you will be able to inexpensively duplicate the coil used by Tesla in his demonstration (on a smaller scale).

A Tesla coil is a transformer used for stepping up medium-high voltages to fantastic potentials, both electric and dramatic. If a stiff piece of wire about 4 inches long is mounted on a free moving metal spinner and coated along its entire length with shellac (except at the tips) it will be driven around luminously when the high frequency current rushes into it. If you have always had a high respect for glass as an insulator try this one: set up a spark gap between the output of the coil and the ground wire. Make the gap about one half inch across, then, while the spark is jumping the gap, insert a sheet of one quarter inch plate glass between the electrodes, and watch the spark continue right through!

In spite of these facts and its terrifying appearance, the discharge of this coil (called the corona) is quite harmless. If you hold a copper rod in your hand and bring its free end close

(*Continued on page* 14)

(*Continued from page* 13)

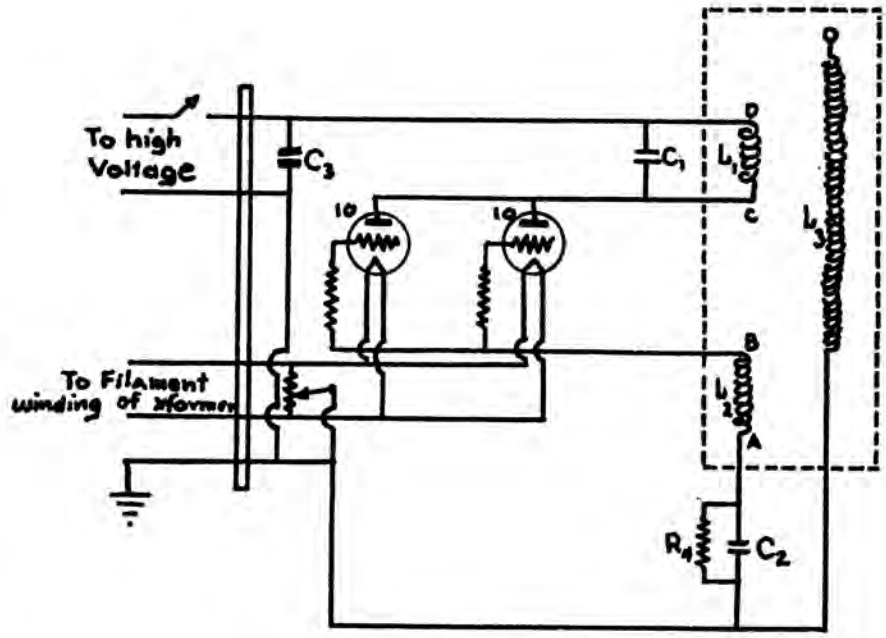
to the corona the current will jump to the rod, and on to ground via your body. But you won't even feel it.

Not enough current? On the contrary. While it is true that the power output of this coil is not very high, 50,000 volts and the current you have here would normally burn you to a crisp. Safety lies in the frequency of the current, which is well over a million cycles per second. All high frequency currents travel on the surface of conductors (this is known as the skin effect). When you are the conductor your skin carries the current and your internal organs aren't affected.

A striking visual proof of the skin effect can be accomplished by spelling out a word, or making a design out of small diameter wire; when this wire is attached to the coil, the current will leap out into the surrounding space, causing the wire to glow with a ghostly light.

One of Telsa's great dreams concerned the transmission of power without wires. The idea was never quite practicable, but it will work enough for you to amaze your friends and amuse yourself with these stunts based on wireless power transmission. Connect a metal plate to the high tension terminal. This power transmission plate must be well insulated from the ground. A short distance away, arrange another insulated plate so that its face is parallel with that of the first. If you touch this power receiving plate with a screwdriver, you will draw sparks from it even though it has no wired connection with any source of electrical energy. At still greater distances (8 to 10 feet) you should be able to light a neon tube by bringing it close to the receiving plate. Small nails scattered on the table between the two plates will also throw sparks at your screwdriver.

One amazing demonstration of the power transmitting ability of your coil is that of lighting a fluorescent tube with no connections to it. Place the tesla coil in one room and locate the power transmitting plate close to a wall that connects with another room.



Telsa Coil Circuit Diagram

Darken the adjoining room and pull a chair up close to the wall and begin to read a book. Do you need light? Just pick up a handy fluorescent light tube and it will light up. The tube will stay lit as long as you keep your hand on it (your body is acting as the receiving plate). This works as far as 12 feet.

All high voltage devices generate some static, and this coil is no exception. Out of consideration for your neighbors, you should avoid using the coil at those hours when you know that most people are using their radio and television sets.

Actual Construction Of The Coil

The coils are wound on ordinary cardboard tubes. A core 2½ inches in diameter by 26 inches long is used for the high-voltage secondary. Coat the outside of the tube with hot paraffin, and, when it has cooled, wind a 21 inch coil of 30-gauge D.C.C. wire evenly and smoothly, starting 1 inch from the bottom. The end of this wire is brought up inside the tube through a wood block and insulator.

For the other two coils, cut an oatmeal box down to 6 inches in length and use 16-gauge D.C.C. wire for both windings. Let L, start 1 inch from the bottom and continue for 15 turns. Leave a one inch space and wind 20 turns for L2. Cover all the coils with a good shellac.

Attach the secondary coil to the cigar box with small metal brackets. Bring the ground lead into the box, making sure that it does not come near the primary. Then slip the larger form over the other and attach it in the same way. Carry the leads into the box through four small holes.

Connect the high-voltage side of a power transformer (500 volts or more) to the input of the tesla coil through a single pole, single throw switch. Use a separate switch for the filament leads.

A pair of 4 prong sockets is needed for the type 10 tubes; other parts shown in the wiring diagram are R1 & R2: 2,700 ohm, 10 watt wire wound resistors; R3: 40 ohm, center-trapped; R4: 5,000 ohm 10 watt; C1: .001 mfd., 1,000-volt, mica; C2 & C3: .0005 mfd., 1,000-volt mica condensers.

When your coil is complete, close the filament switch. Ten seconds later, close the high-voltage switch. Immediately a 3 inch arc will leap from the high-voltage terminal. If it doesn't the primary coils are probably bucking, and either one or the other should have its connections reversed.

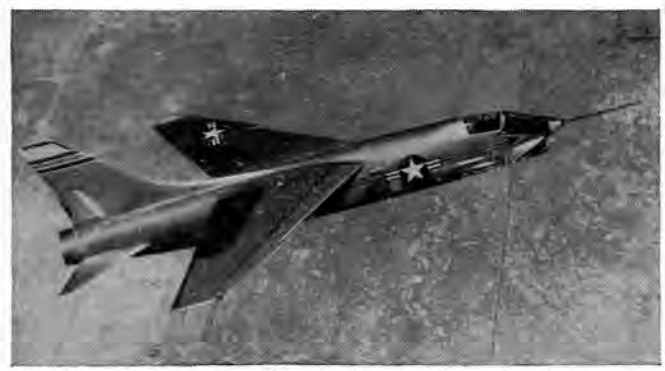
World's most powerful production aircraft engine

The J-57 axial-flow jet engine with afterburner, designed and developed by Pratt & Whitney Aircraft.

McDONNELL F-101 — The Voodoo, an Air Force supersonic fighter that has two J-57 engines with afterburners, is the most powerful jet fighter yet built.

BOEING B-52 — Eight J-57 engines, mounted in pairs, power this all-jet, heavy Air Force bomber.

BOEING 707 — The Stratoliner will usher in commercial travel in the jet age. It is the counterpart of the KC-135, a military tanker-transport powered by four J-57 engines.



CHANCE VOUGHT F8U — Powered by a J-57 with afterburner, the Crusader is the Navy's fastest carrier-based fighter.

The best airplanes... are designed around the best engines

Today's most valuable military aircraft, capable of supersonic or intercontinental flight, include various Air Force and Navy fighters, bombers and transports. Among these are nine types that have a significant feature in common. They all fly on one type of engine — the J-57 turbojet.

Also entrusted to the efficient, dependable operation of Pratt & Whitney Aircraft's jet engines will be the commercial jet transports soon to travel along the air lanes of the world.

The excellence of the J-57 is attributed to the engineering team that has determinedly maintained its leadership in the field of aircraft powerplants. Effort is now being directed toward the improvement of advanced jet and turboprop designs. Still to be anticipated is mastery of current technology's most provocative problem — the successful development of a nuclear aircraft engine.

Many engineering graduates would like to be concerned with the air power of the next generation. One way to fulfill that ambition is to pursue a career alongside the Pratt & Whitney Aircraft engineers who have consistently produced the world's best aircraft engines.

World's foremost designer and builder of aircraft engines

PRATT & WHITNEY AIRCRAFT

DIVISION OF UNITED AIRCRAFT CORPORATION

EAST HARTFORD 8, CONNECTICUT

By JERRY HERDAN, M.E. '57

NETWORK ANALYZER BOARD INSTALLATION HALTED

Due to the present Westinghouse labor strike, assembly operations have ceased at the Westinghouse plant where the network analyzer board is being constructed. It is estimated that once work is resumed on the analyzer, it will take six weeks to complete. Meanwhile, the special room which has been modeled, equipped with the lighting equipment, and connected to the city power lines is ready for reception of the analyzer board. The reason that city electric power is going to be used instead of University power-plant current is that the frequency variation is too great from the M.U. power-plant. The city is buying a new frequency control in order to supply controlled frequency electricity to the analyzer board and its other consumers. In order to attain close frequency control the equipment has to "anticipate" the frequency variation before it actually occurs and to correct it before it does vary. An anticipator-type control is consequently a complex and expensive instrument.

WILLEY LEY, ROCKET AUTHORITY, SPEAKS

Willey Ley, authority on rockets and guided missiles, spoke at the University O. M. Stewart Lecture December 9, 1955. Mr. Ley's background was not given at that time and in the hopes that it will be of interest we are giving it here. Mr. Ley was born in Berlin in 1906. He studied at the Universities of Berlin and Konigsberg in East Prussia, concentrating on paleontology, astronomy, and physics. He had planned to be a geologist until he became interested in theoretical work being done on rockets and space travel. In 1927, Ley became one of the founders, and later was vice-president, of the German Rocket Society. After Hitler's advent in Germany, Willy Ley left for an extended vacation in England, came to America in 1935 and is now an American citizen. In this country, Ley has been science editor of New York newspapers, a research engineer for the Washington Institute of Technology and consultant to the Office of Technical Services of the U. S. Department of Commerce. He is a contributor to many scientific and popular publications and his books include "Days of Creation," "The Conquest of Space," and "Rockets, Missiles and Space Travel." Ley has detailed in his many books and writings how we now have the information and the engineering skill to realize without delay a revolution in rapid transport and to create interplanetary bodies for the advancement of travel, communications, and scientific research.

NEWS OF PROFESSORS

Mr. Lypirides, a citizen of Greece, who is an instructor in the Electrical Engineering Department here, is being called to service by his homeland's army. Mr. VanHoozer, also in the E.E. Department, is taking an extended Christmas vacation. He is not, however, doing much of the Christmas nature, but is undergoing the removal of his appendix.

ROLLA DIVISION GETS BIG JOB

The School of Mines and Metallurgy has been awarded $11,500 by the Missouri State Highway Commission and the U. S. Bureau of Public Roads to finance a study of the effects prestressing will have upon thin concrete pavement slabs.

Dr. Curtis L. Wilson, dean of the University of Missouri school here, announced the award. The grant, he

(*Continued on page* 24)

MIZZOU MEMOS

By SHELTON EHRLICH, M.E. '56

Career Sketch: *Hal W. Hilker*

Hal W. Hilker, 1942 graduate of the University of Missouri, received a bachelor of science degree in mechanical engineering. After graduation he joined Bailey Meter Company as a member of their 1942 cadet engineering training class. The company, manufacturers of instruments and automatic controls for the power and process industries, has headquarters in Cleveland, Ohio, with 24 sales-service offices throughout the United States.

Hilker, who had been on the staff of the Los Angeles district office since 1946, was appointed Manager of the company's Ceramics & Non-Ferrous Metals Division August 1, 1955.

A Registered Professional Engineer in the State of California, Hilker belongs to the American Society of Mechanical Engineers and the Instrument Society of America. Married, he has two children, Glen and Gail.

Virgil Sohns, Ch.E. '38, is now in charge of the Industrial Fermentation Unit, Engineering and Development Section of the Northern Utilization Research Branch of the U. S. Department of Agriculture. He is working in Peoria, Ill.

William G. Purdy, C.E. '41, has been selected as the administrative head of the "Vanguard Project" of the Glen L. Martin Company. This is the space satellite project which will move to Denver in the near future. Mr. Purdy was chief engineer of the "Viking Project".

John L. Chapman, B.S. '43, is a consulting engineer in the uranium industry, mining and milling. His current address is Route 3, Grand Junction, Colo.

John F. Leuck, E.E. '49, was married to Mary Katherine Maupin on Sept. 3 at St. Mary's Church, Glasgow, Mo. He is employed at Phillips Petroleum Co. of Kansas City, where they live.

Walter Vandelicht, C.E. '49, has been promoted to Plans and Surveys Engineer for Dist. 5, State Highway Dept. at Jefferson City. He has recently been chief designer in that office.

Ernest Ray Cunningham, Jr., Ag.E. '51, is now Western Editor of "Design News". His office is 20 N. Wacker Drive, Chicago 6, Illinois.

Oriville J. DuPree, C.E. '53, has recently been appointed to the manager of the Wichita office of the American Blower Corporation. His current address is 307½ Laura St., Wichita 7, Kansas.

Donald H. Wade, '55, was married to Anna Jean Welch on July 30 at the First Baptist Church, Elvins, Mo. He is employed with the Missouri State Highway surveyors. They live at 221 West Main St., Elvins.

Career Sketch: *Robert E. Byers*

Robert E. Byers was graduated from the University of Missouri in 1948 with a bachelor of science degree in mechanical engineering. Byers who comes from Columbia, Mo., is District Manager of Bailey Meter Company's Memphis (Tenn.) district office.

During the summer of 1947, he worked for the company as a junior cadet, joining Bailey Meter on a full-time basis as a 1948 cadet engineer after his graduation from Missouri.

After completion of his cadet training, Byers was assigned to the company's St. Louis district office. On January 1, 1955, he was appointed Manager of the Memphis district office.

While at Missouri, Byers was initiated into Pi Tau Sigma, Tau Beta Pi, and was a member of Omicron Delta Kappa and the Mystical 7. His professional activities include the Instrument Society of America. Married, Byers has two sons, Ronald and Roger.

We were recently informed of the deaths of two alumni. Mr. John Thomas Garrett, class of 1889, passed away on August 29, 1955. Mr. Robert Peel Garrett, class of 1896, passed away on April 5, 1951.

Frank Thorton, Jr., E.E. '08, is now retired from the Westinghouse Electric Corporation and is a consulting engineer in Pittsburgh, Penn.

J. I. Metz, C.E. '16.

After graduation Mr. Metz, a native of St. Louis, took his first job with the Illinois State Highway commission. At this job Mr. Metz participated in a "first" in road-building. The occasion was the laying of the first ½ mile strip of concrete highway without expansion joints. Prior to this highways were made of brick.

Next Metz joined the St. Louis Park Department.

During World War I, Metz served in France and upon returning he went for the City's Building Department. After this he was employed by the Koerner Engineering Company, and Glencoe Lime and Cement Company. In 1929 he founded the Metz Engineering Company which he still heads.

David R. Cannon, B.S. '23, writes from Iran that his work has been very interesting. He is amazed at what the people of Iran can build using mostly mud, lime, straw, brick, and gypsum, all native materials and very cheap. He is in his second year as construction engineer for the Near East Foundation in Tehran. His current address is Near East Foundation, A.P.O. 205, New York, N. Y.

Col. Frank H. Skelly, C.E. '26, is now Professor of Military Science at the University of Missouri.

William H. Klinger, '36, is now owner of W. H. Klinger & Associates Engineers of Quincy, Ill.

It has been 100 years since we graduated our first class and this is our year to celebrate. It will be the best opportunity for many of our alumni to return to the campus and see many of their classmates and the progress we have made since they have graduated. We of the "Missouri Shamrock" would like to urge as many of the alumni as possible to attend this great occasion.

RCA TV camera encased in special diving bell televises the activities of sea life in sunlit waters off the Gulf Stream.

Now RCA puts TV underwater to help the Government protect marine life

Ten fathoms down, an RCA television camera moves through darting schools of fish. On the surface, U.S. Fish and Wildlife experts hover over an RCA remote control TV monitor. From what they see will come new fishing techniques to help the government protect marine life.

The electronic and engineering skill behind underwater TV is inherent in all RCA products and services. And continually, RCA scientists at the David Sarnoff Research Center in Princeton, N. J., delve into new "Electronics for Living" that will make life fuller, easier, 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.

U.S. Fish and Wildlife Service technicians study fishing methods and equipment of an RCA remote control TV monitor.

RADIO CORPORATION OF AMERICA

ELECTRONICS FOR LIVING

NEWSTUFF

By DANIEL R. CAPPS, B.S., E.E., '56

ELECTRIC STAIRWAYS

Shades of college days and those long desperate treks across campus! Now college students are changing classes on electric stairways! The innovation has already taken place in the University of Illinois' new $5,500,000 East Dentistry - Medical - Pharmacy Building in Chicago, where classroom and laboratory space is provided for students of pharmacy and other professional colleges.

Ten Westinghouse electric stairways travelling at 120 feet per minute are capable of transporting more than 10,000 students to their classes in a ten-minute period. Considerably faster than usual stairways which travel 90 feet per minute, these express models can carry a student from the basement to his class on the fifth floor in 78 seconds, with no puffing.

What will they think of next? The common auto dashboard cigarette lighter has invaded the realm of electronic warfare as a built-in part of a complex new ground-based USAF air defense system in development at Syracuse, N. Y.

The lighter has a distinctly scientific purpose in the complex, classified electronic equipment being built under a multimillion-dollar contract by General Electric's Heavy Military Electronic Equipment Department.

Engineers say an operator, scanning the system's glowing indicator radar scopes for hours in semi-darkness, could be temporarily blinded by the flare of a match or pocket lighter when lighting a cigarette. Furthermore, his hands must be free to work the dozens of knobs, switches and buttons on the control panel.

Accordingly, the built-in lighter was ordered as a part of a "human engineering" program to keep the operator as undistracted as possible.

POCKET-SIZE WALKIE-TALKIE RADIO

The smallest walkie-talkie FM radio ever built — a transistorized instrument tiny enough to be carried in a shirt pocket, yet powerful enough for two-way communication over a quarter-mile range — has been developed experimentally by the Radio Corporation of America.

The U. S. Signal Corps has purchased a quantity of the developmental walkie-talkie radios (transceivers) for field tests and evaluation as communications devices for squads and other small tactical military groups in the field. Tests are being conducted by the Operations Research Office, Department of Defense, at Fort Carson, Colorado.

The ultra-miniature FM transceiver, designed for military communications in the 45-to-50 megacycle band, features a receiver which is small enough to store in a vest pocket, according to Theodore A. Smith, Vice-President and General Manager, RCA Engineering Products Division. The receiver could be produced as an independent unit for one-way communication applications, to link, for example, a platoon or squad leader with

(*Continued on page* 24)

Dr. Ward Kuentzel and Dr. Edmund Field, co-inventors, observe operation of the new Magne-Dash autoclave in Standard Oil's Whiting research laboratory.

Orders for inventions taken here

MODERN RESEARCH creates a need for brand-new types of equipment. In petroleum laboratories, mixing up some stuff in a beaker usually isn't the answer. The research pioneer may have to use high temperatures and high pressures. If he must stir his mixture, he has a tough job. How can he prevent leakage past the shaft of the stirrer?

To meet this and other difficult situations, Standard Oil has set up a "Special Devices Program". A group of scientists creates the apparatus needed to solve today's problems.

An example is the Magne-Dash* autoclave. It has a magnetically operated agitator, and no external moving parts. Leaks cannot occur. Research men now use freely the high pressures that lead to new plastics and other new products.

Like many other inventions made by Standard Oil scientists to solve our own problems, the Magne-Dash is licensed for production and sale by a maker of scientific equipment.

The Special Devices Program is just one of the creative activities at Standard Oil. Young scientists find it stimulating to work in such an atmosphere.

*Manufactured under Standard Oil license by Autoclave Engineers, Inc., Erie, Pa.

Standard Oil Company

STANDARD

910 South Michigan Avenue, Chicago, 80, Illinois

AROUND THE COLUMNS

(*Continued from page* 18)

said, provides for a cooperative project that will be under the general supervision of E. W. Carlton, professor of structural engineering and chairman of the Department of Civil Engineering in the School.

He said the major research studies will be made by faculty members and graduate students in civil engineering.

Prof. Carlton explained that in this project prestressing will be accomplished by stretching steel wire or cable running lengthwise through thin concrete slabs. Slabs of only 6 inches in thickness, instead of the usual 9 or 10, will be poured on a rolled stone base. After the concrete has set, he said, the lengths of alloy steel rods or cables, which will be prevented from adhering to the concrete, will be stretched by hydraulic jacks and anchored at each end of the slab.

Tension on the cables, he added, will pre-load the slab and prevent it from cracking.

"We want concrete pavement to wear out, not break up," Prof. Carlton said. "If prestressing of concrete can be applied to highway construction and we are able to build roads that wear out instead of cracking up, the highways now costing upwards of a million dollars a mile to construct will last forty years instead of ten or fifteen."

Also, he said, the use of a thin slab in highway construction would result in a saving of 40 per cent or more in concrete.

He mentioned another possible advantage, saying that it might be possible to put traffic on a prestressed slab in fourteen days or less instead of twenty-eight days, the time now required for the present type of concrete pavement.

Much experimentation has been done on prestressing concrete slabs for airstrips and warehouse floors, Prof. Carlton said, and it is hoped that, through the type of research made possible by this grant, prestressing can be successfully adapted to highway construction.

He believes that in the actual laying of pavement, the distance between joints would be 100 feet or more, but in the experiments to be conducted the strips will be about 20 feet long. He pointed out that the steel rods or cables in each length of slab would maintain the individual slab sections in compression, even under load conditions; therefore, there would be no expansion joints as now used in pavements. Only construction joints would be necessary.

Experimenting with small slabs will be done in the laboratory, he said, as well as in the field where the effects of various temperature and moisture conditions on the slabs can be studied.

It is hoped that the first preliminary studies will be completed by Jan. 1, 1957, when the grant expires, he said, and if these are conclusive enough to justify experimentation by the Missouri Highway Commission it is possible the Commission would build a short highway test section or passing lane to be tested by truck traffic.

"One of the principal types of heavy duty highway pavements in use in Missouri and in many other states is known as portland cement concreted rigid type pavement," Prof. Carlton said, in discussing the project. "There have been two trends in design of this type of pavement. One consists of concrete slabs containing distributed reinforcement such as wire mesh or bar mats and the other trend resorts to the articulation of the slab by jointing at very short intervals with no distributed reinforcement. Another improvement in highway design has taken the form of expensive sub-grade stabilization.

"There exists an additional approach to this problem in the form of prestressed pavement slabs. This type of design is being used in structural work at an increasing rate. It is, however, not as yet available for pavement use because the necessary research studies have not been carried out to produce design information on which full scale pavement sections can be based.

"It is the purpose of this project to study the effects of prestressing upon thin concrete sections such as would be considered for pavement use. Preliminary studies, such as are intended in this project, are the basis upon which the Missouri Highway Department and others may develop criteria which, if economical, can be used in the establishment of standards of practice for the construction of prestressed concrete highway slabs."

NEWSTUFF

(*Continued from page* 22)

individual soldiers.

A completely self-contained and self-powered radio, the RCA transistorized transceiver houses a receiver-transmitter, microphone-earphone, collapsible antenna, and a battery in a single compact assembly which weighs only 15 ounces and approximates a small tobacco tin in size. It measures only 5½ inches high, 3 inches wide, and 1 inch deep.

"Built around 12 transistors and a single electron tube, the pocket-size transceiver represents a new design approach to walkie-talkie equipment," Mr. Smith said. "Application of transistors and new electronic circuitry made possible the achievement of an ultra-miniature unit which also offers the advantages of high stability, dependable performance, long battery life, and ruggedness found in appreciably larger walkie-talkies. Further, the equipment designed is readily adaptable for fully automatic production.

"Designed for quick, convenient operation, the RCA transceiver incorporates only two simple controls for two-way communication—a push-to-talk button and a combination on-off and volume-control switch. It requires no tuning or adjustment, and the built-in microphone-earphone provides clearly audible reception when held several inches from the ear."

The ultra - miniature walkie - talkie can be preset for operation on any frequency between 45 and 50 megacycles; incorporates an all-transistorized superheterodyne receiver and a two-transistor, one-tube transmitter; and provides up to ten hours of service life with a single tiny radio battery. Its construction features corrosion-resistant materials.

A job you can grow with ...

Union Carbide offers you opportunities to grow in some of the most rapidly expanding fields in industry. You may have the qualifications that will help you to "get in on the ground floor" on new developments by the Divisions of Union Carbide in alloys, carbon products, industrial gases, chemicals, plastics and atomic energy. Examples in four of these growing fields are illustrated below.

RADIOISOTOPES — Union Carbide's Divisions are leaders in the field of nuclear research and development. One Division, Union Carbide Nuclear Company, operates for the government Oak Ridge National Laboratory, the Nation's chief source of radioisotopes. In medicine, radioisotopes are used to investigate the human bloodstream —how it supplies nourishment, defends against disease, or becomes diseased itself.

TITANIUM — Electro Metallurgical Company is rapidly completing a new plant to produce titanium, the wonder metal whose strength and lightness are combined with resistance to heat and corrosion. The new plant will use a process developed by Union Carbide research, and will have an annual capacity of 7,500 tons of crystalline sponge —half again as much as the total United States production in 1954.

PETROCHEMICALS — Carbide and Carbon Chemicals Company produces more petrochemicals than any other company in the world. Some are being used to develop whole families of new adhesives and bonding agents. It is now possible to make almost any materials stick together permanently. Union Carbide research into the nature of bonds—mechanical, chemical, molecular—will make possible new and better adhesives.

EPOXY PLASTICS — Bakelite Company is a major producer of most types of plastics, including the sturdy epoxies. Two liquids, a resin and a curing agent, form a tough, dimensionally stable solid when poured together. They are used for long-lasting, accurate patterns for foundry work, for dies that stamp out auto parts and airplane wing sections, for embedding delicate electronic parts to protect them from moisture and vibration.

THE HORIZONS ARE UNLIMITED *for engineers, chemists, physicists, and business and liberal arts majors. Union Carbide offers many opportunities to explore those horizons.*

Contact your Placement Director and make appointments with the recruiting representatives of Union Carbide and its Divisions.
For further information, write:

UCC divisions include . . .

Bakelite Company · Carbide and Carbon Chemicals Company
Electro Metallurgical Company · Haynes Stellite Company
Linde Air Products Company · National Carbon Company
Union Carbide Nuclear Company

UNION CARBIDE
AND CARBON CORPORATION
Industrial Relations Department, Room 406
30 East 42nd Street UCC New York 17, New York

BULLARNEY

By DUNK

The Soviet commissar was examining a young Czech boy to determine whether he had been properly indoctrinated. When asked who his father was the boy replied, "Josef Stalin."

Beaming, the examiner then asked who his mother was. "The great Soviet Union," came the prompt reply.

"Splendid," grinned the commissar, "You'll make a fine Red Army soldier. Now tell me," he continued, "what do you want to be when you grow up?"

"An orphan!" snapped the boy.

♣

A salesman was trying to sell a farmer a bath tub. "Could I interest you in a bath tub?" the salesman asked.

"Nope," said the farmer. "We tried one once; that's what killed Grandpa."

"Killed him! What happened?"

"Well, after we got the tub in the house I plugged her up and filled her full of water. Then the whole family, from the youngest to the oldest, took turns. The youngest hopped in, then out. The next oldest — all the way up to Grandpa, who was the last. And that's what killed him."

"It did?"

"Yep, poor Grandpa died in the quicksand."

♣

"Where have you been?"

"Over in the phone booth talking to my girl but some punk came over and wanted to use the phone so we had to get out."

♣

The best way to drive a baby buggy is to tickle his little feet.

♣

Situation: Two infants in the nursery of the maternity ward of the hospital.

First Infant: "Are you a little boy or a little girl?"

Second Infant: "I don't know."

First Infant: "I'm a little boy."

Second Infant: "How can you tell?"

First Infant: "Wait till the nurse leaves and I'll show you."

The nurse leaves and the First Infant pulls the cover down and says: "See, blue booties."

♣

C.E. Senior: "Gee, but I'm thoisty."

Frosh: "Wait a minute, I'll get you some water."

Senior: "I said I'm thoisty not doity."

♣

A little fellow who had just been spanked turned to his mother and asked: "Mother, did grandfather spank father, when he was little?"

"Yes, certainly he did."

"And did his father spank him?"

"Yes."

"And did his father spank him?"

"Yes."

"Well, who in the hell started this, anyway?"

♣

"I seem to have run out of gas," he said softly.

Her face, small and white, was turned up to his, her eyes glowing from beneath heavy lids. Her head swam.

Slowly he bent over her.

Relax . . . He was her dentist.

♣

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

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

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

♣

Note to all liberal arts students: A slide rule is not a regulation pertaining to baseball.

Lives there a man with soul so dead,
Who never to himself hath said,
To hell with these studies,
I'm going to bed.

♣

Sign in front of crematory. "We're Hot for Your Body."

♣

Some people sow their wild oats on Saturday night and then go to church on Sunday and pray for crop failure.

♣

Professor (irritated) — "If there are any morons in the room, please stand up."

A long pause, and a lone freshman rose.

Professor — "What, do you consider yourself a moron?"

Freshman — "Well, not exactly that, sir; but I do hate to see you standing all alone by yourself."

♣

There is an engineer on this campus who never takes a drink. You gotta hand it to him.

♣

A lady bought a parrot from a pet store only to learn that it cursed everytime it said anything. She put up with it as long as she could, but finally one day she lost her patience. "If I ever hear you curse again," she declared, "I'll wring your neck."

A few minutes later she remarked rather casually that it was a nice day. Whereupon the parrot promptly said, "It's a hell of a fine day."

The lady immediately seized the parrot by his head and spun him around in the air until he was almost dead.

Now, then," she said, "It's a fine day, isn't it?"

"Fine day!" exclaimed the parrot. "Where in hell were you when the cyclone struck?"

(*Continued to page* 30)

Engineering is more than a department at the Timken Company—it's everything!

That's why we offer such a promising future for graduate engineers

FEW companies can offer engineering and metallurgy graduates such a wide variety of opportunities as you will find within the Timken Company. And we are constantly seeking college graduates who have specialized in these fields because every phase of our manufacturing, research, and marketing requires advanced technical skills and training.

PROMOTIONS MADE FROM WITHIN There is an unusual opportunity for you to advance in the Timken Company. This is highlighted by the fact that one hundred percent of the men in executive and supervisory positions, including the president of the company, have risen from the ranks. And most of these key men are graduate engineers or metallurgists.

MANY FINE TECHNICAL OPPORTUNITIES The Timken Company offers a splendid opportunity to every graduate in one of the many specialized spheres of the company's operation. These include research and development in tapered roller bearings, alloy steel, and rock bits; production of fine alloy steel; metallurgical testing, quality control, and technical service; bearing design and manufacturing control; bearing application engineering for aircraft, automotive, agricultural, railroad, industrial, and other fields; rock bit design, forging, and heat treatment; and sales engineering, covering development work in every market where Timken bearings, steel, and rock bits are used or have a potential.

Another especially important part of engineering work at the Timken Company is the design of plants and specialized equipment for making Timken Company products better and faster. An outstanding example is our revolutionary new, completely automatic bearing plant now in operation in Bucyrus, Ohio.

SOLVE PROBLEMS FOR ALL INDUSTRY You can be assured of an interesting and stimulating career with the Timken Company because of the diversity of applications into which our products go. Every industry is a user of these products. That means that Timken Company engineers and metallurgists are constantly involved in solving problems and designing for new applications in fields far removed from their own drafting table or laboratory bench. We believe that this opportunity to play a part in the advancement of *all* American industry is an important reason why technically trained graudates like being on the Timken Company team.

RECORD OF PIONEERING, PROGRESS The Timken Company was founded 56 years ago. Since then, it has grown to become the world's largest manufacturer of tapered roller bearings and removable rock bits, and a foremost producer of fine alloy steel bars, billets and seamless steel tubing. Our unique combination of experience and research has built an enviable reputation for solving difficult problems for our customers. By constantly expanding and strengthening our technical staff with aggressive and imaginative young engineers and metallurgists, we intend to continue our record of pioneering and progress. And if you possess the abilities and qualities we need, we'll be happy to have you share in that progress.

SEND FOR MORE INFORMATION For more detailed information about The Timken Roller Bearing Company, its training program, and the career opportunities for you, write to the college relations manager for your free copy of the booklet, "*This Is Timken*".

The Timken Roller Bearing Company

Canton 6, Ohio

TAPERED ROLLER BEARINGS • ALLOY STEEL & SEAMLESS TUBING • REMOVABLE ROCK BITS

UNIONS

(*Continued from page* 11)

limiting the kinds of work that particular crafts can do, through arbitrary apprenticeship regulations, and through actual restriction of output, closed shop unions probably have done more to lower than to raise quantity and quality of output. Moreover, there is danger that, under a closed shop contract, an employee will get the idea that his job depends less upon the quality of his work than upon his standing with the union.

Having examined the main arguments advanced in favor of the closed shop, let us now turn to some points against it. One of these is the obvious danger that, under a secure monopoly of labor, union officers may become more powerful than the foreman in influencing shop conditions. Workers are likely to hold their jobs and qualify for advancement through union regularity rather than through the quality of their work or their loyalty to the company. This transfer of allegiance from the employer to the union is destructive of both workmanship and discipline. Danger of this result is increased if, under the terms of the contract or the customs of the industry, it is difficult or impossible to discharge a man without the consent of the union business agent.

With membership secure and dues guaranteed, whatever benefits the union otherwise might render to its members are likely to be lessened, since organizers and business agents are relieved of the necessity of devoting their efforts to the interests of the workers. A disgruntled member can not quit the union without losing his job. Sometimes the same result follows criticism of the officers of the local. This situation offers attractive possibilities to the labor leader who is inclined to indolence, or who is even not averse to making deals on the outside that are not in the interests of the men whose dues pay his salary.

Reference already has been made to restriction of output. Here it needs only to be added that, under a closed shop contract, a union can set the maximum amount of work members may perform, or the maximum hours they may work. In an open shop this is more difficult, since non-members are not bound by union rules. Besides these crude and open restrictions, there are numerous arbitrary requirements which limit the quantity of work or add to manufacturing costs. Restriction of production conflicts with the interests of industry and of consumers.

From the standpoint of economics and industrial management, perhaps the chief argument against the closed shop is that it gives a union veto power over the labor policies of management, and forces the worker to give allegiance, not to the company which pays his wages, but to an external organization which has no financial investment in the business and no responsibility for the success of the enterprise. Under a system of private industry, this is more power than any outside agency should possess. It is contrary to all the principles of free enterprise, through which American industry, has raised living standards and the status of working men far above any level found elsewhere in the world.

In the minds of many employers, the compelling objection to closed shop unionism lies in the field of ethics and principle. These employers believe the closed shop is un-American, undemocratic, and morally wrong. They do not think management has any right to require all employees to join an organization which some of them do not want to join and which perhaps some of them can not join.

We should remember that even if a worker wants to join a union, he cannot always do so. A clause that unions usually have in a closed shop contract enables them to force the discharge of men who have stayed at work during a strike and thus have resigned or been expelled from the organization. Loyalty to the union comes first. If it conflicts with loyalty to the employer and an employee chooses the latter, he does so at his own peril. He risks losing the privilege of earning his living.

BULLARNEY

(*Continued from page* 28)

Little boy: "May I kiss you, Mary?"

Mary: "Not yet, I have scruples."

Little boy, throwing out his chest: "S' all right Mary, I've been vaccinated."

♣

One day a little mouse was hurrying across a wheat field when suddenly it was scooped up by a big reaping machine. The poor little mouse was tossed from side to side, and was finally thrown back on the field. Another little mouse came upon his friend lying on the ground, bruised and beaten, and asked him what had happened. "I've been reaped," came the reply.

♣

You know what the once over is?
That's this!
when like
you girl
look at a pretty

♣

On his way home, a drunk stopped at a lamp post and pulled out his house key.

A passing policeman noticed his fumbling around, trying to insert the key into the post, and asked politely, "Nobody home?"

"Your crazy," said the drunk, "there's a light upstairs."

♣

A lecturer who was speaking on the drink question: "Now, suppose I had a pail of water and a pail of beer on this platform, and then brought on a donkey; which of the two would he take?"

He'd take the water," came a voice from the gallery.

"And why should he take the water" asked the lecturer.

"Because he's an ass," came the reply.

♣

A green little chemist on a fine green day,
Mixed up some chemicals in his own green way
Now the green little grasses tenderly sway
O'er the green little chemist's green little grave.

Popular Choice of Students

It's no accident that so many graduating engineers have selected CONVAIR-FORT WORTH as the most attractive place for starting their professional careers.

Young engineers with imagination and ambition have unlimited opportunities with CONVAIR. Broad diversification of projects provide opportunities in numerous fields of specialization. Working in ideal, air-conditioned surroundings and with advancement based on merit, you are enabled to make full use of your individual talents.

Life is good in Fort Worth — where the year-around climate is conducive to outdoor living and recreation — and there are excellent schedules of athletic events, musical and theatrical presentations, ice arena, large lakes, etc. CONVAIR'S in-plant program enables candidates to earn graduate engineering degrees.

Write now for information about CONVAIR'S interest in Engineering graduates.

Address
H. A. BODLEY
CONVAIR Engineering Personnel Dept.
FORT WORTH, TEXAS

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

FORT WORTH, TEXAS

An enlarged reprint of the above cut-out silhouette, suitable for framing or pinning up, will be sent free to any engineering student on request.

A FEW YEARS AGO, HE WAS ON CAMPUS AT PURDUE UNIVERSITY, AND NOW . . .

FLOYD D. (Doug) WALLACE, JR., above, is a senior project engineer at Allison.

He left Purdue in 1947 with his AE degree and came to Allison the same year. Presently, he is in charge of instrumentation and automatic process controls at Allison's new Research & Development test center.

With Allison now in the midst of a $75 million engineering expansion and building program, much of his time is spent in vendor contact work, studying and selecting equipment most adequate to do the job; observing, and helping with installation. He is shown above checking a control valve positioning amplifier on the instrument panel for controlling air pressures and temperatures of four electric motor-driven, axial flow compressors. This new facility is part of the new Research and Development test center, which—when completed—will enable testing of individual combustion components for turbo-prop and turbo-jet engines, compressor and turbine components.

Doug's work is "cut out" for him for some time to come, for only recently, Allison broke ground for the engineering building which is to be the center of expanded Research and Development facilities for advanced types of aircraft engines for commercial and military use.

With this long-range expansion program, Allison needs more engineering personnel, and opportunity for young graduate engineers is unlimited. Arrange now for an early interview with our representative on your campus, or write for information about the possibilities of YOUR engineering career at Allison: Personnel Dept., Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

ALLISON
TURBO-PROP ENGINES
American built for the new era in air travel

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

FEBRUARY, 1956

FEATURES:

Sam for You
How to Make a Car Dangerous
What Is Tau Beta Pi?

25c

John A. Bauscher, ***Class of '43***
speaks from experience when he says . . .

"United States Steel offers first-rate opportunities in research and product development"

JOHN BAUSCHER graduated from college in 1943 with a B.S. degree in Metallurgy. After a stint in the Navy, he returned to college as a metallurgical research assistant. In 1949 he received his M.S. in Metallurgy and then came to work at the U.S. Steel Applied Research Laboratory. After just four and a half years, Mr. Bauscher had progressed to Division Chief for Sheet Products Development – responsible for the improvement of present sheet steel products and the development of new and improved types.

Why did Mr. Bauscher choose U.S. Steel? Because, says he, "U.S. Steel produces such a great diversity of products and maintains such a thorough research program on all its products – not only theoretical research, but also applied research or product development. The graduate engineer has unusual latitude in selecting the type of products and the type of research that interest him most. Work is done not only on steel, but on many raw materials and by-products as well.

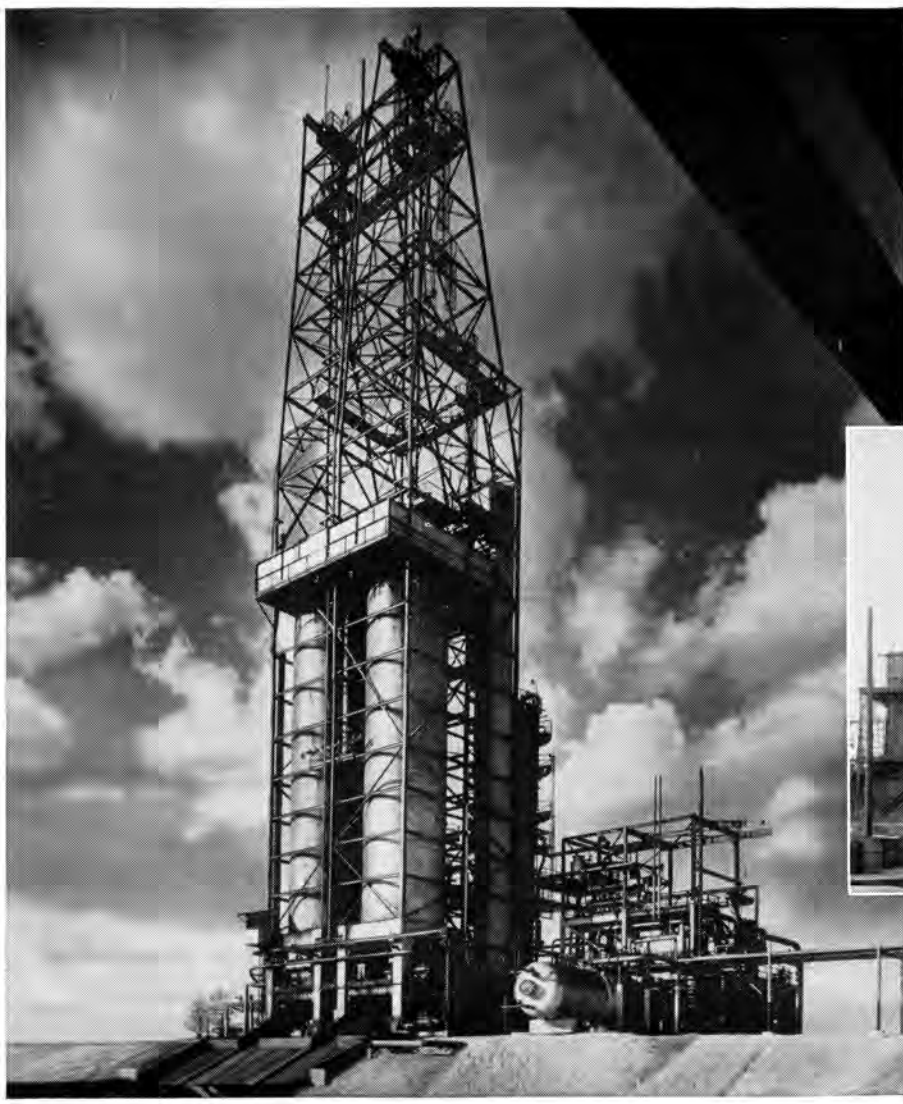
"And," says Mr. Bauscher, "Opportunities at U.S. Steel are better now than ever before because of the emphasis on product development and the recent expansion of research facilities."

If you are interested in a challenging and rewarding career with U.S. Steel and feel that you can qualify, you can get details from your college placement director. And we will gladly send you a copy of our informative booklet, "Paths of Opportunity," which describes U.S. Steel and the openings in various scientific fields. Just write to United States Steel Corporation, Personnel Division, Room 1622, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

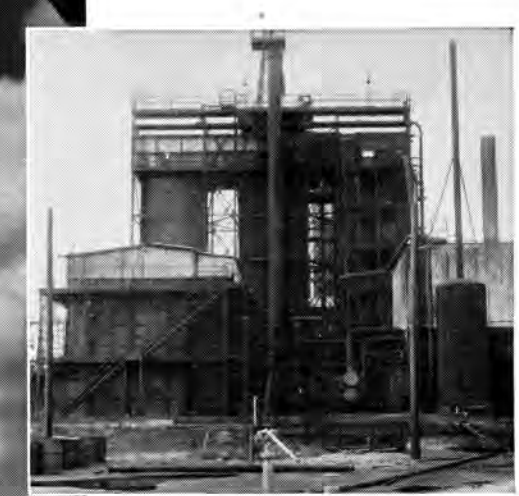
SEE THE UNITED STATES STEEL HOUR. It's a full hour of top flight TV drama, presented every other week by United States Steel. Consult your local newspaper for time and station.

UNITED STATES STEEL

AMERICAN BRIDGE . . AMERICAN STEEL & WIRE and CYCLONE FENCE . . COLUMBIA-GENEVA STEEL . . CONSOLIDATED WESTERN STEEL . . GERRARD STEEL STRAPPING . . NATIONAL TUBE
OIL WELL SUPPLY . . TENNESSEE COAL & IRON . . UNITED STATES STEEL PRODUCTS . . UNITED STATES STEEL SUPPLY . . *Divisions of* UNITED STATES STEEL CORPORATION, PITTSBURGH
UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY 5-47



This towering modern unit at the El Dorado, Ark., refinery of Pan-Am Southern Corporation, a Standard Oil subsidiary, produces 700 tons of coke daily.



Standard's original delayed coking unit at Whiting recently celebrated its 25th birthday "on stream" and going strong.

How to make an exception prove a rule

TECHNOLOGICAL PROGRESS is rapid in the petroleum industry. Few processes have a chance to "grow old" on the job. Most are killed off through the combined efforts of thousands of scientists working constantly to improve everything we do, make or use in our business.

Every now and then, though, we experience a happy exception to this rule. That occurs when a new development not only meets the immediate need but also provides the right answer to situations yet unforeseen.

Twenty-five years ago last August a process known as "delayed coking" was invented. The new process made a quicker, cleaner job of converting heavy residual oil into gasoline, gas oil, and coke. It paid off spectacularly when catalytic cracking was invented and these giant new units began calling for feed. It paid off again when the diesel locomotive came along to put the heavy oil burning steam locomotive out of business.

Dr. Robert E. Wilson, chairman of the board of Standard Oil today, was the inventor of delayed coking. Almost all of the young scientists who worked with him in its development are still with Standard too, in responsible positions requiring their special skills.

Young scientists in research and engineering at Standard Oil today find it satisfying to see their creative efforts translated into valuable product and process improvements.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

A FEW YEARS AGO, HE WAS ON CAMPUS AT PURDUE UNIVERSITY, AND NOW . . .

FLOYD D. (Doug) WALLACE, JR., above, is a senior project engineer at Allison.

He left Purdue in 1947 with his AE degree and came to Allison the same year. Presently, he is in charge of instrumentation and automatic process controls at Allison's new Research & Development test center.

With Allison now in the midst of a $75 million engineering expansion and building program, much of his time is spent in vendor contact work, studying and selecting equipment most adequate to do the job; observing, and helping with installation. He is shown above checking a control valve positioning amplifier on the instrument panel for controlling air pressures and temperatures of four electric motor-driven, axial flow compressors. This new facility is part of the new Research and Development test center, which—when completed—will enable testing of individual combustion components for turbo-prop and turbo-jet engines, compressor and turbine components.

Doug's work is "cut out" for him for some time to come, for only recently, Allison broke ground for the engineering building which is to be the center of expanded Research and Development facilities for advanced types of aircraft engines for commercial and military use.

With this long-range expansion program, Allison needs more engineering personnel, and opportunity for young graduate engineers is unlimited. Arrange now for an early interview with our representative on your campus, or write for information about the possibilities of YOUR engineering career at Allison: Personnel Dept., Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

ALLISON
TURBO-PROP ENGINES
American built for the new era in air travel

CHEMISTRY: Radioactive tracers determine effectiveness of solvent extraction in purification of germanium tetrachloride... later processed into metal.

PHYSICS: X-rays of metals show specific pattern for each material. They are used to identify impurities. Here a sample is positioned for careful analysis.

METALLURGY: Rolling uranium strip for fabrication into fuel elements. Strip will be cut to length and further processed before going to reactive coolant.

Sylvania also has attractive openings with similar opportunities for:

Electrical Engineers	Ceramic Engineers
Mechanical Engineers	Glass Technologists
Chemical Engineers	Industrial Engineers

Why not make an appointment now through your College Placement Office... to discuss your career with the Sylvania representative when he visits your campus.

What do CHEMISTS PHYSICISTS and METALLURGISTS do at SYLVANIA?

Sylvania is one of the important names in electronics, America's dynamic $10 billion-plus industry. Where do physicists, chemists and metallurgists fit in? Let's look at the record:

Working as a team, these Sylvania scientists pool their individual contributions to create new products. For example:

IN CHEMISTRY: Development of phosphors, semi-conductors, kinetics of gaseous reactions, ultra-pure materials;

IN PHYSICS: Physical optics, electroluminescence, mass spectroscopy, electron emission phenomena;

IN METALLURGY: Powder metallurgy and the investigation of pure metals and semi-conductors.

From research such as this have come Sylvania's stacked ceramic tube, the pill-sized germanium transistor, traveling wave tubes, panelescent lighting, atomic reactor fuel elements, advanced weapons systems, and others.

Many Sylvania developments are still unreleased. The public hears of them tomorrow... the Sylvania team developed them yesterday.

Upon graduation, you can take part in these exciting discoveries at Sylvania...working and exchanging ideas with top men in your chosen field... as a valued team member, learning by *doing*.

Assignments are as varied as your choice of 40 geographic locations. And advancement comes naturally at Sylvania... ask the men who work there.

Find out *about* YOUR *opportunity as a Chemist, Metallurgist or Physicist at Sylvania... today.*

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

On the cover—A microphotograph of AISI C1045 plain carbon steel furnishes an unusual pattern for this month's cover and brings up an interesting question. Was this specimen rapidly or slowly cooled? We won't keep you in suspense; it is a Martensitic structure resulting from a rapid (water) quench. Photo was taken in M. E. 310 lab. Magnification approximately 3000X.

Microphotograph through the courtesy of Professors Pringle and Gibson.

MISSOURI SHAMROCK

VOL. XXII FEBRUARY, 1956 NO. 5

CONTENTS

FEATURES:

DEPARTMENTS:

MEMBER
ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Chairman, Merk Hobson, University of Nebraska
Publisher's Representative, Littell-Murray-Barnhill, Inc., 101 Park Avenue, New York 17, New York, and 605 Michigan Avenue, Chicago, Ill.

Published monthly except June, July, August, September, by Board of Publications of Engineers Club, University of Missouri. Office of Publication: Room 233 Engineering Building, University of Missouri, Columbia, Missouri. Entered as second class matter at the post office at Columbia, Missouri under the act of March 3, 1879. Printed by The Missouri Farmer, Columbia, Missouri. Single copies 25 cents; subscriptions, $1.50 per year, $2.50 for 2 yrs.

Let The Man With The Facts tell you about careers with Westinghouse

You have a tough decision to make . . . about that all-important first job. Which company offers you your best future?

Let The Man With The Facts discuss with you the varied and challenging opportunities at Westinghouse.

He is a man with broad personal experience who can tell you the specific things you want to know . . . the many kinds of careers . . . training program . . . further education . . . advancement . . . how you can grow with Westinghouse.

Westinghouse is one of the fastest growing companies in America. It is expanding rapidly into challenging new fields like atomic power, semiconductors, director systems, automation. Let The Man With The Facts tell you about these and many other fields that offer almost unlimited opportunities . . . at Westinghouse.

It's your decision, but before you make it, ask your Placement Officer to make a date with the Westinghouse Man With The Facts. In the meantime, ask for your copy of our 48-page book, *Finding Your Place in Industry.*

G-10291

YOU CAN BE SURE...IF IT'S

Westinghouse

Ask your Placement Officer about career opportunities at Westinghouse, or write for these two booklets: *Continued Education at Westinghouse* (describing our Graduate Study Program) and *Finding Your Place in Industry.*

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

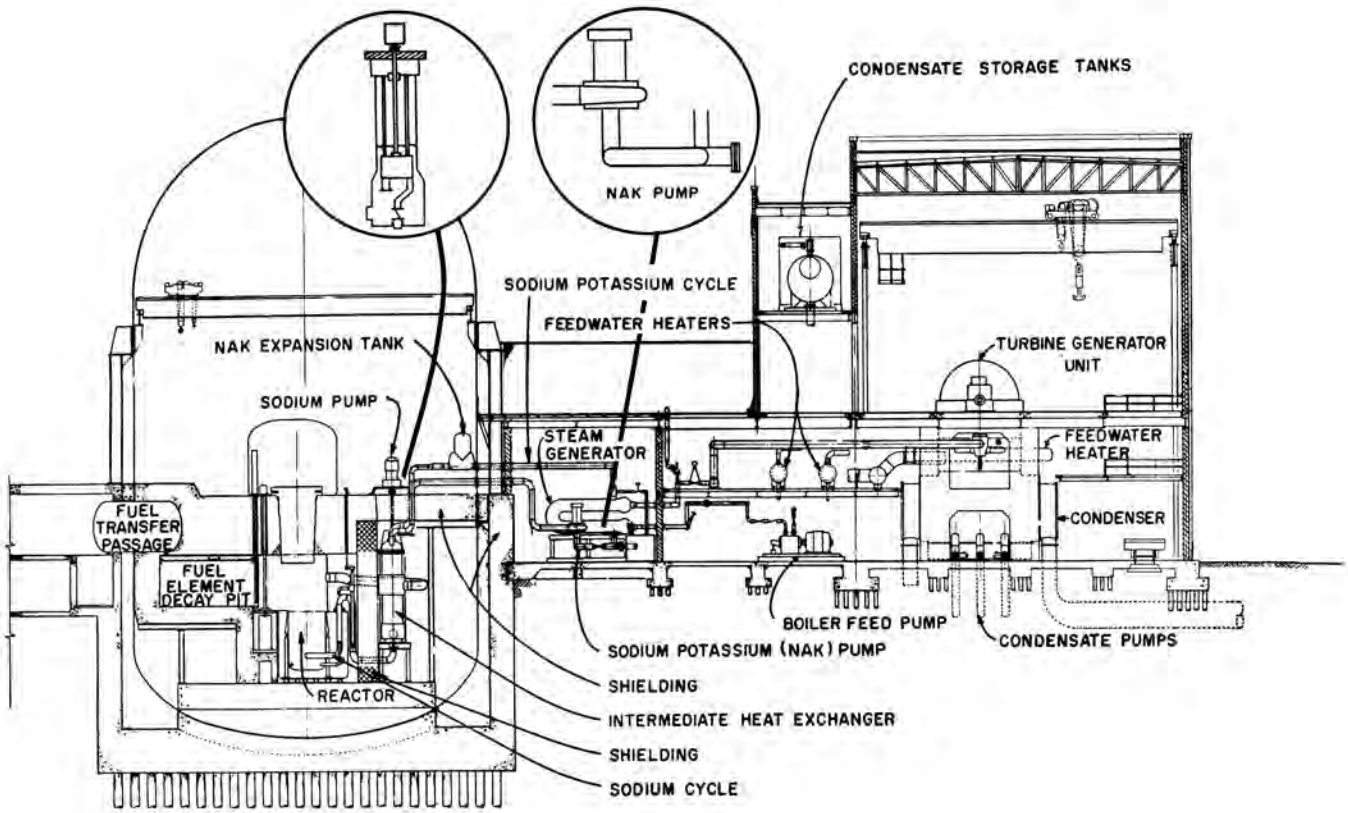


DIAGRAM OF STEAM POWER PLANT UTILIZING NUCLEAR ENERGY IN A FAST NEUTRON BREEDER REACTOR

PUMPS FOR ATOMS?

With the wonders of atomic power will come new and challenging problems for Detroit Edison's mechanical engineers. Today's combustion space in a typical boiler 15 stories high will be replaced by a reactor core scarcely larger than a rain barrel. In these reactors, sodium and sodium potassium alloy will be used as heat exchange agents.

One of the primary problems concerns the design of pumps and piping suitable for handling these liquid metals. You should remember that these pumps must be rugged yet simple, they must require minimum maintenance yet be able to handle large quantities of 950° F. sodium which will become highly radioactive. How and with what materials would you design these pumps?

WANTED . . . MECHANICAL ENGINEERS

As a mechanical engineer with Detroit Edison you will have the opportunity to work on many unusual and diversified problems. If such forward-looking programs appeal to you, Detroit Edison offers a firm foundation on which to build a highly successful career.

The future of Detroit Edison is a bright one. Edison's constant expansion in a thriving industrial area means more opportunities for you. Why not see our representative when he's on campus; visit us when you are in Detroit; or write . . .

Facts about Detroit Edison

Serving Southeastern Michigan, Detroit Edison supplies electricity for eleven counties . . . covering 7,600 square miles . . . 3.8 million people. Compared with other investor-owned power systems, Detroit Edison ranks eighth in plant investment . . . eighth in customers served . . . and seventh in electricity generated.

THE DETROIT EDISON COMPANY

2000 Second Avenue, Detroit 26, Michigan

Thrust gage design is this Boeing engineer's "baby"

From layout to missile firing, this project is a Boeing engineer's responsibility. His assignment: to design an engine mount that will isolate from other loads and measure within ½ of 1% accuracy the tremendous in-flight thrust of a guided missile.

The mount, called a thrust gage, must fit engine and airframe without modification of them, and must "grow" equally in all directions during a temperature rise of several hundred degrees in less than a minute. The object is a stronger missile engine mount with less than half the weight of the present one.

This is typical of the challenging and creative assignments given Boeing engineers. There are more than 6,000 of them—mechanical, civil, electrical, aeronautical and nuclear engineers, and mathematicians and physicists. And more engineers of all kinds are needed.

This engineer is finishing his layout, with the preliminary mockup before him. Next, he will supervise draftsmen and engineering aides in final drawings. Then he will work closely with other engineers in production, structural testing, instrumentation and telemetering. Creating this thrust gage gives him responsibility, career growth, and a real sense of professional achievement.

Boeing engineers have career stability in a soundly growing company that now employs more than twice as many engineers than at the peak of World War II. Living is pleasant for them in the progressive, comfortable-size communities of Seattle and Wichita.

These men take satisfaction in knowing they're on a winning team that has created such aviation milestones as the new 707 jet tanker-transport, the giant B-52, and the Boeing B-47, "backbone" of Strategic Air Command. There's a rewarding job awaiting you now at Boeing in design, research or production.

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

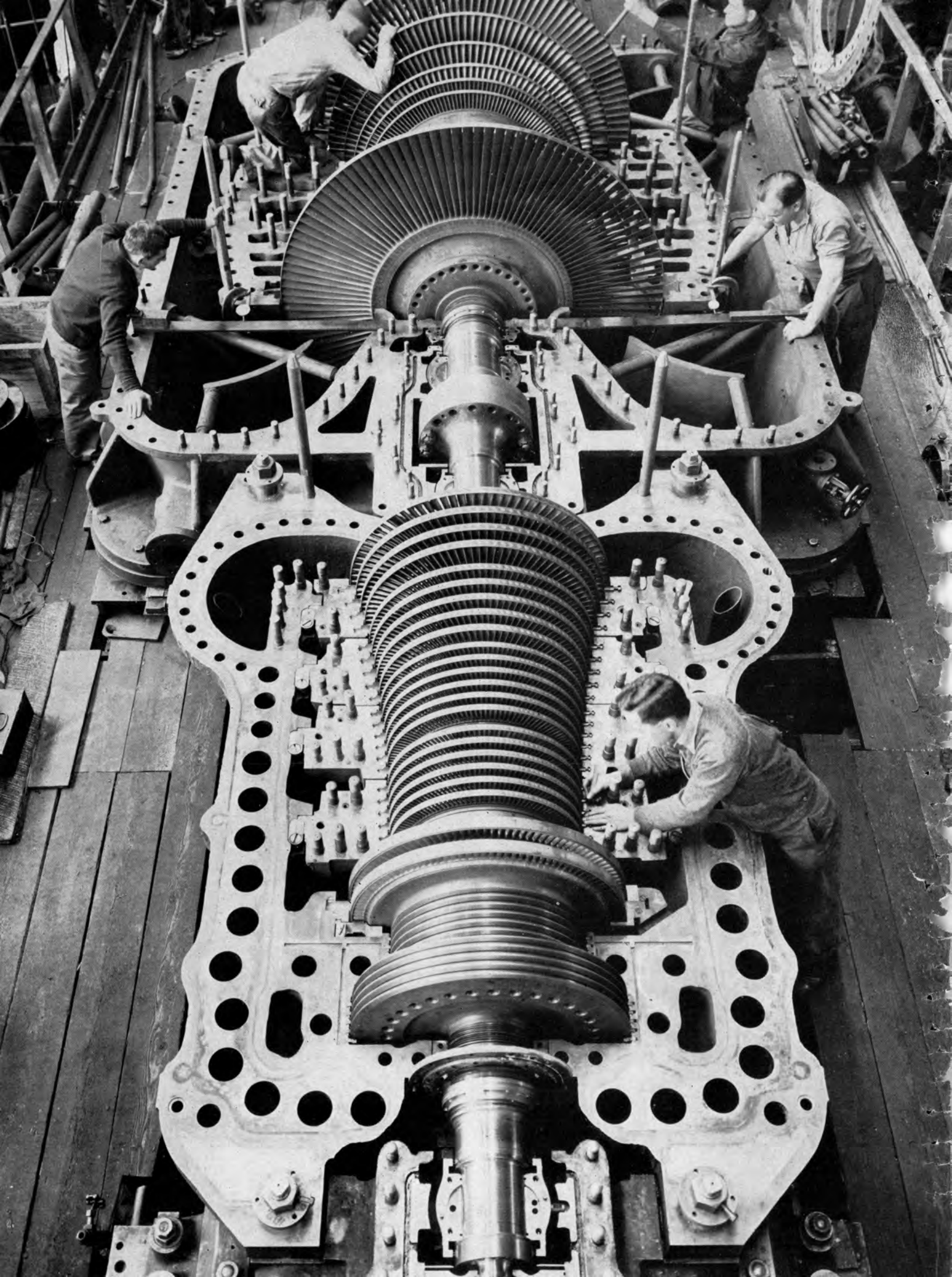
JOHN C. SANDERS, Staff Engineer—Personnel
Boeing Airplane Company, Seattle 14, Wash.

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

BOEING

Aviation leadership since 1916

SEATTLE, WASHINGTON WICHITA, KANSAS



Editorial

One of the outstanding problems of the University of Missouri campus is the parking situation. There are simply too many cars for the available parking space. Inasmuch as everyone else seems to have a "pet" solution we will present ours.

We believe that the problem is one for the University and the city authorities to attack jointly. Both are affected by it. Working together, they could agree upon restricted parking spaces, not only within the campus, but also on the streets surrounding the campus. These street spaces are used primarily by those connected with the University but there are a few Columbians who need them. The spaces could be classified much as the on-campus space is and then allotted to deserving persons.

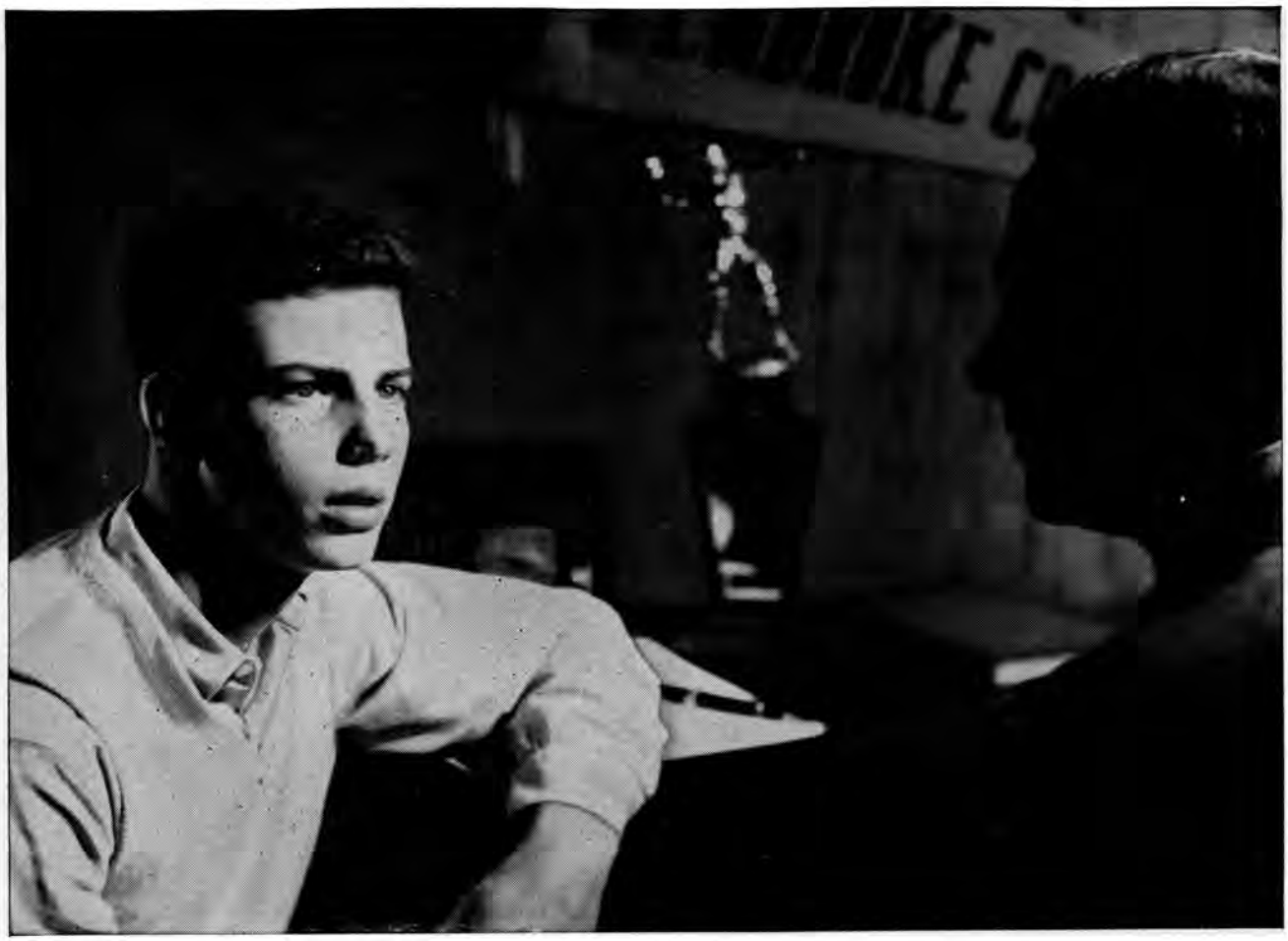
This brings up the $64,000 dollar question . . . who deserves? We believe that there are three groups which should have first priority. They would be Columbia residents with no off-street parking facilities, handicapped students who need a car and students living an appreciable distance from the campus. Notice that we haven't mentioned faculty—we are not certain as to whether they are adequately served by the on-campus facilities. Certainly the upper echelons of the hierarchy of purveyors of knowledge are. Those who are not would be included in this first priority group—indubitably! In a second priority group we would include those students whose extra-curricular activities require use of a car (Exhibit "A"—Ye Ed.). After this and if any space is left, it could be allotted on a "first come, first serve" basis or according to grade point average. The latter would seem to be more idealistic than practical, however.

Of course this is not a complete solution to the parking problem. It would require a great deal of effort to put it or a better solution into effect. We believe that the effort would be worthwhile, not only for the students, but also for the townspeople who must suffer the slings and arrows of outrageous parking!

P. D. G.

A beautiful picture of a single expansion, double flow, tandem compound turbine. Can you tell who built it?

Photo Supplied by Dr. R. L. Scorah



When Your Kid Brother Asks Your Advice About College:

As a college student, you are looked up to by that kid brother (or young friend) still in high school. He'll be coming to you for advice about what college curriculum to take, and how to prepare for college.

As a college engineer, you doubtless will tell him the reasons *you* have chosen an engineering career. You can tell him of the opportunities in engineering or chemistry. He'll be interested to know, for example, that the demand for engineering graduates is tremendous (last year: 40,000 engineers needed; less than 20,000 graduated).

You can tell him that beginning salaries are high (36% higher than in 1949). And, that the future in engineering or chemistry is almost unlimited.

But, most important, that high school student should know how to *prepare* for a college education in engineering. He should know that high school is where the groundwork for college engineering must be laid. From your own experience, you can explain that colleges cannot teach freshman engineering students algebra and geometry or primary physics and chemistry. These courses should be taken in high school, and should be started no later than the junior year.

So next chance you have, sit down with that kid brother. Explain the opportunities in engineering and urge him to see his teachers about including math and science as possible in his high school courses.

In this way, you can help him prepare for what we at Spencer Chemical Company believe is one of America's most exciting, most rewarding careers.

SPENCER CHEMICAL COMPANY, 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) • Cylinder Ammonia.

SPENCER®

America's growing name in chemicals

SAM for YOU

By JERRY HILL M.E., '57

The Society for Advancement of Management, better known as SAM, is an organization which should interest every engineer, business student, personnel management major, or any person associated with scientific management.

One of the first questions the average engineer asks is "Why should I be interested in management." This question has been answered several times at SAM meetings, but one of the most recent was given by T. L. Bloom, Personnel Director of Guide Lamp division of General Motors. Mr. Bloom explained that throughout industry, not specifically General Motors, 75% of the engineering graduates were doing work involving management and hold management positions, while only 25% do strictly engineering work. With this in mind, it can readily be seen that engineers need some association with management.

As we all know, only too well, the engineering curriculum is long and difficult. It is designed to give us some general education, but it consists mostly of technical courses. Since the engineer needs management experience, someone might suggest that we work on a management degree. The answer to this is "who wants to be in school for 6 or 7 years unless they are doing graduate work?"

The next question is how to get some ideas and views on management without taking management courses. We all realize that management courses would be worthwhile if we had the time to take them, but its obvious that we don't. Another factor to consider is whether we want theoretical knowledge alone. Every engineer realizes that theory, practical application, and experience are the basis for success in industry. As for book learning we get plenty of that. SAM is an opportunity for us to get some practical knowledge and experience in the management field from people who have experience and success in industry.

The next thought that arises is, what is SAM and what can it do for me. SAM stands for Society for Advancement of Management. It was established in 1912 and incorporated the Taylor Society, Society of Industrial Engineers, and the Industrial Methods Society. It is a large national organization with both junior and senior chapters. The junior chapters are located at some 100 different colleges and universities, while the senior chapters are in every large city in the United States. You get through your SAM membership, an opportunity to improve your ideas, views and knowledge of management. At SAM meetings we have speakers and films from various companys and departments of the University which help us to get a better view of mangement and industry. We have several inspection trips each year, of which the next one will be a trip to St. Louis for two days on March 23 and 24, where we will visit McDonald Aircraft Corporation, Emerson Electric Company, and one or two other large and interesting companies. Our annual banquet this spring will be April 12, with a very prominent speaker from the University. We are also considering an inspection trip to the A. B. Chance Co. in Mexico Mo., which is well known for its modern and complete manufacturing methods.

One thing we all want to know is the cost of joining SAM. For the worthwhile expense of $5.00 per year or $2.50 per semester, you can become a member and gain much in practical knowledge of management.

Our University chapter with its 40 members is sponsored by the senior Kansas City chapter. Our meetings are held once a month on Thursday night at the Student Union, the next being March 8. If you are in the 75% group of engineers and want some knowledge in the field of scientific management, why don't you plan to attend our next meeting or contact any of the following:

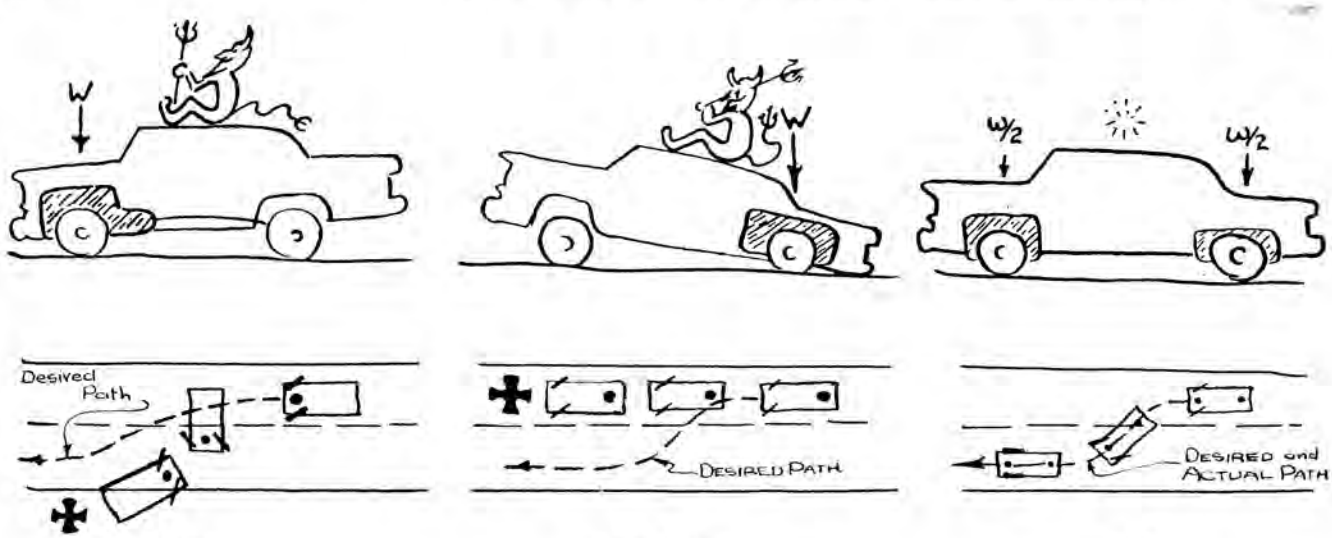
Dr. Robert Eastman, Sponsor, Engineering; Bob McCann, President, Engineering; Ron Powers, Vice President, B and PA; Carolyn McGee, Secretary, B and PA; Jude Pauli, Treasurer, Engineering; Jerry Hill, Membership, Engineering.

SAM members on an inspection trip.

How To Make A Car *Dangerous*

By BOMB McSNAIL

The population of the U.S. has shown a decided upswing in the last ten years and unless something is done about it, we may find ourselves in the plight of India, China, and other overpopulated nations. One of the best methods of population control is the automobile. It is an efficient and widely used population reducer. However, in the last few years a dangerous trend has appeared in the development of the automobile; rudimentary safety devices are making their appearance!



Good **Just As Good** **Bad**

FIGURE 1

Let us examine a typical American automobile, take note of its good qualities and then see where it can be improved and what should be avoided.

First, we will consider weight distribution. Early cars were very poor in this respect. They had the engine mounted *behind* the front axle so that an unreasonable equality existed as to weight on front and rear wheels. The result was that the car cornered in a manner roughly similar to a racing car. This was compensated by making the car top-heavy so that it would easily roll over. Modern cars are not top-heavy so it was necessary to resort to another solution. The engine was mounted directly over the front wheels; in this way the automobile was again returned to its delightfully lethal state. It works like this: If the (*doomed*) driver has to turn his front wheels abruptly to avoid an accident the rear wheels, with little weight on them, immediately start to slip, the rear end of the car whips about, the car goes into the opposing lane or perhaps strikes an earthen bank and overpopulation has received another setback! A design which should absolutely be condemned is one in which the engine has been mounted over the front wheels and the clutch, transmission and differential are mounted over the rear wheels (independently sprung). This would be more likely to give even weight distribution with a controlled slide (see figure 1). Very bad, indeed!

Another strong possibility exists in the design of the interior of the car. All sorts of protruding sharp edged devices may be fashioned to implement the basic laws of impact. Dash knobs are nice for the "one" punch, the windshield is good for the "two" punch, and if both of these fail the heater provides a handy substitute. Two things must be avoided at all costs: First, safety belts, second (and by far the worst) any vehicle in which all but the driver face to the rear with a seat cushion between them and eternity — this could be catastrophic! Fortunately, people would rather die than ride backwards (see figure 2).

An excellent trend in modern vehicles has been the removal of supporting pillars for the top of the car —the top easily collapses and with it, crowded highway conditions. The progess in this direction is truly amazing — as recently as eight years ago, cars had an unbelievable amount of support for the top (see figure 3). Now, we can point with pride at the latest innovation; the "four door hardtop" (or is it "notop?).

(*Continued on page* 26)

Around the Columns

By JERRY HERDAN, M.E. '57

MAN O MAN!!! March promises to be a super-colossal, stupendous, tremendous, fabulous, nothing-short-of-terrific month! WOW! is just about all one can say as a summary to the month's activities and describe them properly. Are you excited? You should be! Because March is the Anniversary Month for the hundredth Anniversary of the School of ENGINEERING here at the UNIVERSITY OF MISSOURI. I'm so excited that I'm in a frenzy as to what to tell you about in the short space that is allotted. I wanna tell you that you're just plain taboo if you're not helping on the exciting and interesting plans which are already being carried out in preparation for St. Pat's Week and the Anniversary Celebration. St. Pat's Week and the Anniversary Celebration are being put on simultaneously and they are both sponsored by the Engineer's Club. In conjunction with the celebration is the MID-WEST CENTENNIAL INDUSTRIAL EXHIBIT, with over one hundred companies participating, which will be here in Columbia at Brewer Field House March 16-17. Can you imagine what a gigantic display of engineering and science this thing will be? The Greek-Week Carnival will seem like a charity bazaar. This EXHIBIT is so big it's going to get national publicity and recognition. Now don't come unless you're prepared to witness one of the largest and most varied shows of engineering in the United States. Friday, March 16 will also be the dedication of the campus stunt and the Beard Judging Contest. March 17 (Saturday Night) will be the St. Pat's Dance and Queen Crowning. Don Roberts Band may furnish the music.

The Queen finalists were chosen Thursday night, Feb. 16. The Queen will be chosen the night of March 6th. The bleachers in Brewer Field House have to be taken down for the EXHIBITS. This will take many men few hours or many hours for few men. What we want is about five hundred burly, hairy chested, guys to cut classes (you'll get a Dean's excuse for this job) and to help de-assemble the bleachers. Get in touch with Dan Capps.

What this Engineering School has needed for a long time is an Anniversary, like the one coming up, to unify all its members. We haven't had spirit, interest, or anything else in extra-curricular activities in the dark past and don't think for a moment we're not known for it. But, this coming St. Pat's week is the most ideal opportunity to make everybody eat their own words by showing the rest of the campus that the Engineers are organized, that they are friendly toward one another, that they are interested in the welfare of their school, and that they can out perform, out-do, and overshadow the other schools around the Quadrangle (and elsewhere). Let's not let ourselves down.

NEW CALENDAR FOR '56

President Elmer Ellis released the official calendar of the University of Missouri, which sets Monday, Sept. 17, 1956, as the opening day of the 1956-57 academic year.

He said that the calendar was recently adopted by the Board of Curators after approval by the Committee of Deans and the University Faculty.

The calendar shows that the new academic year will close with the 115th annual Commencement at 10 a.m. Saturday, June 8, 1957.

The 1957 summer session of eight weeks will open with registration Monday, June 10, and will close with the Summer Commencement on Friday, August 2.

Students of the Columbia divisions will have four and a half days away

(Continued on page 28)

NEWSTUFF

By DANIEL R. CAPPS, B.S., E.E., '56

FIRST REMOTE CONTROL CLOSED-CIRCUIT TV SYSTEM DEVELOPED BY DAGE

For the first time, closed-circuit TV installations can be remote controlled, to provide operator safety in hazardous locations, assure undetected operation in security and surveillance work, and permit quick and accurate viewing of widely spaced objectives.

This was reported today, (Saturday, November 26), by Dage Television Division, Thompson Products, Inc., Michigan City, Ind., manufacturer of closed-circuit television equipment, which announced development of a unique remote control TV system.

Called the "285-A Servo System," it includes a multi-lens TV camera which is entirely directed by a separate monitor-console. Simply by turning an appropriate knob on the console, any function of the TV camera can be achieved.

Lenses on the camera are changed, focusing is set, and the camera is directed up or down, right or left, all by remote control.

A built-in "memory" in the control console also makes it possible to automatically point the camera in up to three different "pre-set" directions simply by pushing a button.

These "pre-set" positions, which may be readily changed to meet varying observational tasks, greatly facilitate repeated viewing of more than one area or operation.

Dage's "285-A Servo System" and its accessories are described in a detailed brochure available free of charge from Dept. MJ, Dage Television Division, Thompson Products, Inc., Michigan City, Ind.

ARCHITECTURAL DESIGN COMPETITION

A design competition with $15,000 in prizes and fees and open to students has been announced by the Morton Arboretum of Lisle, Ill., for a series of six "small two- and three-bedroom suburban and country houses" to be featured in a permanent exhibit of residential landscape planting.

The competition is sponsored by the Arboretum in cooperation with the American Institute of Architects, the Chicago Building Congress and the Chicago Museum of Science and Industry. The architectural adviser is Howard T. Fisher, A.I.A., 322 W. Washington St., Chicago 6, Ill., with whom competitors must register. There is no registration fee. Closing date of the competition is May 7, 1956, with announcement of winners to be made by June 11.

Object of the competition is "to stimulate and demonstrate original thinking on the relationship between the interior and exterior of houses" and is open to architects, architectural draftsmen and students, and "all others interested in small house design."

Awards will include a grand prize of $1000, six first prizes of $500 each, 10 second prizes of $100 each, and 20 honorable mentions of $50 each. Also, six contracts for design services are planned, three each for $1800 and $1200.

(*Continued on page* 30)

Icy water steams and sputters harmlessly in this informal demonstration of the Westinghouse Lamp Division's new line of Weather Duty® mercury and fluorescent-mercury lamps.

An outer bulb of tough and heat-resistant special glass permits the new lamps to be operated out-of-doors and indoors, wherever exposure to corrosive vapors, moisture, thermal change, or slight mechanical hazards requires a heavy-duty lamp.

Developed by Westinghouse to permit wider application of mercury lighting, the new lamps are available as alternates to standard lamps in 400- and 1000-watt ratings.

What Is Tau Beta Pi?

By ROBERT COMBS, E.E., '56

There are many students in the College of Engineering who may ask, and justifiably so, "What is Tau Beta Pi?"

All engineering students are exposed at one time or another to a few physical pieces of evidence of the organization, e.g., the "Bent" in the front lobby display case, the once a semester appearance of the signboard announcing new members and the occasional notices of meetings on the bulletin boards. These things attest to its existence, but what are the objects and purposes which motivate this existence?

This article will very briefly outline some of these factors and attempt to point out some of the significant features of the organization as they pertain to an engineering student at the University of Missouri.

Tau Beta Pi, as a national organization is no stripling. It is over 70 years old and many of the most distinguished engineers of the past seven decades and our own era have regarded the association as worthy of their active participation in an alumni capacity. What considerations merit such high esteem?

History and tradition play no small part. In the latter part of the 1800's, when engineering was just beginning to establish itself in the professional world, there were no organizations on any of the college campuses for the purpose of recognizing outstanding engineering students. Edwin H. Williams, a professor of mining engineering at Lehigh University, was well aware of this void in the student curriculum and decided to do something about it. The idea was no sudden inspiration but was the culmination of long and careful thought, so careful in fact, that the basic principles upon which the parent chapter was founded are the supporting pillars of the ninety nine chapters which now comprise the association.

Our own chapter at the University of Missouri is no youngster either. Missouri Alpha, our official name, became an integral part of the national association in 1902, the tenth chapter in the United States to be so instituted. Tau Beta Pi was beginning to grow and as more and more schools began to take notice of the useful role that the organization played in campus life, the petitions for admittance increased rapidly.

Although history and tradition are important, an organization cannot long endure unless it stands for something, or to use a much overworked analogy, a house is only as good as its foundation. Tau Beta Pi is far from being in a state of static equilibrium as shown by the establishment of three new chapters just this year. Not only does it endure but it continues to grow. What is the explanation?

One answer may be based on the very principles for which the association was founded. " . . . to mark in a fitting manner those who have conferred honor upon their Alma Mater by distinguished scholarship and exemplary character as undergraduates in engineering, or by their attainments as alumni in the field of engineering, and to foster a spirit of liberal culture in the engineering colleges of America." It can be seen that the underlying feature is " . . for those who have conferred honor upon their Alma Mater." A furthur distinction is " . . as undergraduates . . . as alumni . . . " For undergraduates the emphasis is placed on scholarship and character, the one requirement being as equally important as the other. The basis for alumni membership being attainment in the field of engineering. One must not overlook the last object because the fostering of a spirit of liberal culture is extremely important. It has often been said and more often been proved to be true that "a large idea is not the product of a small mind." Such a brief outline cannot begin to do justice to a topic so broad in scope and far reaching in its implications. It will, however, serve as a basis for answering questions which may have arisen over the subject.

Who may belong?

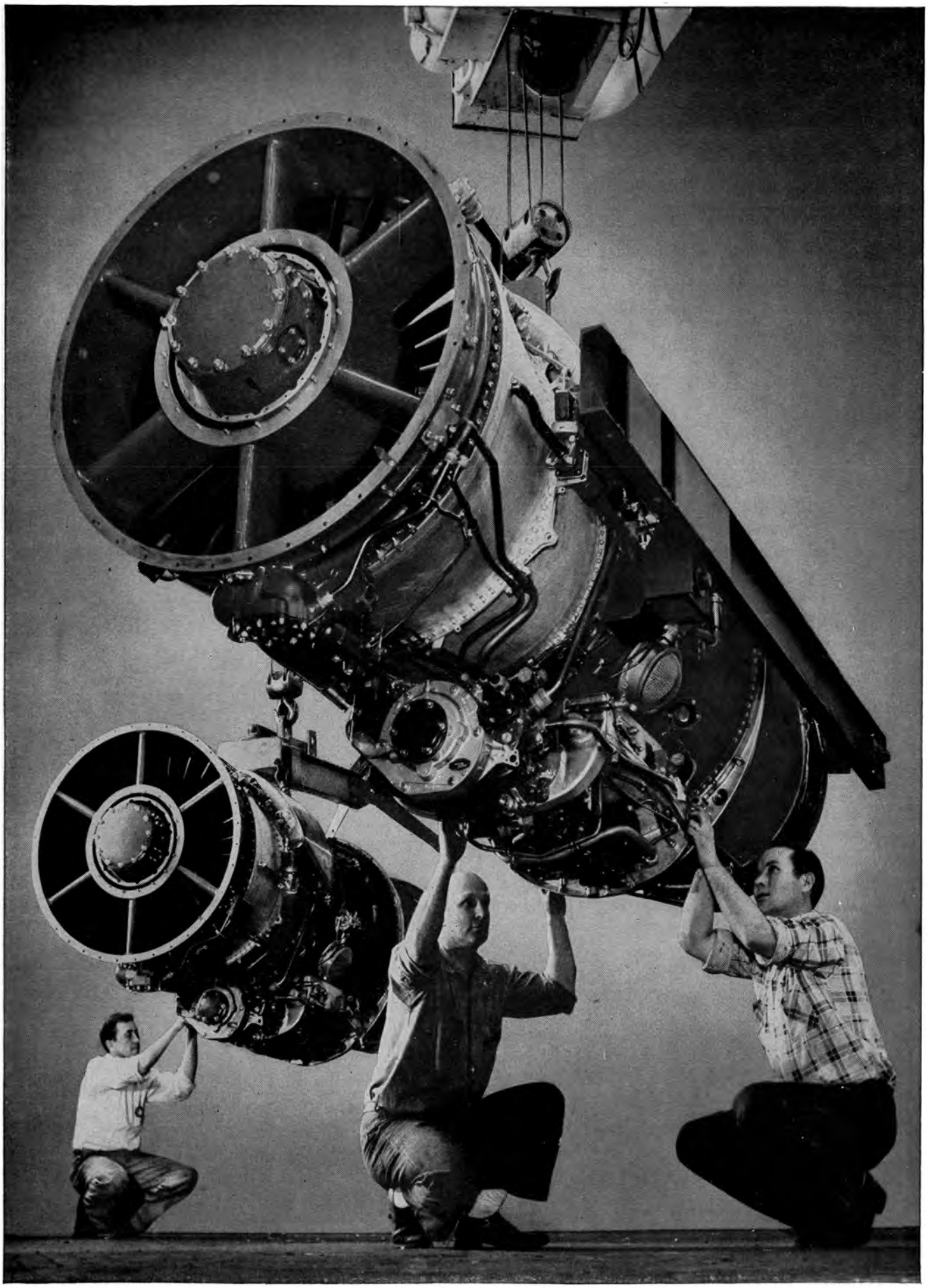
One requirement for undergraduate membership is scholastic standing. For good or bad, the only concrete method for determining this factor is the grade point average. To be more specific, only a certain percentage of the junior and senior classes are eligible for membership. *Ed. note — There is no definite dividing line so far as the grade point average is concerned. In practice at Missouri, an average of 3.00 is usually sufficient to merit consideration as a second semester junior and 2.75 as a first semester senior. These values may vary from year to year.*

Although scholastic standing is a prerequisite, this fact alone does not guarantee admittance. The originators of Tau Beta Pi recognized the folly of using this as the only criterion and established character as a second and equal requirement. Since character is an abstract quantity, the sole judge of its possession can come only through its manifestations. Associations with other students, participation in school activities, social and moral ideas are but a few which might come under this category.

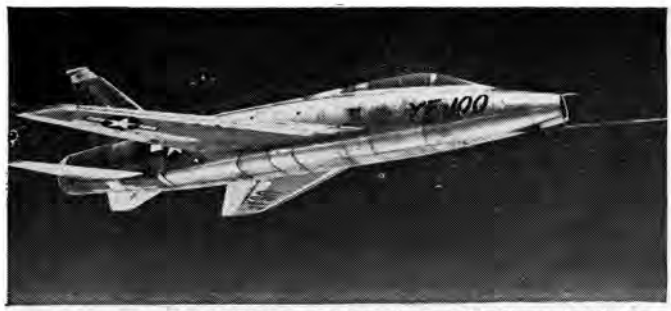
Alumni members are continually being brought into the organization because of their attainments in the field of engineering. Just a short glance at the list of alumni members will show that eminent men in all phases of engineering value the election of membership to Tau Beta Pi because of the organization and what it stands for.

From this brief sketch of Tau Beta Pi, one might get the idea that its ideals are a little high blown and its rules a bit arbitrary. Everyday evidence, however, shows quite the contrary to be true. The ideals of ethics, individual integrity and friendly rivalry are necessary for the existence and growth of any profession. Nevertheless, ideals are worthless unless they

(*Continued on page* 36)



The J-57, in the 10,000-pound thrust class, is the most powerful turbojet engine now in production. A new generation of U.S. air power has been designed around this mighty new Pratt & Whitney Aircraft engine.



North American's F-100 Super Sabre, fastest Air Force jet fighter, is powered by Pratt & Whitney Aircraft's J-57 engine.

First all-jet heavy U. S. Air Force bombers are the huge Boeing B-52s, powered by eight J-57s mounted in pairs.

The Douglas F4D Skyray, fastest Navy jet fighter, will be powered with the big J-57 engine.

The Douglas A3D, the Navy's most powerful carrier-based attack airplane, has two J-57 engines.

Blazing the Way for a New Generation of Air Power

The most powerful turbojet engine in production is blazing the way for a whole new generation of American aircraft.

That engine is Pratt & Whitney Aircraft's J-57, the first turbojet to achieve an official rating in the 10,000-pound thrust class.

But the J-57 provides far more than extreme high thrust. Its unique Pratt & Whitney Aircraft design, achieved after years of intensive research and engineering, offers as well the low specific fuel consumption so vital to jet-powered bombers and future transports, plus the additional important factor of fast acceleration.

The importance of the J-57 in America's air power program is clearly shown by the fact that it is the power plant for three of the new "century series" fighters for the U. S. Air Force—North American's F-100, McDonnell's F-101 and Convair's F-102—as well as Boeing's B-52 heavy bomber. The Navy, too, has chosen the J-57 for its most powerful attack aircraft, the Douglas A3D, the Douglas F4D fighter and for the Chance Vought F8U day fighter. And the J-57 will power the Boeing 707 jet transport.

The J-57 is fully justifying the long years and intensive effort required for its development, providing pace-setting performance for a new generation of American aircraft.

Engineering graduates who can see the challenge in this new generation, might well consider a career with the world's foremost designer and builder of aircraft engines.

PRATT & WHITNEY AIRCRAFT
DIVISION OF UNITED AIRCRAFT CORPORATION
EAST HARTFORD 8, CONNECTICUT

MIZZOU MEMOS

By SHELTON EHRLICH, M.E. '56

S. P. Reynolds, C.E. '83 who was designated one of five outstanding American engineers by Missouri University last year, celebrated his 94th birthday on November 5th at a surprise dinner given by members of the Tennessee-Missouri Bridge Commission. Mr. Reynolds was born near Fulton, Mo., in 1861 and pioneered the field of levee and flood control work.

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.

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, E.E. '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.

Ernest A. Fisher, E.E. '23 is now Distribution Development Engineer for the Union Electric Company of Missouri. His new address is 244 No. Gay, Clayton 24, Mo.

Charles R. Fisher Sr., Che.E. '24 is now Staff Engineer Railway Sales the National Carbon Company, New York. His current address is 22 Whittaker Dr., Fremont, Ohio.

William R McMillan, E.E. '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.

C. E. Schooley, E. E. '28, who was formerly the chief engineer of the Southern Bell Telephone Company, has been appointed assistant chief engineer of the American Telephone and Telegraph Company, 195 Broadway, New York City.

Career Sketch: R. L. Williamson

Robert L. Williamson, manager of pig and ingot sales for Aluminum Company of America, was graduated from Missouri University in 1929 with a degree in civil engineering. He earlier had studied mechanical engineering at Purdue University.

Mr. Williamson attended elementary schools in Kansas City, Mo., and St. Louis, Mo., before moving to Kirkwood, Mo., where he attended high school.

R. L. Williamson

Before his graduation from Missouri, Mr. Williamson worked for the construction engineering dept. of the Missouri Pacific Railroad, for which his father, now retired, was freight claim agent.

He joined Alcoa as a sales apprentice in 1929 and was assigned to the electrical conductor sales department at Pittsburgh. In 1931, Mr. Williamson transferred to the New York office, in 1935 to the Atlanta office and in 1941 to the Washington, D.C. office. He was made assistant district sales manager in Washington in 1943 and was named district sales manager at Kansas City in 1945.

In March, 1951, Mr. Williamson became product manager in charge of die castings sales at Garwood, N. J., and transferred to Pittsburgh in December, 1951.

His appointment as manager of pig and ingot sales came in July, 1955. In this capacity he is responsible for Alcoa sales of these products and also coordinates sales activities with other Alcoa departments. His work includes making studies to determine future estimated requirements of non-integrated companies which use aluminum in pig and ingot form.

Mr. Williamson, whose offices are in Pittsburgh's modern aluminum Alcoa Building, is married and the father of two sons, Robert B. and Otis T. Williamson. The Williamsons reside at 5500 Aylesboro Ave., Pittsburgh 17, Pa.

Robert 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.

James H. Brown, C.E. '48 is now Division Engineer for the Frisco Railroad Co. His address is 700 W. Vickory, Ft. Worth, Texas.

We were recently informed of the deaths of two alumni. Mr. John Thomas Garret, Class of '89, passed away on August 29, 1955 at the age of 90. His brother Robert Peel Karret, Class of '96, passed away on April 5, 1951 at the reported age of eighty years.

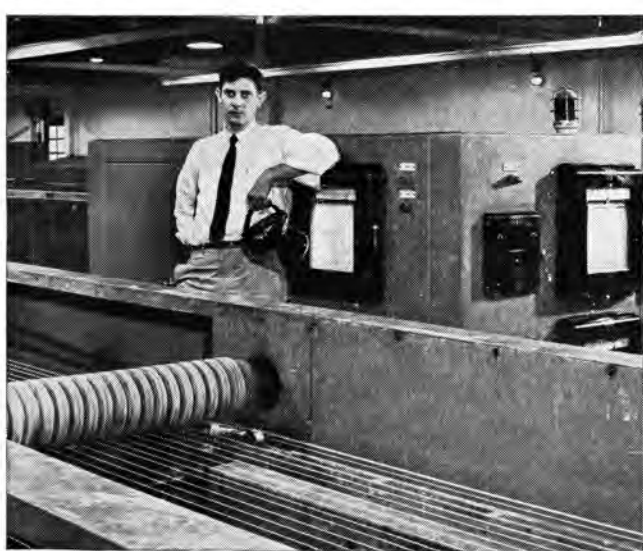
Young engineers making news at Western Electric

Richard C. Shafer, B.S. in mechanical engineering at Lehigh, was one of 16 engineers assigned to one of Western Electric's toughest post-war projects — developing manufacturing techniques for mass-producing *(with great precision!)* the tiny but amazing transistors which are already causing a revolution in electronics.

Western Electric's primary job — which goes 'way back to 1882 — is to make good telephone equipment that helps Bell telephone companies provide good service. It's a very big job — and a very important one — which calls for the pooling of varied types of engineering skills.

New manufacturing processes and methods are constantly required to produce better telephones, better central office equipment, better wires and cables, new types of electronic equipment to keep pace with the nation's ever-growing need for more and better telephone service at low cost.

In addition to doing our job as manufacturing unit of the Bell Telephone System, Western Electric is busy producing many types of electronic equipment for the Armed Forces. Here again, young engineers of varied training are doing important work in connection with the manufacture of radar fire control systems, guided missile systems and special military communications systems.



Paul J. Gebhard, B.S. M.E. at the University of Maryland, was one of a team that helped develop Western's new electroforming process for coating steel telephone wire with copper, lead and brass in one continuous operation. His job: to develop conductor resistance-annealing equipment and electrolyte filtration and circulating systems.

Bobby L. Pettit (at right), an E.E. from Texas A. & M., is one of several hundred members of Western Electric's Field Engineering Force. These F.E.F. men can be found all over the world — working most closely with the Army, Navy and Air Force — advising on the installation, operation and maintenance of complex electronic equipment made by W.E.

BULLARNEY

By DUNK

Conversation heard on Ag Campus.
"I gotta girl"
"Gurl? What's that?"
"You know"
"Show me a pitcher"
"Here"
"Oh, like a boy . . . what'r those"
"Those?"
"Yeah, those"
"Well, they all have em"
"Same number?"
"Yep"
"What'r they for?"
"Girls"
"I like horses"

♣

When the newly-weds got on the train the groom tipped the porter and whispered: "Don't tell anybody we're just married."

The next day the couple was very embarrassed to find everyone staring at them, and finally confronted the porter.

"No suh," came the emphatic reply. "Everytime they asked me if you was just married, I'd tell 'em, no indeed, you is just good friends."

♣

It was the sleepy time of the afternoon. The prof. droned on and on; formulae, constants and figures. An engineer, sitting in the second row, was unable to restrain himself and gave a tremendous yawn. Unfortunately, as he stretched out his arm he caught his neighbor squarely under the chin, knocking him to the floor. Horrified, he bent over the prostrate form just in time to hear a murmur, "Hit me again, Sam, I can still hear him."

♣

One day, while we were eating, our waitress asked what we thought of the new uniforms that the girls had been outfitted with. They were black with white trimming around the neck, the sleeves and the pockets, and across the left breast pocket each waitress had her name embroidered in white. After pirouetting for our benefit, she faced us and asked, "Well, how do you like it?" John, my dinner partner, convulsed the house by staring at her embroidered name and dryly answering, "I like it very much, but tell me, what are you going to name the other one?"

♣

"Have you stopped your grandmother from sliding down the bannister yet?"

"Well, last week we wound barbed wire around it."

"Did that stop her from sliding down?"

"No, but it sure slowed her down."

♣

Blue eyes gaze at mine—vexation.
Soft hands clasped in mine— palpitation.
Fair hair brushing mine—expectation.
Red lips close to mine—temptation.
Footsteps—damnation.

♣

"I shall now illustrate what I have on my mind," said the professor as he erased the board.

♣

He had been walking with one foot on the sidewalk, and the other in the gutter, and he was not doing so well. About a mile down the street he encountered a policeman.

"You're drunk," snapped the latter.

"Oh, is that what it is?" he replied. "Thank goodness, I thought I was lame."

♣

Then there was the Scotsman who bought only one spur; he figured if one side of the horse would go, the other side would go also.

♣

Social Worker: "Sir, would you be interested in contributing something to the old ladies home?"

Spendthrift: "Sure, I'll send my mother-in-law over tomorrow."

Notice in want ads—

Young man transferring from engineering to business administration would like to trade one good study lamp for comfortable bed.

♣

Have you heard about one of the new lecturers?

He's not a fast lecturer.
He's not a slow lecturer.
He's a rather half-fast lecturer.

♣

Then there was the actress who married a director, longed for children, but didn't have any. So she divorced the director and married a producer.

♣

A bedraggled old man walked into a bar with his dog. The man took a stool and the dog jumped up on one next to him.

"Bartender, give me a free drink and I'll show you a talking dog."

The bartender scowled but agreed. He gave the man a free shot. The old man turned to the dog and asked, "What's my wife's name?"

"Roof", said the dog.

"That's right, Ruth is her name," said the old man.

The bartender wasn't impressed and was ready to throw the old man out, but was talked out of it. In fact he was talked into setting up another drink on the proposition that the dog would answer another question.

"Who was the greatest baseball player of all time?" asked the old man of the dog.

"Roof", said the dog.

The bartender threw the old man out on his ear. As he was sprawled in the gutter the dog came up to him and asked, "DiMaggio?"

All over the world technical "Minute Men" of the RCA Service Company assist the U. S. Army, Navy, Air Force.

How RCA "Minute Men" give added strength to our Armed Forces everywhere

In Northern Japan, in Florida, in Guam—all over the world, the technical "Minute Men" of the RCA Government Service Department are assisting our Armed Forces.

These "Minute Men"—experts in electronic installation, maintenance, and training—are backed by the RCA organization that provides a wide range of complete electronic services and systems to the nation. Behind them stand RCA's 37 years of experience in communications; more than 70,000 RCA employees in manufacturing plants stretching from coast to coast; plus the fullest research facilities devoted to electronics that industry has ever known.

In all these ways, the RCA Government Service Department has proved its ability to give added strength to our Armed Forces.

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.

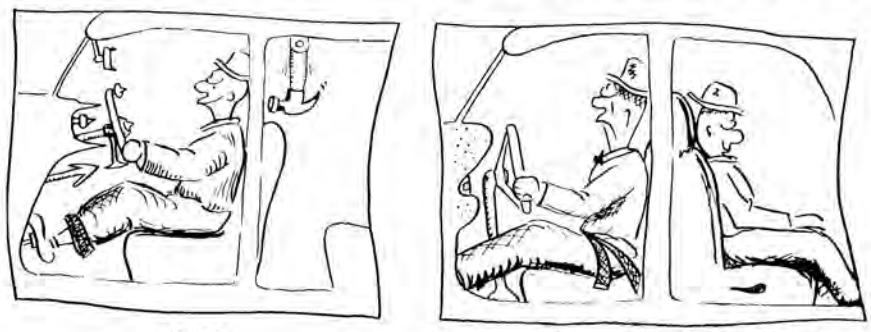
RADIO CORPORATION OF AMERICA

ELECTRONICS FOR LIVING

HOW TO MAKE A CAR DANGEROUS

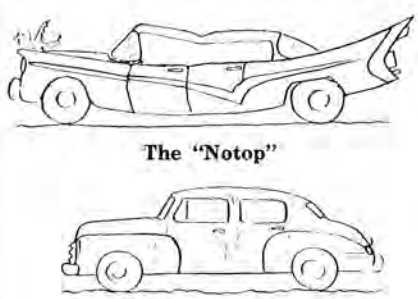
(*Continued from page* 15)

Instrument design has been the subject of much experimentation on the part of automobile designers. In a few instances, some really promising designs have appeared, but on the whole the automotive engineer lags badly in this respect. One very encouraging development was the removal of the ammeter from directly in front of the driver to a position on the right side of the dashboard approximately where the glove compartment is located. This was a clever move. First, it made it necessary for the (*doomed*) driver to look 45 degrees to the right of the direction of travel to see what his generator was doing. Second, it gave (*Hero*) passenger an excellent and legitimate excuse for distracting the (*doomed*) driver. Passenger simply says "Look, the generator isn't charging!", and driver, in a burst of curiosity, allows the car to go charging over a cliff! (see figure 4).



Good Bad The Worst!

FIGURE 2



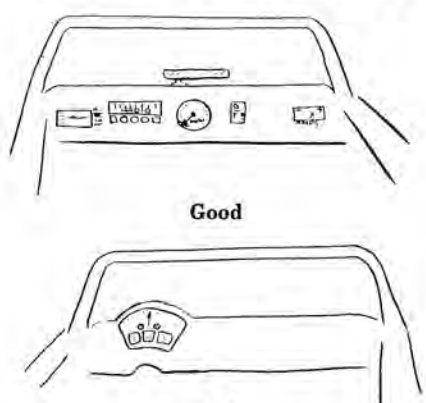
The "Notop"

FIGURE 3

The most discouraging development in instrument design was the one in which all instruments were located *within* the speedometer and the whole was located directly in front of the driver. Fortunately, this design has lost its sales appeal and is no longer widely used.

We are all familiar with the state restrictions placed on the intensity of light emitted from the headlights of automotive vehicles. This has baffled designers for some time, but they have at last found a suitable substitution. Taillights! Modern cars are equipped with taillights which emit a brilliant red flash at the slightest pressure on the brake pedal. This is most effective when used at night and just prior to entering a sharp curve on a highway. Following (doomed) driver does not see curve — happily plunges into deep ravine beside highway!

Safety slogans can contribute to population reduction. Take a common slogan such as "Speed Kills". It really doesn't say anything because "speed" is a relative matter. Yet many drivers may see that one phrase and decide it is the whole answer to highway safety. So what happens? Dad goes out for a Sunday drive on the highway (at 40 mph), decides to let Junior (he would have been four in May) drive the car and Junior does drive it — right into

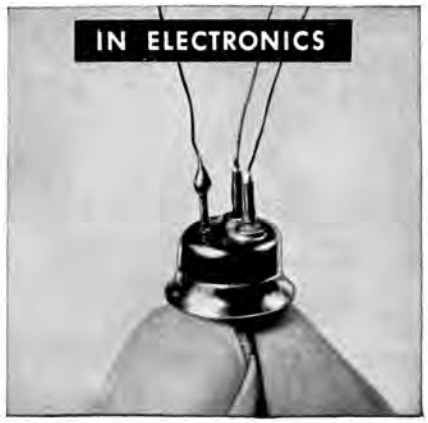


Good

Bad

FIGURE 4

(*Continued on page* 34)



Horizons unlimited for research, test, design, production, industrial and sales engineers

Honeywell offers you a future in a variety of exciting fields

THE opportunities for engineers in the automatic control field are as varied as today's world—and as intriguing.

The development and manufacture of power transistors for electronics . . . providing automatic flight for supersonic jets and missiles . . . developing temperature controls for today's modern homes and skyscrapers . . . instruments for automation and atomic installations.

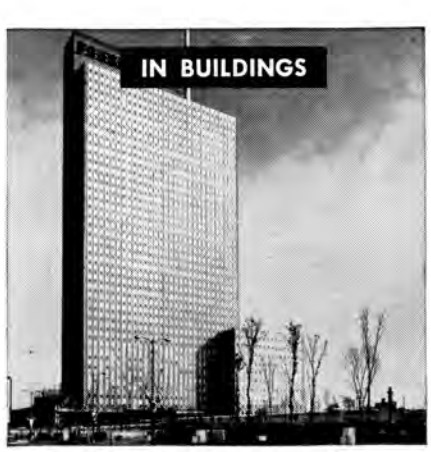
These are a few of the fields in which Honeywell is now engaged, and an indication of the exciting challenges waiting in the future. And it is all based on the creative imagination of highly trained engineers working with the very latest research and test facilities.

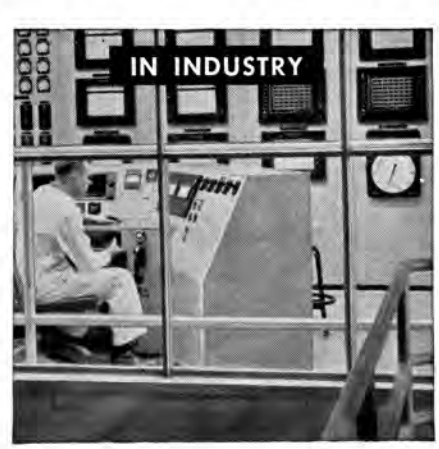
With 15 separate divisions located throughout the United States and with factories in Canada, England, Japan and Europe, Honeywell offers opportunities in many expanding fields.

Begin now to plan your career in this vital and varied industry. Consult your college placement office concerning the next visit of our representative to your campus. Or write today to Honeywell, Minneapolis 8, Minnesota.

MINNEAPOLIS
Honeywell

H HONEYWELL *First in Controls*





AROUND THE COLUMNS

(*Continued from page* 17)

from classes during the Thanksgiving weekend, and will have two weeks of Christmas vacation before closing out the Fall Semester's work with final examinations beginning on January 26.

The second semester will begin at Columbia with registration on February 4 and classes will begin the following day. Students will have a five-day Spring recess during April. Final examinations will begin on May 30, and June 2 has been designated as Baccalaureate Sunday for those Columbia churches that wish to hold special exercises for graduates in their congregations.

Official registration for the Fall Semester at Columbia will be September 18 and 19, and classwork will begin on September 20. The orientation program and convocation for new students will be held for one day only, Monday, September 17, the day preceding registration.

Parents' Day is Saturday, October 6, but classes will be held as usual on this day.

The Thanksgiving holidays begin at 12:30 p.m. Wednesday, November 21, and classes will be resumed the following Monday morning, November 26. Christmas vacation begins at 12:30 p.m. Thursday, December 20, and ends at the same hour on Wednesday, January 2, 1957. The Fall Semester officially closes at 5 p.m. February 2.

After the one-day registration and orientation on February 4, the second semester classwork begins the following day, February 5. The Easter recess begins at 12:30 p.m. Thursday, April 18, and ends with the meeting of 12:40 p.m. classes the following Tuesday, April 23. The semester officially closes at 5 p.m. Thursday, June 6, and Commencement exercises will be held at 10 a.m. on June 8.

Registration and orientation for the Summer Session will be on Monday, June 10, with classwork beginning the following day. Independence Day, July 4, is the only holiday during the session. The eight-week term closes at 5 p.m. Friday, August 2, with Commencement at 8 o'clock that evening.

The Tau Beta Pi Initiation Banquet was held in the Student Union on January 11, 1956. Dr. N. S. Gingrich of the Physics Department was the featured speaker of the evening. In his talk, which was entitled "The Nevada Test Site", he described his experience as an observer of an atomic explosion. Active members were entertained by the pledges, who sang "Tau Beta Pi To You" in close disharmony. The initiates were L. R. Axelrod, W. F. Carlson, J. H. Endebrock, B. D. Engle, E. R. Fink, W. E.

(*Continued on page* 36)

Tau Beta Pi Initiates: Song leader, W. F. Carlson; L. to R., front row, G. W. Kahle, T. H. Laferre, J. W. Palen, R. Rippell, R. T. Simmons, B. D. Weathers, J. T. Wray; L. to R., back row, L. R. Axelrod, J. H. Endebrock, B. D. Engle, E. R. Fink, W. E. Govro, D. Harris, W. B. Jorden.

College graduates getting ahead...
growing with UNION CARBIDE

"I'm a chemical engineer, Class of '52, and a Technical Representative for Carbide and Carbon Chemicals Company. I work through one of Carbide's 23 Sales Offices, calling on all the process industries in my area. My job is to open up markets for new products and find new uses for old products. I try to be a valued technical consultant to my customers."

"I'm a metallurgical engineer, Class of '51. I wanted to get into development work, so I started with Electro Metallurgical Company in their Metals Research Laboratories in Niagara Falls. Three years' research work in steels and titanium gave me the technical background I needed. Now I'm working on applications of titanium as a development engineer."

"I'm a mechanical engineer, Class of '49. I started in the Tonawanda, N. Y., laboratories of Linde Air Products Company. In a few months I was doing research in low-temperature rectification and heat transfer equipment. Now I'm a Section Engineer, responsible for a group of research and development engineers—a member of LINDE's management team."

"I'm a chemical engineer, Class of '50. I started with Bakelite Company, in their training program for production. Now I'm Assistant Department Head at the main plant in Bound Brook, N. J. The group I direct handles resin quality control and technical service. BAKELITE gave me the chance to rise to a significant position in management."

THEY ARE KEY MEN WITH A FUTURE If you are interested in a future in production, development, research, engineering, technical sales, or advertising and public relations, check the opportunities with any Division of Union Carbide. Get in touch with your college placement officer, or write directly to:

UCC DIVISIONS INCLUDE...

- Bakelite Company • Carbide and Carbon Chemicals Company
- Electro Metallurgical Company • Haynes Stellite Company
- Linde Air Products Company • National Carbon Company
- Union Carbide Nuclear Company

UNION CARBIDE
AND CARBON CORPORATION

UCC

Industrial Relations Department, Room 406
30 East 42nd Street, New York 17, N. Y.

NEWSTUFF

(*Continued from page* 18)

The Morton Arboretum is a privately endowed educational and research foundation devoted to the scientific study of arboriculture and horticulture. It covers over 1000 acres near Chicago.

WORLD'S LARGEST LATHE

The biggest lathe in the world — 144-inch swing and 55 feet between centers—has been installed in the General Electric Company's Large Motor and Generator Department at Schenectady, N. Y.

The Betts-Bridgeford lathe was built by the Consolidated Machine Tool Corporation of Rochester, N. Y., a division of the Farrel-Birmingham Company, and cost about half a million dollars.

The new tool is part of the department's expansion and modernization program, designed to equip the department to meet the expected production needs of the next ten years, and beyond.

Looking to the future, G. E. ordered a lathe bigger than needed for any job now under way, foreseeing a demand for ever bigger hydraulic turbine-driven generators, direct-current motors, flywheels and other rotating equipment for utilities and industry.

Feature of the new tool that will be needed soonest is the 144" swing. G-E design engineers were previously limited by the 120" swing of the shop's largest lathe. Center-to-center length of the new tool, 55 feet, is expected to be ample for some time, but provision has been made for increasing the length by adding new sections to the bedways.

The live tailstock quill center is accurate to a total indicated runout of .0005". All-electronic longitudinal and cross feeds permit feed settings at any increment from .002" to .75" per spindle revolution. The machine can carry jobs weighing up to 200 tons at speeds ranging from one-half to 40 RPM. Centers alone will carry 200-ton loads at slow speed while steady-rests are being positioned.

Bedways and carriage ways are of hardened steel, ground and polished. Renewable bronze liners are provided on both mating surfaces of the carriage cross slide and on the top mating surfaces of the auxiliary top slide and the swivel. Tailstock bearings and carriage apron shoe bearings are bronze.

An adjustable panel beside the operator's platform on the carriage contains pushbutton controls for starting and stopping, spindle speed regulation, and adjusting speed and direction of tool travel.

Automatic limit switches at the ends of all travel ways prevent over-travel.

Main drive is a General Electric adjustable-speed direct-current motor, 150/200 HP, drip-proof, blower-ventilated, and rated for continuous use from 60 to 300 RPM at constant torque and 300 to 1200 RPM at constant HP.

A motor generator set provides 540 amps at 230 volts, dc, from three-phase, 60-cycle, acline current at 200

(*Continued on page* 32)

Dave McGinnis asks:

Does Du Pont Have Summer Jobs for College Students?

C. David McGinnis will receive his B.S. degree in mechanical engineering from the University of Texas in June 1957. Currently, he's senior manager of men's intramural sports and a member of the Delta Upsilon and Phi Eta Sigma fraternities at Texas.

Ivar A. Lundgaard obtained two degrees, B.S. in Ch.E. and A.B. in economics, from the University of Rochester, and joined Du Pont's Photo Products plant at Parlin, N. J., in 1942. Later that year he became a shift supervisor and was promoted steadily thereafter. By 1951 he was Production Superintendent at Du Pont's Rochester plant. Today Ivar is Polyester Department Superintendent at Parlin, well able to speak about Du Pont employment policies out of his own experience and observation.

Ivar Lundgaard answers:

Yes, Dave, the Du Pont Company regularly employs students of science and engineering in its *Summer Technical Training Program*. The chief purpose is to provide good technical training under industrial conditions. And we learn about the students while they learn about us.

Students selected for the program after campus interviews include candidates for the B.S., M.S., and Ph.D. degrees. Assignments are related to their academic interests. Last summer 270 students from 93 institutions participated in the program. In this way, ties are often established which can lead to permanent employment after graduation.

In addition, many other students are hired directly by individual Company units to help out during vacation periods of our regular employees. For this "vacation relief work," assignments are likely to be varied; but these students also gain valuable insights into industrial practice, and many acquire experience related to their fields of study.

Altogether, about 750 college students, from both technical and nontechnical fields and at all levels of training, obtained experience with us during the summer of 1955. So you can readily see, Dave, that the Du Pont Company attaches a lot of importance to summer jobs for college students.

NOW AVAILABLE *for free loan to student A.S.M.E. chapters and other college groups, a 16-mm. sound-color movie, "Mechanical Engineering at Du Pont." For further information about obtaining this film, write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington 98, Del.*

DU PONT

REG. U. S. PAT. OFF.

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

WATCH "DU PONT CAVALCADE THEATER" ON TV

NEWSTUFF

(*Continued from page* 30)

amps, 550 volts.

Nine other motors, ranging down to ¼ HP, power the various carriage and tailstock drives, blowers, lubricant pumps, and a chip conveyor.

Chips drop to a shake-type conveyor between the bedways, and then travel past the tailstock to an elevator that empties them into waste bins.

The cast iron faceplate, 10 feet in diameter and weighing (with its shaft) about 20 tons, is so finely balanced and lubricated that a man can turn it by hand.

Icy water steams and sputters harmlessly in this informal demonstration of the Westinghouse Lamp Division's new line of Weather Duty® mercury and fluorescent-mercury lamps.

An outer bulb of tough and heat-resistant special glass permits the new lamps to be operated out-of-doors and indoors, wherever exposure to corrosive vapors, moisture, thermal change, or slight mechanical hazards requires a heavy-duty lamp.

Developed by Westinghouse to permit wider application of mercury lighting, the new lamps are available as alternates to standard lamps in 400- and 1000-watt ratings.

EARTH SATELLITE

General Electric will build the first stage rocket propulsion system for the earth satellite which will be launched in 1957 in connection with the International Geophysical Year. The program, "Project Vanguard", was recently announced by the Department of Defense.

The company's Aircraft Gas Turbine Development Department will be responsible for producing the rocket engine. Design, manufacture and testing of the engine, it is expected, will be carried out in the Cincinnati area and in Schenectady, New York.

The development marks more than 10 years of General Electric experience in the relatively new guided missile and rocket field. The satellite's power plant will be the fifth major engine to be designed and produced by the company.

G.E.'s first major engine, which had a thrust rating of 16,000 pounds, was produced in 1950 for the company-designed Hermes A-1 missile. Prior to 1950 G.E. reconstructed and launched many German V-2 missiles in addition to performing research on new rocket engine designs.

The company's two-stage Bumper program was a significant preliminary step in the development of a satellite. It helped solve the problem of starting rocket engines at high altitudes.

Started in 1946, the Bumpers were composed of a WAC Corporal missile mounted on a V-2. After the V-2 burned out in flight, the second stage fired and ascended under its own power.

The fifth of these two-stage rockets, fired in 1949, exceeded the minimum orbital altitude required for satellite operation, gaining an altitude of 244 miles. The velocity, however,—5150 mph—was only about one third that needed to establish orbital flight. G-E engineers believe that, had the Bumper rocket been multi-staged, the added thrust and velocity of the added stages could have resulted in an artificial satellite.

General Electric entered the rocket business in 1944 on a broad Army Ordnance contract which covered a range of projects, including technical supervision of V-2 firings, the Bumper vehicle, several different Hermes missiles, and supporting research in ramjets, high energy fuels, and combustion stability. The over-all program was named Project Hermes after the figure of Greek mythology who was herald and messenger of the gods.

The V-2 firing program was conducted over a period of five years at the White Sands Proving Grounds, N. M. However, not all of the Company's activity with the V-2 was confined to White Sands. Bumper, Pushover, Blossom, and Sandy were code names for offshoots of the V-2 program. "Operation Pushover" was the deliberate explosion of a V-2 rocket to determine its effect on a shipboard launching. "Operation Blossom" involved rockets in upper air research. In "Operation Sandy," a V-2 was launched from the deck of an aircraft carrier in 1947, proving that large rockets could be launched at sea. By the time the tests were concluded in 1951, G-E engineers has supervised the flight testing of 67 German V-2's modified for rocket research.

In 1950 the second phase of G-E's missile program got under way with the launching at White Sands of the first Company-designed missile. Named Hermes A-1, it was smaller than the V-2 and designed as an anti-aircraft missile. A series of these vehicles were launched during the following year. At the same time, other groups within the Hermes project were working on the Hermes B supersonic ramjet missile and test vehicle, and the Hermes C-1, a three-stage, long-range, hypersonic glider-type missile.

Achievements of the Hermes project included the first launching of a large rocket in this hemisphere; design, construction, and operation of

(*Continued on page* 36)

ALCOA WANTS YOU

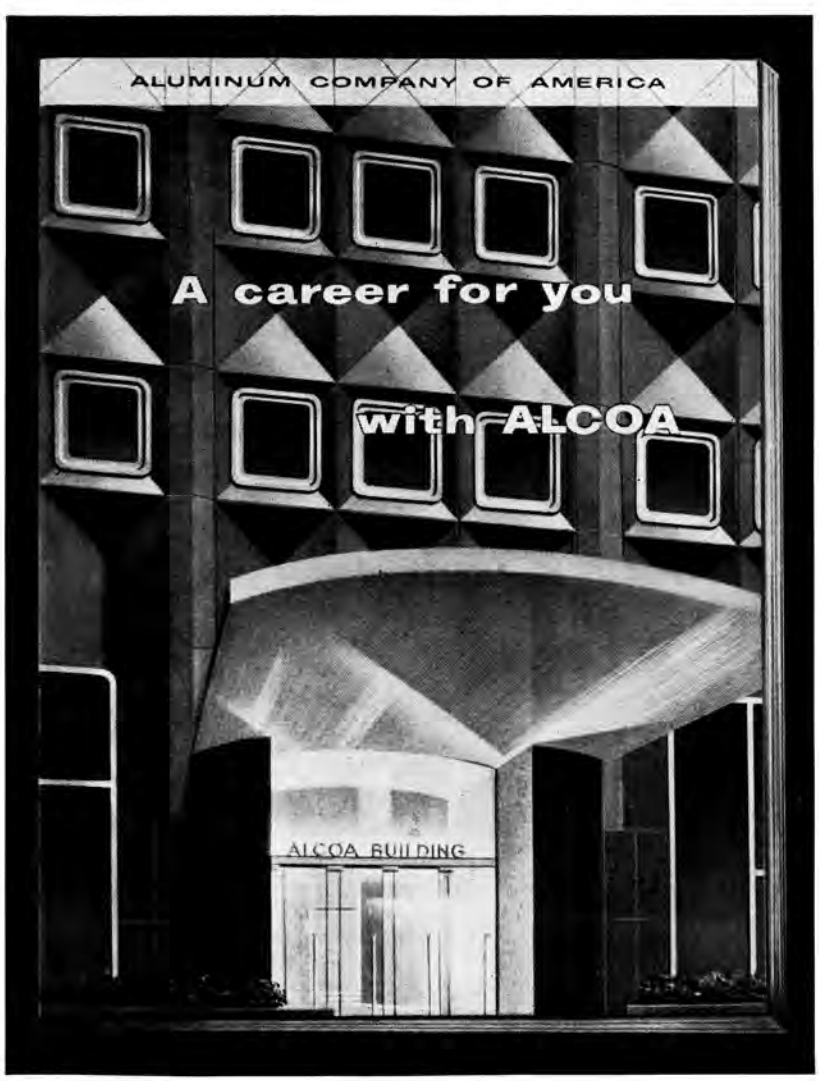
Here's a book that tells about exciting career opportunities in every branch of engineering

The opportunities at Alcoa are so many, so promising, so rich in recognition it took a book to tell the story. And Alcoa wants *you* to have a copy.

If you choose a career with Alcoa, you'll get intensive training from the men who built the aluminum business. You'll have the opportunity of working in our production plants . . . sales offices . . . research laboratories; and positions are open in almost every section of the country. Your work will be challenging and your associates stimulating.

The whole fascinating story of careers with Alcoa is told in this colorful new book. See your Placement Director or send in the coupon below for *your* copy of *A Career for You With Alcoa.*

Your Guide to the Best in Aluminum Value



Tune in the ALCOA HOUR, television's finest hour of live drama, alternate Sunday evenings.

Write for your copy today!

ALUMINUM COMPANY OF AMERICA
1825 Alcoa Building
Pittsburgh 19, Pa.

Please send me a copy of *A Career for You With Alcoa*.

Name_____

Address_____

City and State_____

College_____ Degree_____ Date of Graduation____

HOW TO MAKE A CAR DANGEROUS

(*Continued from page* 26)

a concrete abutment. The only difference between driving a car into a concrete abutment at 40 or 80 mph is that at 80 mph you might make the *front* page of the newspaper.

On the whole, it must be admitted that the safety slogan is at best only passively on our side but consider what would happen if people studied all causes of highway accidents and applied this knowledge to their driving. We'd better settle for the safety slogan! (Incidentally, here's a good one: "Accidents Kill")

The last topic we will consider is that of "horsepower." This has received a great deal of publicity as an aid in population reduction but most of it is unwarranted. It is a proven fact that a one hundred horsepower car can "eliminate" just as effectively as a three hundred horsepower car. The enormous fuss over horsepower does aid our cause, however, for it furthers the "clouding" of the major causes of death on the highway.

Ed. Note — Are we kidding? Yes but . . . have you looked closely at your car lately?

final solution?

Some guys sweat for a week
Give a fortune to peek
At the final that's turning them gray.
Others cram day and night
Just to get one fact right
Comes the final, they forget what to say.
There's a simple way out
And you won't lose the bout
With that teacher that's making it rough.
It's as easy as pie
Cross my heart, hope to die
And you won't have to cram all that stuff.
Have a ball through the week
At your books do not peek
Live it up and make everyone gay.
Some will think you are cracked
Tell 'em you've got it sacked
On your final, you'll know what to say.
This will work like a charm
And can do you no harm
You'll go up like a hot cake of yeast.
But before you all sing
Only one little thing
Better have an "E" average, at least!

Ray Mathews, M.E., '56

NEWSTUFF

(*Continued from page* 32)

the first large static test facilities in the U. S. at Malta, N. Y., the development of an engine with one of the highest specific impulses ever achieved in rocket flight; and the flight testing of the largest solid propellant rocket ever built.

In early 1955, the Rocket and Ramjet Section of the guided missile program became a part of the Aircraft Gas Turbine Development Department at Evendale. This consolidation gives the rocket engine staff access to Evendale's multi-million-dollar development facilities.

WHAT IS T B P

(*Continued from page* 19)

have adherents and boosters all of which finds expression in the dynamic everyday activities of the members of Tau Beta Pi.

Heredity, social position or wealth have no bearing on student eligibility for membership. Only scholarship and character can open the doors of Tau Beta Pi.

AROUND THE COLUMNS

(*Continued from page* 28)

Govro, D. Harris, R. C. Haynes, W. B. Jorden, G. W. Kahle, T. H. Lafferre, D. L. Ohsiek, J. W. Palen, R. Rippell, R. T. Simmons, B. D. Weathers, and J. T. Wray.

ST. PATRICK WAS AN ENGINEER!

Sunday, March 11
- 10.30 A.M., Assemble in front of Engineering Building.
- 11:00 A.M., Burrall Class in Stephens College Auditorium.

Monday, March 12
- 10:00 P.M., Serenade (meet at Engineering Building)
- 11:30 P.M., Midnite Show

Tuesday, March 13
- 8:00 P.M., Engineering Wives Tea for the Queen Finalists.

Wednesday, March 14
- Barbecue at Rollins Springs

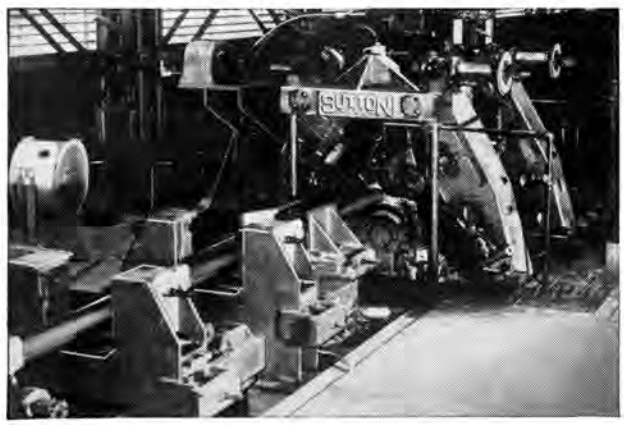
Thursday, March 15
- All Night Column Guard

Friday, March 16
- 9:00 A.M. to 10:00 P.M., Industrial Exhibits at Brewer Field House.
- 9:15 A.M., Dedication of Campus Stunt
- 9:20 A.M., Judging of the Beard Growing Contest

Saturday, March 17
- 9:30 A.M., Centennial Honors Convocation (Jesse Hall) Awarding of Student Honors and Engineering Achievement Medals.
- 10:45 A.M., Arrival of St. Patrick and Knighting Ceremony at the Engineering Building.
- 3:00 P.M. to 5:00 P.M., Centennial Green Tea in the Engineering Library
- 6:45 P.M., Student-Faculty-Alumni Banquet at the Daniel Boone Hotel, Ladies are invited.
- 9:00 P.M., St. Pat's Ball at Rothwell Gym.
- 10:00 P.M., Coronation of Queen of Love and Beauty.

Another page for **YOUR BEARING NOTEBOOK**

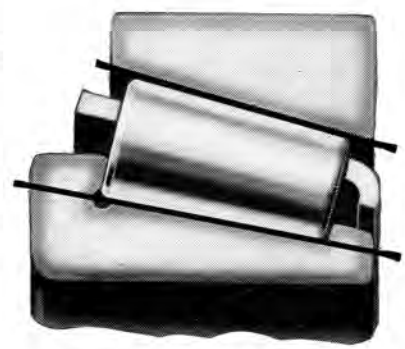
How to make a tube straightener true



The engineers who designed this tube straightener were faced with the problem of building a machine that could withstand the constant stresses of handling 16½″ O.D. tubes of standard thickness and yet provide the necessary precision. Their answer was to mount the two driven rolls and the five idler rolls on Timken® tapered roller bearings. Timken bearings take both radial and thrust loads in any combination and have the extra load-carrying capacity to keep the rolls in rigid alignment.

Why TIMKEN® bearings have high load capacity

This cross-section of a Timken tapered roller bearing shows one reason why Timken bearings stand up under heavy load conditions. There is full line contact between the rollers and races. It's this full line contact that distributes the load over a wider area, giving Timken bearings their extra load-carrying capacity.

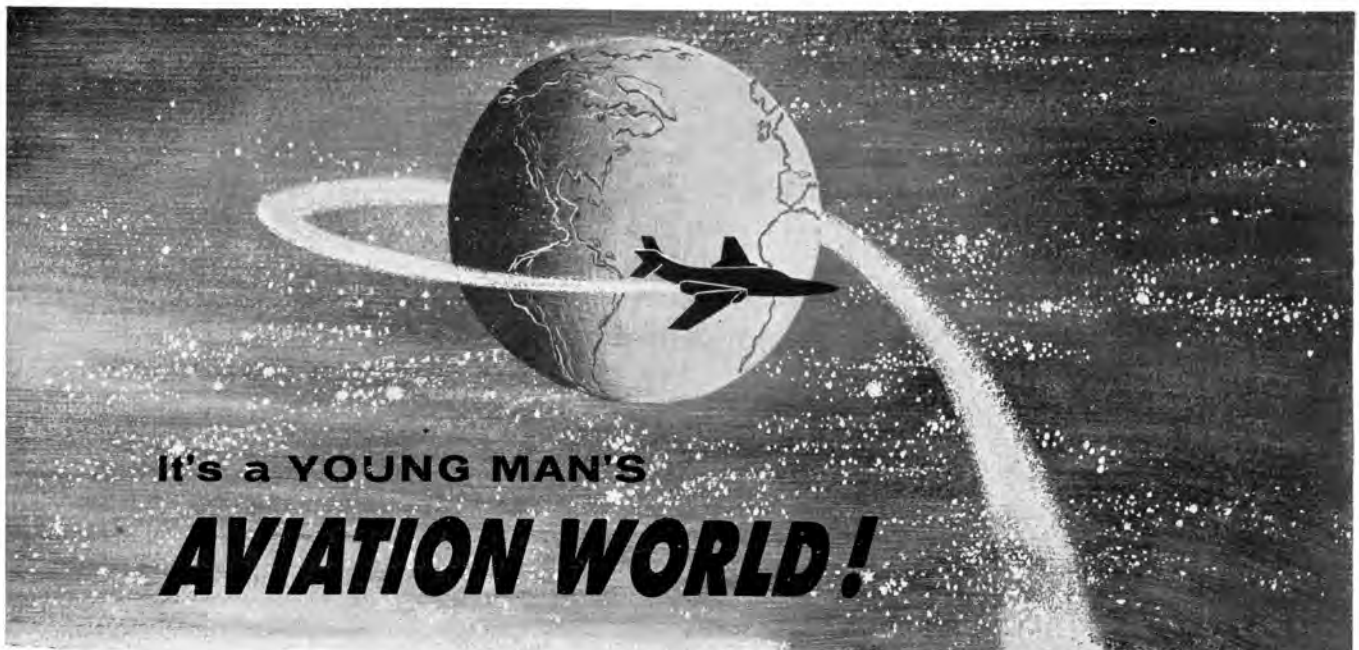


Want to learn more about bearings or job opportunities?

Many of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken Bearings. And for information about the excellent job opportunities at the Timken Company write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, O.

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

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



It's a YOUNG MAN'S AVIATION WORLD!

THE AVIATION WORLD is a rapidly changing, competitive one. Youth is an asset, for a young flexible mind can best visualize today's research data and evolve from it tomorrow's aircraft. This type of vision characterizes the McDONNELL engineering team—a team that places the accent on youth.

Thirty is the average age of the McDONNELL engineer. Young engineers find that working with men of their own age group facilitates the gaining of that *"feeling of belonging."* Also, by working in a small group, the young engineer's abilities are quickly recognized and he is given increased responsibility faster.

Pictured below are examples of our policy of "promoting from within." These young engineers typify MAC's engineering management.

and McDONNELL is a YOUNG MAN'S COMPANY!

R. C. LITTLE
Age—30
Chief Test Pilot
Airplane Division
(B.S.M.E.—Texas A & M '48)

C. D. MARKS
Age—30
Chief Strength Engineer
Missile Division
(B.S.A.E.—Notre Dame '45)

C. H. PERISHO
Age—31
Dynamics Group Engineer
Helicopter Division
(B.S.A.E.—Purdue '47)

See your Placement Office to secure our Engineering Brochure, or write:
TECHNICAL PLACEMENT SUPERVISOR
P. O. Box 516 • St. Louis 3, Missouri

McDONNELL *Aircraft Corporation*

CONSTRUCTION— Tremendous rotary kilns, like these, typify Allis-Chalmers role in the cement industry.

Join the company that serves 3 GROWTH INDUSTRIES

Match your engineering talents to the future needs of the construction, power and manufacturing industries. These are growing needs—for the population is climbing at the amazing rate of 50,000 people every *week!*

Many billions of dollars for highway *construction* alone are called for by the President in the next ten years. Allis-Chalmers builds equipment used in making cement, aggregate and steel as well as earth movers and graders.

Electric *power generation* will double in ten years. A-C builds the machines that make electricity.

Manufacturing output must increase $3.5 billion by this time next year. Allis-Chalmers builds motors, control, drives and many other types of equipment for this industry.

MANUFACTURING—A-C aids high speed production and helps improve quality with dielectric sand core dryers like the one above.

POWER GENERATION—Growing use for power means growing demand for A-C steam turbines, transformers, and other equipment.

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.

ALLIS-CHALMERS

A-4685

SHAMROCK SEZ

Ed's note: There has been some comment going about recently to the effect that Shamrock has forgotten or ignored its birth place, the ivy walls within which it was conceived, in the years since it achieved world renown, moved its offices to New York, and proceeded to surpass the combined circulation of LIFE, the NEW YORK TIMES and the LONDON DAILY MIRROR. In rebuttal we give you the following article by a member of our staff who recently visited the old Alma Mater.

* * *

It is a crisp February morning; a brilliant sun has just begun its diurnal traversal of the iridescent plastic weather dome and is reflected as a myriad of azure and scarlet jewels in irrigation canals as we are turned off at the Columbia interchange of the Kansas City-St. Louis Freeway. It looks as though we have picked a beautiful day for our visit to the campus of the technical college of the University of the ancient state of Missouri. You may be more familiar with this institution's contemporary designation, Public Technical School Number 4,537 of the Uniworld. For our overseas readers we might add that this campus is located in Representation Section 452 of Continent Americus. A cursory perusal of your Uniworld may well reveal that this is a highly developed area of Continent Americus, as evidenced by the fact that it is more than 70% paved. We resume manual control of our machine and circle the quadrangle at the upper level. This institution has lost little of its old world charm in the last century of technological development. On the one hand it preserves a sextet of archaic columns (Doric) and a weird architecture that could only have been conceived in what historians refer to as the age of poor taste or the ginger bread period, on the other hand it exhibits a very pure form of 20th century Gothic, complete with gargoyles to ward off evil spirits. We park our machine in the 20,000 unit facility provided by the College and take the elevator to the ground level. We then proceed, strolling leisurely over a resilient grass-like carpet, across the campus in the general direction of the molding ruins of the original buildings of the "College of Engineering". Enroute we note a profusion of small statues, all of dogs and all possessing only three legs (symbolic of the phallicism of the 1950s no doubt). On arriving at the ruins we pause to read a small placard telling of the unfortunate accident that leveled the ancient edifice. It seems that the blast originated in a gas furnace in the Chemical Engineering Lab, however, the vents leading up to the blast were witnessed only by a small black dog (with four legs) and consequently few details are known. The only one of the original buildings that remains intact is a small one story half submerged structure partitioned into minute monastic cells and preserved for posterity by virtue of the foresight of the Dean incumbent at the time of its conception who probably envisioned an atomic bombardment when he caused it to be built in a hole in the ground. This structure presently houses an exhibition devoted to the crude mechanisms of a century past, among them a rare example of engineering practice according to the theory of models that is placarded "Network Analyzer".

One item in the exhibit that aroused some conjecture on our part was a death mask of an elderly gentleman. Although the cast was evidently made post-mortem, it was complete with a soft-crushed felt hat and skewed bow tie, both of which had subsequently been painted black. We could not but wonder if the skewness of the bow tie was the fashion in the old gentleman's time, or if, perhaps, it was somehow indicative of the manner in which he met his end. The mask seemed poised to speak, frozen by Medusa in the act of imparting some great truth now lost to the world. As we were leaving the exhibit we were hailed by the Chancellor of the College saying that he had been anticipating our visit and "didn't we bring a photographer". And then: "Gentlemen, this campus today is a model of efficient educational procedure. It has been beautifully integrated into our system of specialization by natural selection. (The reader will recall the history of this development beginning with the abolition of all trade barriers between the ancient nations which led to a high level of competition between those nations which in turn led to a degree of industrial specialization which made it impossible for those nations to war upon one another which, finally, eliminated the justification for the existence of those nations and thus begat our Uniworld). As a consequence of the agrarian background of the geographical area, this educational institution specialized in the preparation of young men for careers in the foodstuffs industry during the transitional period.

There was a brief interval between the dissolution of the national government and that of the state government during which the school was entirely dependent on the state legislature for support and faced the alternatives of either complete conversion to a school of agricultural engineering or disestablishment. It chose the former. This institution's remarkable growth has been a function of its own influence on our society. This influence is manifest in our highly efficient agriculture to which only ½ of 1% of our population need be devoted as opposed to some 35% less than 100 years ago. Obviously the 34 and ½% of our population displaced in the interest of progress had to be provided for in our Utopian society and it only followed that they should be given college educations in order to render them harmless. And thusly this school has lifted itself by its bootstraps. Its graduates slip silently into some of the most secure positions in the foodstuffs industry from which they may retire at age 40 and receive an income (equivalent to 1 and ½ times that which they earned in their productive period) for the rest of their lives (not to exceed 150 years). As for the system: the student's education has been reduced to its most fundamental elements. Very little is required of the student, his presence at the college is sufficient. It is assumed that after a concentrated exposure to an intellectual atmosphere he will absorb by osmosis. The student's every comfort is provided for. Each student is fitted with a contour reclining chair from which he need not stir for the duration of his exposure. These chairs are equipped with 3D Spectral TV, a sufficient supply of concentrated foodstuffs to last 6 years, one tap each for liquor, Scotch whisky and synthetic goat's milk and other necessary plumbing; heating and air conditioning units are also available at the housing office (there is a waiting list of course). Some chairs are even equipped with caterpillar treads for motoring beside the beautiful waters of the Hinkson.

The student receives his lectures by means of his 3D Spectral TV. These lectures are revised annually by the Uniworld Educational Board of Regents with the assistance and co-operation of the local faculty. The lectures are interspersed with commercials which are never revised and which are for the purpose of providing the student with a hate object so that he will not become emotionally frustrated in our society of love and peace. The lectures are also interspersed with the traditional anecdotes delivered with such alacrity and wit by the professional after-dinner epigramists of the faculty as to leave the student in a convulsive state after each harlequinade, er, that is to say, dissertation. The anecdotes, of course, are never revised as the students would become rather disturbed if they could not anticipate the punch line and react accordingly . . . At this point the Chancellor pauses to note a passing student who is watching a telecast. On the screen an aged and bewhiskered instructor casually attired in a nylon shirt is lecturing on the design of combine elements, saying " . . . but on the other hand we don't really know anything about that either . . . " And with this profound thought we beg leave of the Chancellor to retire to the Collins' for needed refreshment.

PHOTOGRAPHY AT WORK—
No. 19 in a Kodak series

Camera and film stand ready in the delivery room at San Antonio Hospital, Upland, California.

Teresa Jo McCarter, only minutes old—and still near mother—a photographic record makes identity certain.

New eyes open on a bright wonderful world

—and photography makes identification positive, records vital statistics in life's first few minutes

At San Antonio Community Hospital, Upland, California, a positive means of *prompt* baby identification brings peace of mind to parents and hospital administrators alike.

In the delivery room, camera and film stand ready. And virtually seconds after the baby is born they capture a record which identifies the mother and establishes the baby's name, sex, date of birth, and weight. So even before mother and baby have become accustomed to being separate individuals, their relationship is permanently and positively preserved on film.

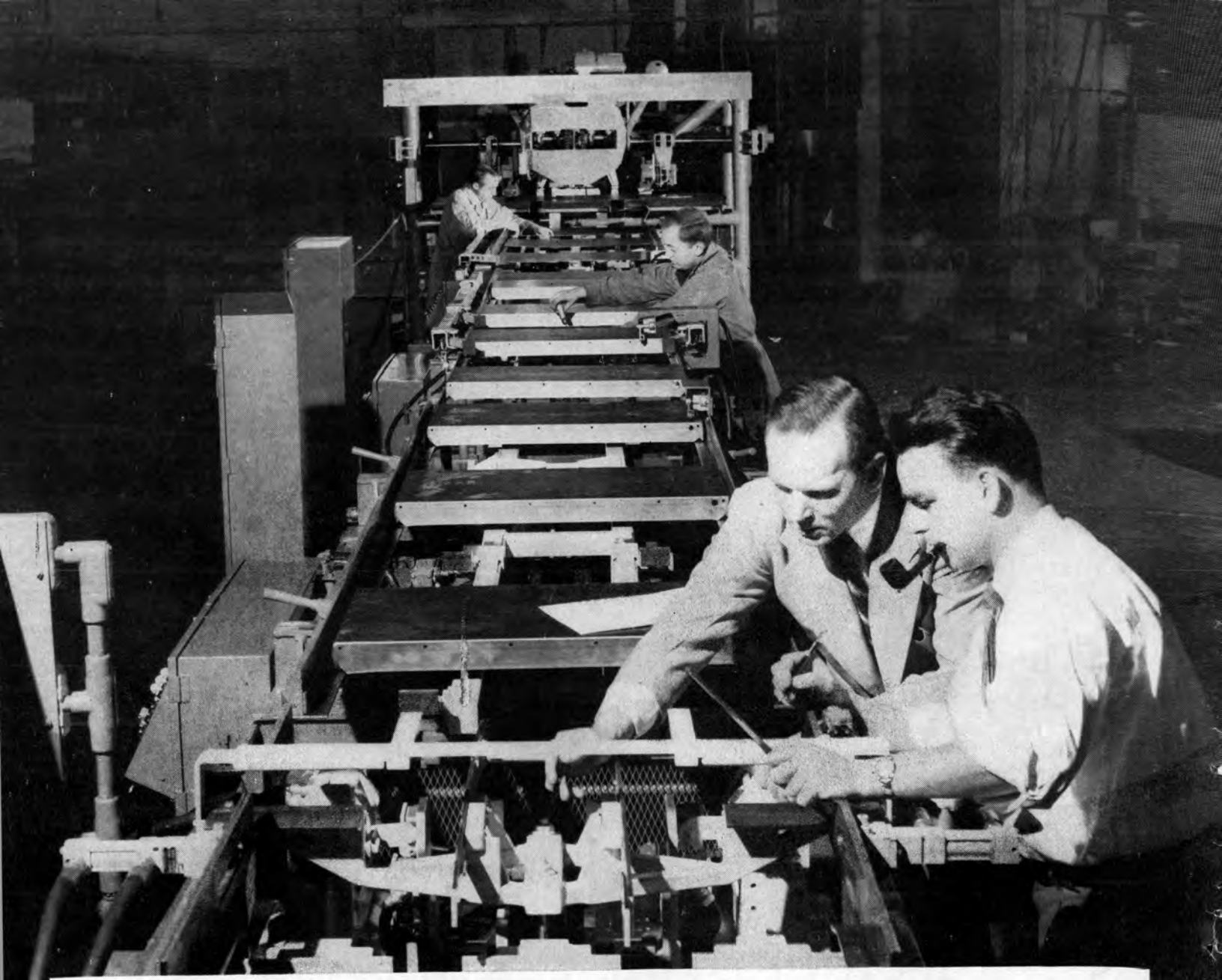
As it is for medical officials, photography is an equal boon to any engineer, scientist or industrialist who must record fleeting instrument readings. It captures action far too fast to see. It analyzes metal structure. It probes for hidden faults. It teaches technics. It makes sales. It is one of the greatest servants business and industry have today. It is helping improve design, speed production, control quality, increase sales and banish office chores.

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

Kodak
TRADEMARK



MISSOURI

SHAMROCK

MARCH, 1956

Centennial of Engineering ♣ ♣ ♣ 25c

James Chisholm, class of '41, speaks from experience when he says,

"Men with ability and ambition really have a chance to get ahead at U.S. Steel"

• A responsible position can come quickly to those graduate engineers at U.S. Steel who show ability and ambition. Management training programs are designed to stimulate and develop these qualities as the trainee "learns by doing." His training is always a fascinating challenge and he works with the best equipment and the finest people in the business.

James Chisholm is typical of the young men who rapidly rise to an important position at U.S. Steel. Jim came to U.S. Steel as a trainee in 1941 after graduating as an M.E. Shortly thereafter he entered military service for four years. Upon his return to U.S. Steel in 1946, he advanced steadily until, in 1951, he was appointed to his present position as Assistant Superintendent of Blast Furnaces at the new Fairless Works at Morrisville, Pa.

Jim is now in charge of quality control for open hearth furnaces at Fairless, the unloading of all ore ships and the operation of the plant's two big blast furnaces—each with a rated output of 1500 tons per day.

Jim feels that the opportunities for graduate engineers are exceptional at U.S. Steel. He remarked that in his own department alone, six college trainees have been put into management positions within the last couple of years. He says that chances for advancement are even better now with the current expansion of facilities and the development of new products and markets.

If *you* are interested in a challenging and rewarding career with United States Steel, and feel that you can qualify, you can get details from your college placement director. And we will gladly send you a copy of our informative booklet, "Paths of Opportunity," which describes U.S. Steel and the openings in various scientific fields. Just write to United States Steel Corporation, Personnel Division, Room 1622, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

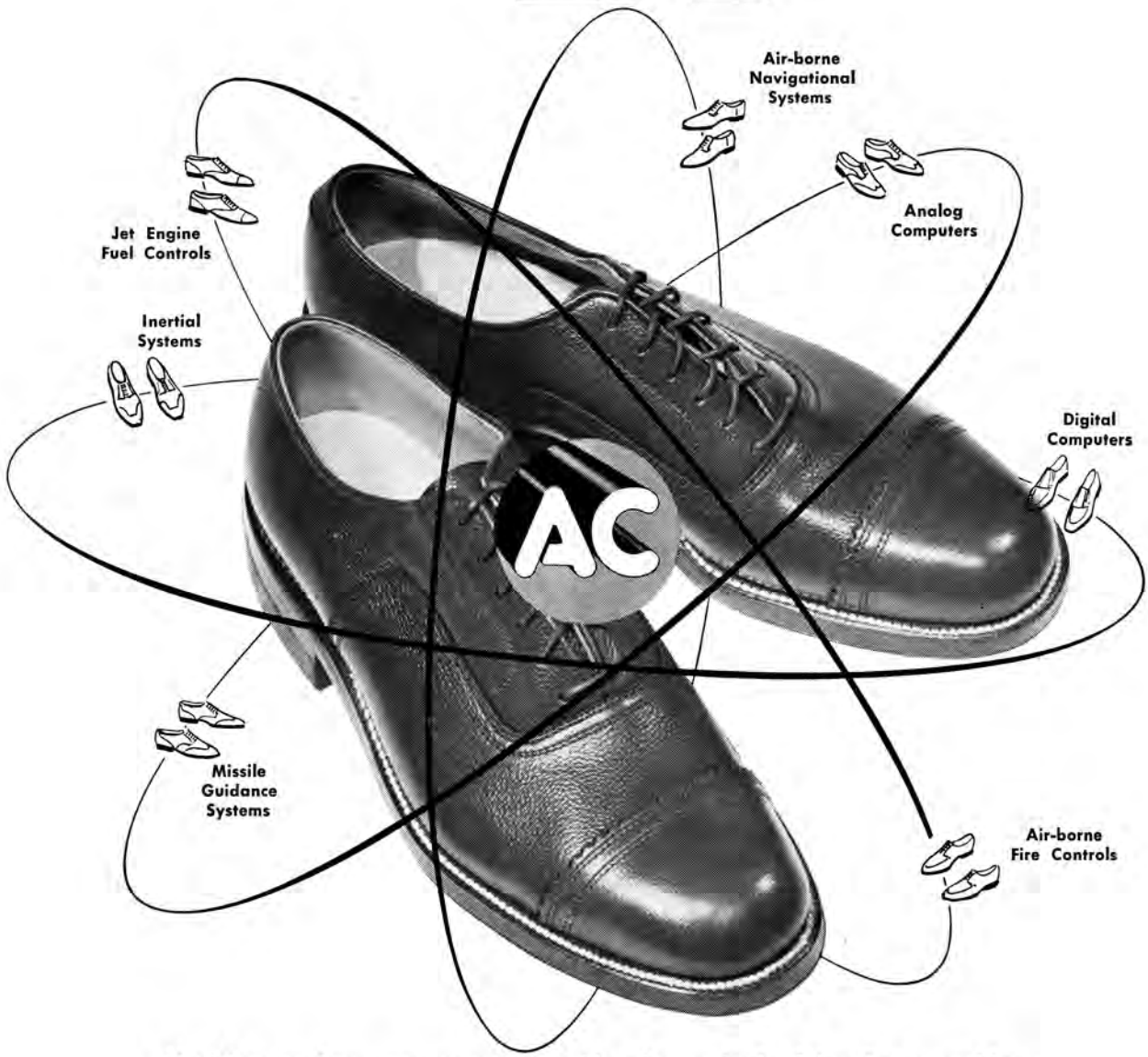
UNITED STATES STEEL

AMERICAN BRIDGE . . AMERICAN STEEL & WIRE and CYCLONE FENCE . . COLUMBIA-GENEVA STEEL . . CONSOLIDATED WESTERN STEEL . . GERRARD STEEL STRAPPING . . NATIONAL TUBE
OIL WELL SUPPLY . . TENNESSEE COAL & IRON . . UNITED STATES STEEL PRODUCTS . . UNITED STATES STEEL SUPPLY . . *Divisions of* UNITED STATES STEEL CORPORATION, PITTSBURGH
UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY 5-690

Fill these shoes and there are

OPPORTUNITIES UNLIMITED

for you at AC



No job experience necessary. We will train you in the following capacities:

Mechanical Engineers. Coordination of complete product designs on precise mechanical or electro-mechanical instruments . . . computers . . . fine-pitch gearing.

Electrical Engineers. Complete systems and circuitry activities in complex electronic equipment . . . amplifiers . . . data transmission . . . servo systems . . . gyro stabilizers.

Mathematicians and Physicists. Analysis of basic problems in bombing, such as ballistics, pursuit curves and systems evaluation.

Field Engineers. Short term in plant training for immediate placement in field activities as engineering representatives for our air-borne electronic equipment.

Please send additional information on AC's Milwaukee and Flint operations.

Name_____

Address_____

_____

College_____ Degree and year_____

ADDRESS: Supervisor of Employment, AC Spark Plug Division of General Motors, Milwaukee, Wisconsin

AC SPARK PLUG
THE ELECTRONICS DIVISION OF GENERAL MOTORS
Milwaukee, Wisconsin **Flint, Michigan**

GM GENERAL MOTORS

Some Examples of Sylvania's Engineering Diversification

LIGHTING: Testing bulb light transmittance photometrically

RADIO: Subminiature tubes designed & developed at Sylvania

ELECTRONICS: Testing the characteristic of a counter tube

TELEVISION: Color screen inspection, microscope & ultra-violet light

ATOMIC ENERGY & RESEARCH: Compacting powders on new presses

What College Seniors Want Most They Get as Sylvania Engineers

Everyone knows that engineers are men with minds of their own. But when it comes to what they want in a job, they're in solid agreement (according to a recent engineering college survey). And what they want bears a marked resemblance to what they find at Sylvania.

1. ENGINEERS WANT: *Significant work where their engineering knowledge can be directly used*

SYLVANIA OFFERS: Sylvania believes you learn by doing—not by looking over someone else's shoulder or being bogged down in routine details. And so, engineering there is what you hoped it would be: You work on a project and see it through; your assignments are varied; and you're given responsibilities sooner than even you anticipate.

2. ENGINEERS WANT: *Company with challenging, diversified products*

SYLVANIA OFFERS: Sylvania's operations span the fastest-growing, most dynamic fields in American industry today. Products ranging from color television tubes to atomic reactor fuels... from powdered metals to advanced missile systems and microwave devices... from semi-conductors to photo-flash and Softlight bulbs, and many others... constantly present you with new problems, new challenges.

3. ENGINEERS WANT: *Desirable location*

SYLVANIA OFFERS: With 43 plants and 16 laboratories located in 40 communities in 11 states, Sylvania offers you a wide choice of locations in modern, progressive communities.

4. ENGINEERS WANT: *Advancement*

SYLVANIA OFFERS: In a company where planned expansion plays a vital role in management philosophy, advancement is a natural way of life. Under Sylvania's decentralized operations, new executives come to the fore quickly.

Down the line: **SALARY, BENEFITS, EDUCATIONAL OPPORTUNITIES**—the answer is the same: Sylvania has what engineers want!

Whether your interests lie in research, development, design, production or administration, you can find what you're looking for at Sylvania.

Why not make an appointment now through your College Placement Office... to discuss your career with the Sylvania representative when he visits your campus.

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.

1740 Broadway—New York 19, N. Y.

LIGHTING · RADIO · ELECTRONICS · TELEVISION · ATOMIC ENERGY

A FEW YEARS AGO, HE WAS ON CAMPUS AT PURDUE UNIVERSITY, AND NOW . . .

FLOYD D. (Doug) WALLACE, JR., above, is a senior project engineer at Allison.

He left Purdue in 1947 with his AE degree and came to Allison the same year. Presently, he is in charge of instrumentation and automatic process controls at Allison's new Research & Development test center.

With Allison now in the midst of a $75 million engineering expansion and building program, much of his time is spent in vendor contact work, studying and selecting equipment most adequate to do the job; observing, and helping with installation. He is shown above checking a control valve positioning amplifier on the instrument panel for controlling air pressures and temperatures of four electric motor-driven, axial flow compressors. This new facility is part of the new Research and Development test center, which—when completed—will enable testing of individual combustion components for turbo-prop and turbo-jet engines, compressor and turbine components.

Doug's work is "cut out" for him for some time to come, for only recently, Allison broke ground for the engineering building which is to be the center of expanded Research and Development facilities for advanced types of aircraft engines for commercial and military use.

With this long-range expansion program, Allison needs more engineering personnel, and opportunity for young graduate engineers is unlimited. Arrange now for an early interview with our representative on your campus, or write for information about the possibilities of YOUR engineering career at Allison: Personnel Dept., Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

ALLISON
TURBO-PROP ENGINES
American built for the new era in air travel

Evelyn W. "Susie" Jones; St. Patrick's Queen of Love and Beauty.

Photo courtesy of Smith Studio.

MISSOURI
SHAMROCK

VOL. XXII MARCH, 1956 NO. 6

CONTENTS

FEATURES:

DEPARTMENTS:

MEMBER
ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Chairman, Merk Hobson, University of Nebraska
Publisher's Representative, Littell-Murray-Barnhill, Inc., 101 Park Avenue, New York 17, New York, and 605 Michigan Avenue, Chicago, Ill.

Published monthly except June, July, August, September, by Board of Publications of Engineers Club, University of Missouri. Office of Publication: Room 233 Engineering Building, University of Missouri, Columbia, Missouri. Entered as second class matter at the post office at Columbia, Missouri under the act of March 3, 1879. Printed by The Missouri Farmer, Columbia, Missouri. Single copies 25 cents; subscriptions, $1.50 per year, $2.50 for 2 yrs.

F4D, "SKYRAY"— only carrier plane to hold official world's speed record

A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier

RB-66 — speedy, versatile jet bomber

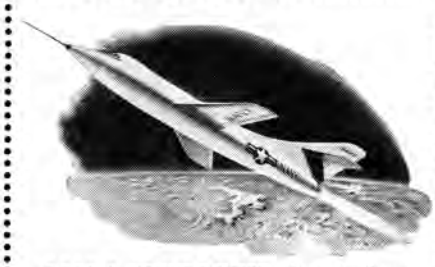
A3D, "SKYWARRIOR"— largest carrier-based bomber

C-124, "GLOBEMASTER"— world's largest production transport

DC-7 "SEVEN SEAS"— America's finest, fastest airliner

Engineers: join this winning team!

"NIKE"— supersonic missile selected to protect our cities



D558-2, "SKYROCKET"— first airplane to fly twice the speed of sound

At DOUGLAS you'll be joining a company in which the three top executive officers are engineers...you'll be associated with men who have designed the key airplanes and missiles on the American scene today! Nothing increases an engineer's ability faster than working with other engineers of top calibre.

Not only is Douglas the largest manufacturer of commercial aircraft in the world, but it also produces outstanding aircraft and missiles for *every* branch of the armed services! This diversity, besides giving you job security, provides unequalled opportunity for the engineer with an eye to the future.

Challenging opportunities now exist in the following fields:

Mechanical design
Structural design
Power plant installation design
Weapons delivery
Aerodynamics
Thermodynamics
Electronic computers
Systems analysis
Aircraft air conditioning
Hydraulics
Stress analysis
Servo mechanisms
Acoustics
Electronics
Mechanical test
Structural test
Flight test
Process engineering
Missiles

DOUGLAS
First in Aviation

Brochures and employment applications are available at your college placement office.

For further information relative to employment opportunities at the Santa Monica, El Segundo and Long Beach, California divisions and the Tulsa, Oklahoma division, write today to:

DOUGLAS AIRCRAFT COMPANY, INC.

C. C. LaVene, Employment Manager...Engineering General Office
3000 Ocean Park Blvd....Santa Monica, California

John E. Young is working toward his B.S. in chemistry from California Institute of Technology this June. He has maintained honor standing in classwork while serving on the school newspaper, in the debating society, and as treasurer of the student body. John is interested in chemical research and development.

John Young asks:

How does research differ from development work at Du Pont?

John B. Aaron worked for Du Pont as a summer laboratory assistant even before he graduated from Princeton with a B.S. in 1940. After military service he obtained an M.S.Ch.E. from M.I.T. and returned to Du Pont in 1947. Over the years he has had many opportunities to observe Du Pont research and development work. Today John is process and methods supervisor at the Philadelphia Plant of Du Pont's Fabrics and Finishes Department.

John Aaron answers:

Well, John, it's hard to define the difference in a way that will satisfy everybody, because one always finds a lot of overlapping between research and development work. But most people agree that there are differences, especially in time sequence. Research work comes first, because one of its main objectives is to establish or discover new scientific facts that will supply the foundation for new industrial developments. In other words, research men seek new knowledge about matter, generally working with small quantities of it.

Development work comes later, and Du Pont has two main types. First, there is *new process* development. Here scientists and engineers modify, streamline, and augment the findings of research so that new chemical products can be profitably made on a large scale—or existing products can be made by newer and more efficient methods. Pilot-plant and semi-works operations are usually included under this heading.

Second, an important kind of development work is directed toward improvement of *existing processes and products*. Here the men study how to obtain yield increases, utilize by-products, increase outputs, and solve sales service problems as they arise. This may require considerable research, and that brings us back to the overlapping I previously mentioned.

There are genuine differences, John, but a good deal of similarity, too—especially in the constant need for imagination and creative effort. I think you'll find that research and development work are equally challenging and rewarding at Du Pont.

WANT TO KNOW MORE *about working with Du Pont? Send for a free copy of "Chemical Engineers at Du Pont," a booklet that tells you about pioneering work being done in chemical engineering—in research, process development, production and sales. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Bldg., Wilmington 98, Delaware.*

DU PONT

REG. U. S. PAT. OFF.

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

Enjoy "Du Pont Cavalcade Theater" on Television

water works even when you're asleep!

This particular need for water isn't acute.

But if... as so many students have... you elect the challenging field of Sanitary Engineering for your future, you'll come up against many more problems of supplying, distributing, maintaining an adequate supply of water for homes and industries in a thirsty world.

Here, you can count on the help of one valuable ally . . . cast iron pipe. Practically every city in America—large or small—uses it for water and gas mains . . . and over 70 of their public utilities have been served by cast iron pipe for a century or more.

On its record, cast iron pipe is Man's most dependable carrier of water.

CAST IRON PIPE RESEARCH ASSOCIATION

Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

®

CAST IRON

CAST IRON PIPE SERVES FOR CENTURIES

From college to business is a big jump. So, before deciding on that all-important first job, you need *specific* information on what various companies have to offer.

Westinghouse is prepared to give it to you. In a personal conference, The Man With The Facts will give you a complete story on career opportunities at Westinghouse.

Before deciding on your first job see the Westinghouse Man With The Facts

He will tell you about its million-dollar Educational Center and comprehensive training program in classroom and plant . . . the many kinds of careers open . . . opportunities for further education and advancement, and how other graduates took advantage of these to reach interesting and responsible positions.

The Westinghouse $300,000,000 expansion program is constantly opening up new fields and opportunities for young men. Let The Man With The Facts tell you about them.

So you can size up Westinghouse, ask your Placement Officer to make a date with The Man With The Facts. Send now, for copies of booklets offered below.

G-10292

YOU CAN BE SURE...IF IT'S

Westinghouse

Ask your Placement Officer about career opportunities at Westinghouse, or write for these two booklets: *Continued Education at Westinghouse* (describing our Graduate Study Program) and *Finding Your Place in Industry*.

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


FRUEHAUF

Editorial

A famous tale of history concerns the "little Corsican", Napoleon Bonaparte. Confronting the Sphinx during his Egyptian campaign, he says to his soldiers "Forty centuries look down upon you."

We might borrow the line but change the stage and use this same phrase in connection with our Centennial observance. At least forty centuries of man's learning and creating, from the Law of Moses to that of Einstein, look down upon us.

Missouri's College of Engineering is but a single thread in the tapestry of knowledge, woven through the centuries. Yet each thread is important. It is conceivable that one of the young men presently struggling to master the intricacies of the slide rule at this college may some day take part in man's greatest adventure, the flight into space. Less dramatic, but equally important, this college will continue to supply competent men for the "everyday" tasks of engineering.

We can look with pride at the achievements of this college in its first one hundred years. By our achievements, we can give the second one hundred years an auspicious beginning.

PDG

LARGEST ON WHEELS — Believed to be the largest portable transformer ever made, this giant was built by General Electric for the Louisville Gas and Electric Co. Forced-oil, forced air-cooled unit has four windings for connection to circuits of 138,000 volts, 37,000 volts, 14,000 volts or any combination thereof. It is designed for emergency service or where maintenance work is needed. The 25,000-KVA transformer is 11 feet, eight inches wide, and 15 feet high, can supply needs of city of 60,000 people.

The Story of the Engineering College of Missouri

By CHARLENE KORANDO
Ch. E., '59

"Let the columns stand — let them stand a thousand years, a memorial to the men who in their magnificent presence, learned what life and duty are, to live the one and do the other. They will be a rallying point of future devotion and service to the University. And the sad columns will in future years prove of deep significance and impressive force upon the columns of new students growing ever longer as time proceeds. . . ."

Hon. G. F. Rothwell

The columns, the most photographed objects in the Middle West, have indeed become a sacred symbol of college life and traditions to the students of Missouri University. The history of the columns and the College of Engineering is a single history; as the significance of one has increased, so has the prestige of the other. Join us as we retrace the story of the columns and the College of Engineering.

Missouri was only 19 years old when the young legislature passed the Beyer Act in 1839 establishing a free institution of higher learning. The site for the first building, which was to become Academic Hall, was selected by the Board of Curators. The cornerstone was laid in 1840, the first classes were held in 1841, and the first commencement was held in 1843 with two graduates.

The early history of the University of Missouri and the early struggles of the College of Engineering are closely linked; for in 1849 when the University was just entering its tenth year, Acting President William Hudson, professor of astronomy and natural philosophy, offered a course in civil engineering which consisted of "Surveying, Leveling and Classical Topography." The University of Missouri was the first institution west of the Mississippi to offer any distinctly engineering training.

Formal engineering education dates from 1956 when the Board of Curators approved a chair of civil engineering and named Dr. Hudson to head the department. This was only three years after the establishment of the nation's first engineering professorship at Rensselaer Polytechnic Institute. Creation of the chair in engineering here antedated the laying of the Atlantic cable by one year, the Civil War by four years, the invention of the dynamo by ten years and of the telephone by twenty years.

The course in civil engineering in 1856 offered "The Structure of Roads and Railroads (illustrated with instruments in the field including a theodolite for measuring angles in horizontal and vertical planes in land surveys, the first piece of laboratory equipment ever purchased by the University for the teaching of engineering). In addition, courses in physiology and anatomy, logic and rhetoric, intellectual philosophy and Christian evidence, moral science and political grammar, Latin, French and German were required of every engineering student. Such requirements would almost frighten the modern engineering student to some other vocation. Yet classical educators of the time said that engineering which dealt with the production of wealth and with the securing of physical comfort and leisure could not be thought of as higher education and culture.

In the fall of 1859 the curators approved a plan to reorganize the University into seven academic departments and three special courses of

(Continued on next page)

ENGINEERING COLLEGE

(*Continued from page* 13)

study called "schools," namely: a School of Scientific Agriculture and Mechanics, a School of Civil Engineering and a Normal School. But the following year the State Legislature, apparently prejudiced against practical education as opposed to classical education, removed the Board of Curators, dismissed practically the entire faculty including President Hudson and elected a new board. The new board promptly reduced the number of departments to five, causing havoc in the entire educational set-up. After this engineering education seemed doomed at Missouri.

Then came the Civil War and utter disruption. Since most of the students left for service, all activities were suspended and the buildings were occupied by Civil War troops. Early in 1862 the curators, faced with a debt for faculty salaries and having no reliable source of income, were forced to discontinue normal operations.

Prospects brightened, however, when Congress passed the Morill Land-Grant Act. Terms of the grant were formally accepted by an act of the Missouri Legislature on March 17, 1863. Under its provisions the Federal Government provided 330,000 acres of land for the endowment of a college of agricultural and mechanical arts. This act eventually put an end to the prejudices against utilitarian courses of study and the opposition of the legislature to non-classical curriculums. President Lathrop and four professors resumed their instruction without pay so that the terms of the Morill Act could be fulfilled.

In 1864 Joseph C. Norwood, M.D., was appointed professor of natural science and natural philosophy and he again offered training in civil engineering. Dr. Norwood was the first to consider "statical and dynamical electricity" as a sufficiently prominent natural phenomena to be included in the course in natural philosophy at Missouri.

The Federal Government offered to detail Army Officers to the University to give instruction in civil and military engineering. To take advantage of this offer, the curators in 1868

established a department of civil and military engineering and provided that the degree of civil engineering be conferred on a student "who completes and passes satisfactorily examinations in algebra, geometry, calculus, mechanics, astronomy, chemistry, mineralogy, geology, descriptive geometry, military engineering, construction of common roads, pikes, gravel roads, railroads, bridges, canals, slack water navigation, and the improvement of rivers and harbors."

This was a milestone in the life of the University and marks the real beginning of the adaptation of scholastic education to the changing needs of society and the University's realization of the great service it could render the people of the state.

Although the terms of the Morill Act had been accepted in 1863, it was not until February 24, 1870 that the legislature approved a formal act providing that a College of Agriculture and Mechanic Arts be organized specifically to promote "a liberal education of the industrial classes in the several pursuits and professions of life." The College of Agriculture and Mechanic Arts was to include a School of Engineering, a School of Analytical Chemistry and a School of Mines and Metallurgy. This step marked the transition of the University from the old-style classical college into a progressive University.

At this time a code of student conduct was formulated to promote the good order and welfare of the University. Each student was required to be present at the morning Chapel services, to observe definite study hours and to conduct himself at all times as a well-bred gentleman. The student was given to understand that the University was for the "good and industrious young men of the State and not for the idle and disorderly, the vile and the vicious." Students were strictly forbidden to enter billiard or drinking places, to carry concealed weapons, to use indecent language or to whistle within the University building.

As yet, the School of Engineering had no faculty of its own. However, Professor Norwood seemed to be tireless in his efforts to secure funds for the purchase of laboratory equipment for experimental work. The records show no evidences of his success but in a report to the president in 1873 he mentioned the acquisition of an induction coil, "the largest ever made," a Holtz static machine, an automatic arc lamp and a complete set of apparatus for illustrating wave motion. How he managed it is still an enigma.

Other stout supporters of the progressive policy of the University were Erastus L. Ripley, dean of the normal school who helped the new department by offering instruction in mechanical drawing and descriptive geometry and Paul Schweitzer, Prof. of Chemistry and the first instructor to give a course in fuels, steam and the steam engines. A newcomer in mathematics, William A. Cauthorn "Uncle Billy" provided students and faculty with many a chuckle. One day he failed to see the appearance of the Polaris during an observation for time with the

meridian transit. After he had rechecked his calculation for the time and the setting of the vernier for the declination and still could not see the star he ran to Joseph Ficklin, professor of astronomy, and excitedly told him that the star failed to appear in accordance with the ephemeris. Professor Ficklin went to the observatory, deliberately removed the lens cover from the transit telescope and held it up in front of Cauthorn. "Uncle Billy," not used to stronger language, said "I'll declare!"

The School of Engineering was officially separated from the College of Agriculture in 1877 to become a division of its own with Thomas J. Lowry, professor of civil and topographical engineering, named its first dean. The School held its own faculty of nine members. In 1879 the School introduced a program under which it brought noted engineers to the campus for special lectures. These included such famous persons as Capt. James E. Eads, designer and builder of the Eads Bridge in St. Louis, and George C. Pratt, noted railroad builder of that day who later became commissioner of railroads for Missouri.

Electrical engineering as an integral part of engineering education was introduced in 1880 by Benjamin E. Thomas, Professor of Physics. In his course in physics he taught the few practical applications of electricity known at the time. This included information on telegraphy, primary batteries and signalling. Bell's telephone and Edison's incandescent lamp were quite new then.

Professor Thomas endeavored to get an appropriation for an Edison dynamo and lamps for experimental work and teaching, but the University had no funds for this equipment. However, Dr. Laws, the President of the University and a personal friend of Edison, influenced him to give one of the dynamos he manufactured to the School of Engineering. The College still owns this dynamo. A manufacturer donated a steam engine to power the dynamo, and on January 10, 1883, Professor Thomas and some of his students staged the first public demonstration of the incandescent lamp in Missouri and probably the first in this part of the country. The full Board of Curators was present for the exhibit.

What sights these columns have seen! St. Pat's "Sarpent" of 1908. It is 150 feet long.

At the request of the curators, Thomas and his students wired the University chapel in Academic Hall for electric lights. Thomas also installed the first telephone line in Columbia, running a line from the Boone County National Bank to the home of its president about a mile away.

Thomas' energetic and imaginative work in the new field stimulated interest and enrollment in physics courses more than doubled in the next year. To meet the growing demand for competent men familiar with the scientific principles of electricity, the telephone, and allied lines, Professor Thomas recommended the establishment of a department of electrical engineering with a degree in that field. This was done by the curators in 1885. The first electrical engineering department in any American college was established just three years prior to this date at Massachusetts Institute of Technology.

In accordance with the provisions of the Morill Act a department of mechanical arts was finally established at the University in 1891, but it was placed within the College of Agriculture. C. W. Marx, a well-known mechanical engineer, was appointed by the Board of Curators as the "superintendent of the newly created School of Mechanical Arts".

On January 9, 1892 tragedy struck. Academic Hall, the first and principal building of the University, was completely destroyed by fire. Ironically, the fire was apparently started by a short circuit in the electric wiring which Professor Thomas had installed in the chapel. By morning nothing was left of the building except the six stately columns which had graced the front entranceway. Fortunately, the new equipment was little damaged but most of the old equipment was destroyed.

The fire proved a blessing in disguise — particularly for the School of Engineering. A sympathetic governor and a generous legislature, goaded by an aroused public, provided funds for new buildings. Of the six which were constructed immediately, one was the present Engineering Building, another was the Mechanical Arts Building, now a part of the engineering group and a third was a new power house.

The session of 1892-93 was a momentous one in the College of Engineering. The department of Mechanical Engineering was established on the same plane as civil and electrical. The school now had three departments, three degrees and three buildings which provided spacious quarters.

Once again, an adversity befell the school. Its dean retired and the School of Engineering again lost its identity, being placed back under the College of Agriculture, to remain there for ten years.

Nevertheless engineering education had been accepted within the realm of

(*Continued on page* 28)

Formula For Success

JERRY STAPLETON, EE '56

What makes a man successful in his chosen field? How can the engineering student eventually achieve a prominent place in his profession? Perhaps the requirements for success could be combined in a mathematical formula. The purpose of this article is to examine this possibility from an engineering standpoint.

No mathematical analysis of human behavior is available, and, so far as is known, success follows no basic natural laws or principles. The only alternative is to enter the laboratory and obtain an empirical formula. In this case, the laboratory is the engineering world, and the tests consist of compiling data which have affected (or effected) the success of today's engineer.

Perhaps the required components could be predicted in the following formula:

$$S = [ET + J]\ I + KO$$

where S = Success
E = Amount of Education
T = Technical Knowledge
J = Experience
I = Interest
K = Chance Constant
O = Opportunity

If a similar formula is attempted, the difficulties in obtaining it can readily be appreciated. But what results do the actual tests show?

The need for sound basic knowledge is stressed by all engineers and is regarded as becoming more and more important as technology becomes more complex. Robert Doherty, former president of Carnegie Institute of Technology, was noted for trying to teach young engineers to recognize the principle upon which solution of a problem depended, in addition to knowing the principles. His Carnegie Plan, as it came to be known, was arrived at after he had met the problem in industry for many years and experienced the same thing in his own career.

The effects of education and experience are very difficult to evaluate. While the most successful men have had advanced education, there are certainly a number of exceptions. In many cases, experience has taken the place of education. One notable example is that of Senator Edward Flanders of Vermont. This man received only eight years of formal schooling, yet he has received honorary degrees from three great engineering schools. He specialized in machine design and often wrote for technical journals. He rose to become president of a tool-making firm before embarking on a political career. Senator Flanders believes that engineering has been a great help in his present work, because the engineer has to face facts exactly as they are and cannot "let things work themselves out."

Many of today's engineers were interested in telegraphy and machines during boyhood and pursued these hobbies. Is this a requirement for success? The example of Ole Singstad, builder of the Holland Tunnel, would seem to minimize this. His childhood was spent on a farm in Norway, far from any engineering influence. Eventually, he became interested in roads and bridges and made his way to America after graduation from a Norwegian technical school. He engineered many New York City projects before becoming famous as chief engineer on the Holland Tunnel project and an authority in this field.

What other ingredients are needed to make the successful engineer? Not to be overlooked is the matter of the engineer's interest and perseverance in his field. Probably no better example could be found than that of Arthur Rosen. After hearing a college lecture on the Diesel engine, he wanted to specialize in that field; but very few Diesel manufacturers were to be found in this country. He did not take another job, but waited until a Diesel position was open, all the while reading and studying the latest literature on his specialty. Soon he became an authority in his field and the inventor of a fuel injection system for the Diesel.

A difficult question is that of the effect of luck on an engineer's career. Consider the case of Harold Wheeler, who believes he has had "good breaks" coupled with a good education. He spent much of his time before college in his workshop, so that following his freshman year in college, he was able to build the so-called "neutrodyne circuit." Although Alan Hazeltine had independently built the neutrodyne circuit at the same time, he turned part of the royalties over to Wheeler to finance the rest of his college education. By the time World War II broke out, Harold Wheeler had become vice president of Hazeltine Corporation. After the war, he founded his own research laboratory.

Many more examples could be submitted, but the preceding point out some of the expected results. Some other important factors appear in the course of these tests, however. These include the fact that the top engineers knew what they wanted and related every effort to that goal, which is a step more than mere interest. It is also found that many possess a degree of aggressiveness and a sense of responsibility toward social, spiritual, and economic obligations. Much emphasis was also placed on the engineers' having a good command of the English language, so that their ideas could be correctly expressed.

What, then, is the result of this study? Because of the many unpredictable human factors, the only possible conclusion is that no accurate formula for success can be obtained. However, since certain factors appear in almost every case without exception, one may emphatically state the folowing conclusions:

1. The successful engineer had a goal in mind, and worked toward that goal.

2. He learned to think clearly and to express his thoughts in an effective manner.

3. He was a responsible citizen who developed qualities of leadership and tolerance.

Evelyn, Queen of Love and Beauty . . . and her attendants

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 Evelyn W. Jones, known to her friends as "Susie". We wish to be on the best of terms with her and shall call her Susie. 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 are in Nelson, Mo.

Susie is a freshman in the College of Arts and Science and has not decided what her major field of study will be. She is pledged to Delta Delta Delta Sorority but presently calls TD-5 her home in Columbia. Our queen is eighteen years old and is not engaged or "going steady". Knowing of the avid interest in figures which is common to all engineers, we obtained the following information concerning her. Susie is 5 feet 4 inches along the vertical axis and weighs 124 pounds. Her other measurements are 34—24—36.

Susie likes the engineer's beards "because you can tell who the engineers are". Our only comment is "Burmashave!"

We wish to congratulate Susie on behalf of the Engineers; she is a fitting queen for our centennial year.

EVELYN, QUEEN OF LOVE AND BEAUTY

JUDY RISSLER

Attendants to our queen must be attractive and talented girls in their own right. Judy Rissler fulfils these requirements very well. She is not only lovely to look at but also to listen to, for she is an accomplished singer. In addition to this she is an artist and does both portraits and landscapes in watercolor and chalk. This 20 year-old lass comes from Sedalia, Mo. and is a junior in the School of Agriculture, majoring in dietetics. She plans to be a dietitian after graduation.

Judy has dark brown eyes and dark brown hair. She is a member of the Chi Omega Sorority and is not "attached". She attended Christian College for her freshman year but says she prefers the University because of its "greater" supply of eligible young men. Of the beards she says, "They are funny". We agree but must add that they are also scratchy!

For the statisticians here are some figures. She is 5 feet 5 inches tall and weighs 117 pounds. Her other measurements are 37—24—36.

MARY JANE IMMERTHAL

Janie, as she is known to her friends, 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 senior in elementary education and is minoring in music and English. After graduation, she hopes to teach.

Janie is twenty-one years old and is a member of Kappa Alpha Theta Sorority. She has lived in Columbia twenty of her twenty-one years, having spent one year in St. Louis. Before entering the University, she attended Stephens College. When asked for her opinion of the engineer's beards, she said "The beards go along with engineer's week, but the men are more attractive without them."?? We cannot help but wonder if Janie has ever had an opportunity to compare pictures of "Honest Abe", with and without beard.

Janie is 5 feet 4 inches tall, weighs 110 pounds and measures 34—23—34.

BETTY RAE PHEIL

A petite and pretty miss, Betty Rae is nineteen years old and is a sophomore. She is majoring in costume design and hopes to do this type of work for the movies and television. Betty likes to read (fall in line, intellectuals) and to ice skate (fall in line, atheletes).

When queried as to what she thought of the beards, she replied, "They seem very romantic." At what distance? Betty is from St. Louis where she graduated from Riverview Gardens High School. She is now a member of the Gamma Phi Beta Sorority. She is 5 feet 4 inches tall, weighs 115 pounds and measures 35—22—36. Her eyes and hair are a matching dark brown.

In summary, we wish to say "WOW" and to thank all of the girls who have honored us by participating in the St. Patrick's activities, 1956.

AILEEN FAUROT

Aileen is a charming young lady with a sparkling personality and a perpetual smile. She has blue eyes and light brown hair and is a "home town girl", having attended Hickman High School in Columbia. Currently enrolled as a sophomore in the College of Education, she is majoring in speech and dramatics. She plans to teach in high school after graduation (where do we enroll?). Aileen is a member of Kappa Kappa Gamma Sorority and is an "outdoor" girl. She likes swimming, dancing, water-skiing and spectator sports. Her favorites are basketball, baseball and football "of course". Her father is Don Faurot, the famous coach of the Missouri Tiger football team. She is 5 feet 6 inches tall, twenty years old and weighs 112 pounds. The "signals" are 35—23—35. When asked if she knew the meaning of "Erin Go Braugh", she provided a classic answer. She guessed that it meant "Let's go drink beer".

NEWSTUFF

By DANIEL R. CAPPS, B.S., E.E., '56

SHIP DRIVE—General Electric craftsman checks bearing seats for main propulsion gears of USS Saratoga, Navy's newest, most powerful carrier. Chromium, molly, nickel alloy gears are half the weight of earlier types. GE built turbines and gears.

The newly-christened USS Saratoga, fitted with a propulsion system built by General Electric, is the world's most powerful warship.

The Saratoga's propulsion equipment, first of its kind, will develop over 200,000 horsepower, surpassing that of her sister ship the USS Forrestal and the luxury passenger liner SS United States. It will push her 60,000 tons through the water at a top speed "in excess of 30 knots" or more than 34 miles per hour.

The turbines for the equipment will operate at the highest combination of steam temperatures and pressures of any vessel built for operating use.

Specifications called for the development of many new designs and production techniques. This was particularly true with regard to the propulsion equipment which required a completely new design for turbines and gear.

The main propulsion equipment, which consists of four cross-compound turbines and four double reduction gears, was built at the G-E's Medium Steam Turbine, Generator and Gear plant in Lynn, Mass.

With the use of the highest combination of steam pressures and temperatures in her propulsion turbines, the SARATOGA is designed to operate with the greatest efficiency ever attained in a large naval vessel. Lighter and less bulky than World War II types, these turbines also will develop more horsepower and will operate at higher efficiencies. In addition, these new type turbines will enable the SARATOGA to steam efficiently at full power as well as at lower cruising speeds.

The alloy steel propulsion gears, which connect the turbines to the SARATOGA's four propeller shafts and allow both the turbines and the giant propellers to operate at most efficient speeds, are also of a new lightweight design. Notwithstanding their size and rating, these gears are 50 per cent lighter over-all than if they had been built according to World War II design. This means the SARATOGA has an increased capacity for thousands of gallons of aviation fuel or increased cruising radius.

These gears were built to totally new standards of precision manufacturing. Special measuring devices were required to check accuracy during manufacture. Load tests for the gears included operation at full power and full speed. In other tests the gears were successfully subjected to an equivalent of several years of normal operation.

MOST POWERFUL—Equipment built by General Electric makes the new USS Saratoga the world's most powerful ship (over 200,000 hp) and the most efficient to operate. Top speed is over 30 knots. Ship is of Forrestal class.

An over-all feature of this newly designed marine power plant is its compactness. Although propelling a vessel almost five city blocks long and more than a block wide, this equipment occupies no more space than a small corner lot. In fact, the SARATOGA's machinery spaces will occupy approximately 500,000 cubic feet of space, less than 8 per cent of the ship's total cubic footage.

Steam for the propulsion turbines, ship's service and auxiliary turbine-generators, plane catapults, and other ship's equipment using steam is supplied by eight giant oil-fired boilers built by Babcock and Wilcox.

Control of the boilers, turbines, and other elements of the SARATOGA's propulsion plant is almost entirely automatic. Operations are directed through push buttons and levers from air conditioned control rooms in the engineering spaces. These controls are similar to those used in a modern electric power plant.

Construction of the SARATOGA was begun at the New York Naval Shipyard in December 1952. Recently christened, she is scheduled to be completed and commissioned early next year. When completed, in addition to the most powerful propulsion equipment, she will contain several other advances in aircraft carrier design aimed at keeping pace with the rapid evolution of naval aviation, including angled flight deck and steam catapults.

Power for servicing jet aircraft aboard the ship will be supplied by two newly-designed high speed, direct connected turbine-generator sets built by G. E.

Each of these sets is rated 600 kilowatts, 400 cycles, 1,000 volts, and operates at a speed of 12,000 r.p.m. The turbine is directly connected to the generator without any intermediate gear reduction.

The sets are of the "package" design with the turbine and generator mounted on a condenser which forms the base for the set. This type of construction makes a more compact, rugged lightweight unit, easier to install and maintain.

Controls for these units are grouped to simplify starting and operation. Metallic type shaft and valve stem packings are used throughout the equipment for longer packing life. The trip throttle valve and back pressure trip are hydraulically actuated, making them highly resistant to shock. Steam is admitted to the turbine through the lower half turbine casing with a newly-designed valve chest having an integral first stage nozzle, thereby decreasing the number of high pressure steam joints.

Another new feature on the sets is the fully-enclosed water-cooled generator with the cooling element mounted below the generator. This simplifies installation piping and saves space.

G. E. is building similar equipment for planned sister ships of the Forrestal class, the USS RANGER, USS INDEPENDENCE and USS CONGRESS.

"HOT" HEAD—Rubber head devised by General Electric scientists and engineers at the AEC's Hanford, Wash., atomic plant is used to test face masks that must protect workers from radioactive contamination. Human breathing is simulated by multiple pumps fitted to the device. A filter inside the head's "windpipe" collects radioactive particles that find their way through the mask. Thus, a gage of a mask's efficiency is obtained.

IMPACT GUILLOTINE FOR TESTING SHOCK RESISTANCE

To a metallurgist, the Charpy Notch Impact test is as familiar as the chemical symbols Fe, C, and O. Although long used as a method for determining the transition point between ductile and brittle zones of metals, the method has some major disadvantages. For example, sample preparation takes considerable time and a V-shaped notch must be accurately machined 79 mils deep into one side of the small sample. A pendulum-type apparatus breaks the sample by swinging a weight against it. Final data is in the form of a graph with impact energy for rupture plotted against the temperature of the sample. Even after elaborate preparations and careful technique, the exact temperature of the transition is not clearly defined.

A new method now being used by materials engineers at the Westinghouse Electric Corporation uses an impact guillotine and a much larger sample, 14 inches long by 3½ inches wide, by 1 inch thick. Instead of the notch, a weld bead is put on the bottom side of the sample and an artificial crack put into this weld by means of an abrasive cutting wheel. A standard weight is dropped on samples at various temperatures and the transition temperature readily bracketed within a narrow range. For example, if trials at minus 20 degrees F

(*Continued on page* 38)

it takes many engineering skills to create the top aircraft engines

McDonnell "Voodoo", *the most powerful jet fighter ever built in America.*

An aircraft powerplant is such a complex machine that its design and development require the greatest variety of engineering skills. Pratt & Whitney Aircraft's engineering team has consistently produced the world's best aircraft engines.

The best planes are always designed around the best engines. Eight of the most important new military planes are powered by Pratt & Whitney Aircraft J-57 turbojets. The first two jet transports in the United States will use J-57s. Further, no less than 76 percent of the world's commercial air transports are powered by other Pratt & Whitney Aircraft powerplants.

Such an enviable record can only be built on a policy which encourages, recognizes and rewards individual engineering achievement.

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

EAST HARTFORD 8, CONNECTICUT

World's foremost designer and builder of aircraft engines

J-57 POWERED AIRCRAFT

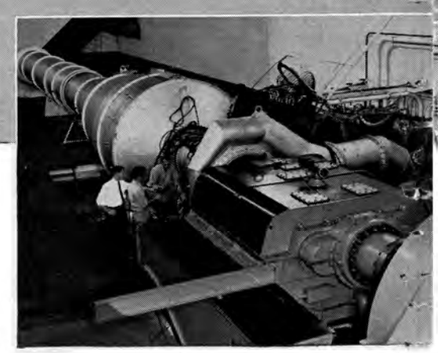
MILITARY

F-100	F8U
F-101	A3D
F-102	B-52
F4D	KC-135

COMMERCIAL

Boeing 707

Douglas DC-8



MECHANICAL ENGINEERS are concerned with many phases including experimental testing and development, mechanical design, stress and vibration analysis, combustion research, heat transfer and nuclear reactor development.

AERONAUTICAL ENGINEERS work on innumerable internal and external airflow problems concerned with design, development and testing of aircraft powerplants. Some who specialize in analytical engineering forecast engine-airplane combinations a decade in advance of design.

ELECTRICAL ENGINEERS directly contribute their specialized skills to the analysis and development of controls, systems and special instrumentation. An example is the "Plottomat" which automatically integrates and plots pressures, temperatures and air angles in performance testing.

CHEMICAL ENGINEERS, too, play an important role. They investigate the chemical aspects of heat-producing and heat-transferring materials. This includes the determination of phase and equilibrium diagrams and extensive analytical studies.

METALLURGISTS investigate and develop high temperature materials to provide greater strength at elevated temperatures and higher strength-weight ratios. Development of superior materials with greater corrosion resistance is of major importance, especially in nuclear reactors.

WORLD'S MOST POWERFUL production aircraft engine. This J-57 turbojet is in the 10,000-pound thrust class with considerably more power with afterburner.

MIZZOU MEMOS

By SHELTON EHRLICH, M.E. '56

Career Sketch: *Wayne H. Lowry*

Wayne H. Lowry was graduated in 1933 with a B.S. in Engineering. He was born on a farm near Lucerne, Missouri, and attended high school at Newtown, Missouri. Following graduation from the University of Missouri, he was employed as camp engineer in emergency conservation work at Albany, Missouri. In 1933, with the development of Sangamon River Project near LeRoy, Illinois, he was appointed assistant erosion specialist with the Soil Erosion Service. When this project was changed to Soil Conservation Service in 1935, he was made assistant agricultural engineer and continued with this work until 1943.

Wayne H. Lowry

In 1943 Mr. Lowry began his employment with the International Harvester Company as a technical writer of ordnance manuals in the Consumer Relations Department. In 1947 he was transferred to Farm Practice Research Section of the Consumer Relations Department where he now is presently employed as a Farm Practice Research Consultant. He is directly responsible for investigation and study of agricultural developments to supply advice and counsel relative to farming practices and to assist in the preparation of recommendations affecting engineering developments of agricultural machines and their attachments. He maintains close contact with state, federal and private agricultural research groups and keeps informed of their activities for the purpose of obtaining the latest information on agricultural developments and practices.

Mr. Lowry has continued to make special studies of soil management and fertilization. In the past year he has made use of radioisotopes to improve fertilizer placement. For example, radioactive phosphorus is being used as a field laboratory tool in testing fertilizer distributing mechanisms on corn planters and other fertilizing equipment. He is planning to develop more techniques in the use of other radioisotopes as a tool to measure efficiencies of tillage tools and other agricultural machines.

Career Sketch: *F. H. Wiley*

F. H. Wiley, General Supervisor of Materials Handling Research started with International Harvester Company on June 16, 1930 as Junior Executive student.

He was born on a Salt River bottom farm located north of Holliday, Missouri. He graduated from Holliday High School in 1926 and entered the University of Missouri on a scholarship. He graduated from the College of Engineering in June, 1930 with a Bachelor of Science degree in Mechanical Engineering. Prior to graduation, he worked during summer vacations and had a variety of experiences working in automotive plants, farm work and road construction.

After starting with International Harvester in 1930 at the Deering Plant, he was transferred to McCormick Works in the same capacity as a student. During this student training period which lasted three years, every phase of implement manufacture was explored. As this was a time of serious financial depression, jobs were scarce and every effort was made to utilize engineers in any capacity in order that they might be available when production was resumed. Typical jobs held during this period were foundry molder, machine operator, machine assembler, and personnel investigator. The position of personnel investigator was of particular interest because of the social service work required to investigate the needs of the unemployed at Harvester and making recommendations for their care until they could be reemployed.

F. H. Wiley

In June, 1933, he was married to Helen Glasscock, a childhood neighbor who attended Kirksville State Teachers College and taught in rural grade schools in Missouri.

The next few years were spent in a variety of occupations such as assistant shop foreman, production department and planning engineer. In this capacity he was engaged in developing estimates of cost and methods of manufacture of new Harvester products.

During the 2nd World War, he worked on a number of different committees planning the production of ordnance material and later was assigned as a Harvester representative to a Central Committee with members from a number of companies such as Pontiac Motors, Westinghouse, American Can Company and Harvester to establish specifications and manufacturing methods for aerial torpedoes. After the war, he was assigned the responsibility of chief draftsman in the

(*Continued on page* 40)

AILEEN FAUROT

Shamrocks Should Be Made of These!

JUDY RISSLER

BETTY RAE PFEIL

MARY JANE IMMERTHAL

Photos by Jerry Herdan

Our Queen (and the fellows who elected her)

Pic by Herdan

Evelyn presents the lesson of the week.

Pic by Proctor

Here we see our Queen to be as she is being interviewed by three very astute young engineers. From left to right we see Dan Capps (overcome by the excitement of it all), Evelyn (laughing heartily as she views what you see in the picture below), Bill Marshall (in complete command of the situation) and Bob Combs (demurely gazing at the floor as he thinks of a question).

Pic by McLaughlin

How the Bell Solar Battery Converts Sunlight into Electricity

Another example of the pioneering opportunities for engineers at Bell Telephone Laboratories

In a career with Bell Telephone Laboratories, young engineers and scientists can expect to take part in pioneering radically new developments in the field of communications. One such development is the Bell Solar Battery.

Like the transistor, the Bell Solar Battery was invented by Bell System scientists. Indeed, it was the study of semiconductors which revealed the fact that sunlight could induce the movement of electrons in silicon and thus create electric current.

The basic unit of the Bell Solar Battery is a thin disc compounded of two kinds of treated silicon. The body of the disc is silicon with a trace of arsenic to provide negative potential. Into this body boron is diffused, to a depth of less than 1/10,000 of an inch, providing positive potential. The junction of these layers of treated silicon is the "*p-n*" junction. Equilibrium between the *p* and *n* regions is upset when the disc is exposed to sunlight, which jolts electrons free, and causes them to move across the *p-n* junction. The charges pass through contacts, and current — though a small amount — flows.

In the past year, the efficiency of the Bell Solar Battery has been increased from 6 to 11%. Right now, in Americus, Georgia, the battery is being used experimentally to power a rural telephone system. And more widespread application is in the offing.

The Bell Solar Battery is one of many developments underway in the Bell System to improve America's telephone service. The special role of Bell Telephone Laboratories in forwarding the exciting search for tomorrow's better telephone service is creating many fine career opportunities for young scientists and engineers. Your placement officer can give you more information about careers with Bell Telephone Laboratories, and also with Bell Telephone Operating Companies, Western Electric and Sandia Corporation.

The Bell Solar Battery consists of 432 silicon discs wired together. It is mounted on telephone poles to catch prevailing sunlight, and on a sunny day can produce 10 watts. Excess energy is fed into storage batteries, to be used at night or in bad weather.

BELL TELEPHONE SYSTEM

ENGINEERING COLLEGE

(*Continued from page* 15)

higher education, and the School of Engineering at the University of Missouri had received recognition from professional societies and organizations. In 1902 the Alpha Chapter of Missouri of Tau Beta Pi was established at the University with eleven charter members. This honor society was a constant inspiration to students in engineering.

New scientific developments were requiring introduction of new curricula. The University adapted its courses to the needs of professions and the demands of industry. Chemical engineering was established as a department in 1903 and soon became one of the important divisions of engineering education at the University.

By 1904 the enrollment in engineering had increased to such an extent that the curators established an office of junior dean of engineering on a trial period of three years. The chairmen of the three departments, Professor H. B. Shaw of electrical engineering, Professor Putnam Spalding of civil and Professor A. M. Green of mechanical each served a year in this capacity. These men proved to the curators the wisdom of the separation and at the end of the three-year period the School of Engineering was again separated from agriculture with Professor Shaw as dean.

Because of the vision and fine cooperation of these pioneer leaders, the College of Engineering was prepared to meet the ever multiplying demands of industry for men with a thorough knowledge of physical and chemical phenomena and of the laws governing their relationships. The separation injected into the faculty and student body a new spirit of self-reliance and strong determination to make good.

Just as the columns stand on the quadrangle in solemn grandeur as a tribute to the superb contributions of the deans and professors, the shamrock reposes above the main entrance of the Engineering building as a tribute to the superb contributions of a group of jovial students.

In relating the story of the Shamrock and the Saint Patrick tradition, it is difficult to separate legend from fact. We have attempted to reconstruct the most probable sequence of events which occurred on that memorable day of March 17, 1903.

It was a few days before St. Patrick's Day of 1903 and the young men's fancy had turned to thoughts of cutting class. A group of senior engineers were gathered in front of the engineering building. The conversation drifted to the same old subject for this was the time of the year when Professors seemed bent on working the engineers to death. They were lamenting the fact that it was a long time between holidays when some ingenuous soul came up with the idea that as St. Patrick had engineered the project of getting the snakes out of Ireland, he was the first engineer and it was only fitting that his birthday be observed as an engineer's holiday.

The Blarney Stone

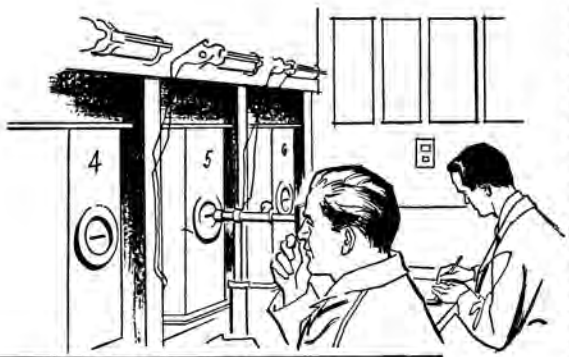
"Erin Go Braugh" translated into English could only mean one thing, "St. Patrick was an engineer!" (*Ed. note — It means "Ireland Forever" in Ireland.*) The idea was immediately recognized as being an inspired one and the group set out to notify the other engineers. Leo Brandenburger set forth the first St. Pat proclamation which reads as follows: —

"WHEREAS, It has been the custom of certain uninformed ministers of the gospel to declare at various times the practices and beliefs of

(*Continued on page* 32)

College graduates develop their skills...

growing with UNION CARBIDE

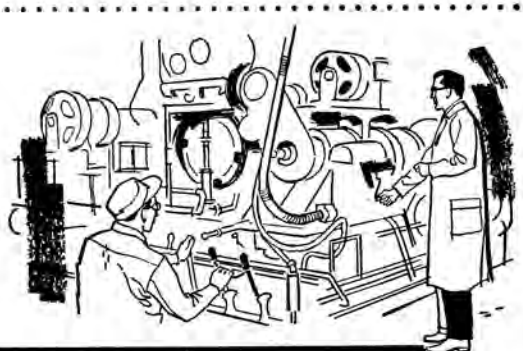


IN TITANIUM RESEARCH...

"After graduating in 1951 with an M.S. in metallurgical engineering, I joined the Metals Research Laboratories of Electro Metallurgical Company. Some of my research in corrosion behavior and notch sensitivity resulted in a patent for a stainless steel. In 1954 I was promoted to Section Leader, supervising research projects in titanium and other reactive metals."

IN ATOMIC ENERGY...

"I graduated in '51 with a B.S. in physics and mathematics. Because of my interest in atomic energy I joined Union Carbide Nuclear Company at Oak Ridge in April, 1954. By November of that year I was classified as a Junior Physicist. I now supervise the operation of mass spectrometers used to analyze radioisotopes produced in atomic reactors here at Oak Ridge."



IN QUALITY CONTROL...

"I'm an electrical engineer, Class of '51. I started in Works Engineering at a National Carbon Company plant. A year later I transferred to a location where Works Engineering covered three plants, and soon became Engineer on important development projects. I was recently promoted to Assistant Head of the Product and Process Control Laboratory at one of the plants."

IN METALLURGICAL CONTROL...

"I'm a metallurgical engineer, Class of '49. I started at Haynes Stellite Company as a Development Engineer in high-temperature alloys, and in 1953 became Shift Foreman in the Metallurgical Control Department. Recently I was promoted to General Foreman, responsible for the Chemical, Spectographic, Material Release, and X-Ray Departments and the Test Laboratory."

THEY ARE KEY MEN WITH A FUTURE...

If you are interested in a future in production, development, research, engineering, or technical sales, check the opportunities with any Division of Union Carbide. Get in touch with your college placement officer, or write directly to:

UCC DIVISIONS INCLUDE...

- Bakelite Company • Carbide and Carbon Chemicals Company
- Electro Metallurgical Company • Haynes Stellite Company
- Linde Air Products Company • National Carbon Company
- Silicones Division • Union Carbide Nuclear Company

UNION CARBIDE

AND CARBON CORPORATION

UCC

Industrial Relations Department, Room 406
30 East 42nd Street, New York 17, N. Y.

How To Conduct A Laboratory Test

By FRANK EGGERS, M.E., '56

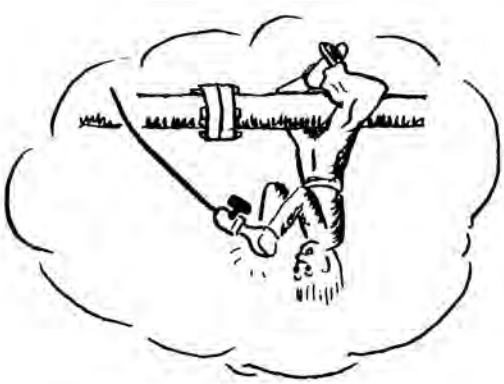
LEROY ANDERSON, M.E., '57

1

Each student has a definite task and is equipped to perform it.

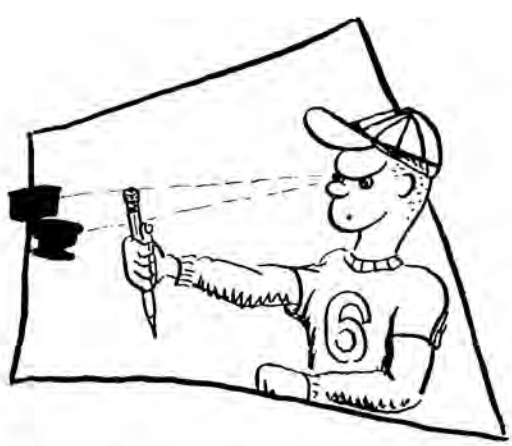
2

Before proceeding with the test, determine all constants.



3

Get those serial numbers, too!

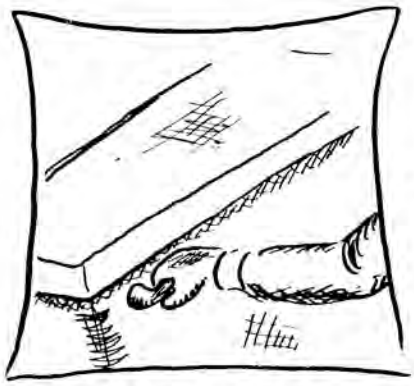


4

Take all measurements as accurately as possible.

5

Simulate actual operating conditions.

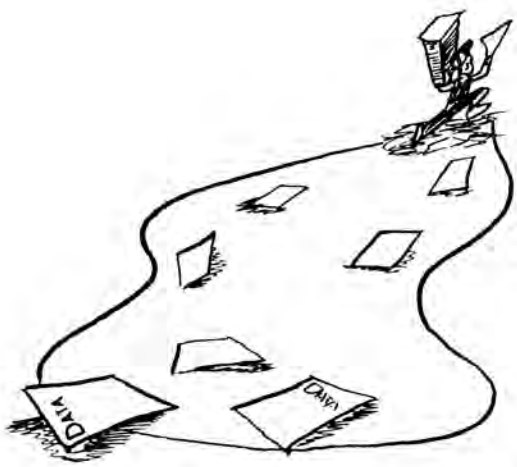


6

Know your job

7

Destroy all bad data



8

Be sure everyone gets a copy of the data.

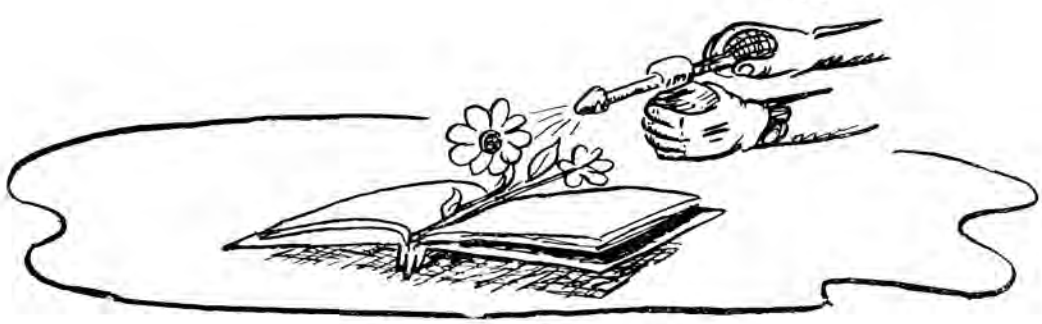
9

Plot graphs accurately

10

Be original

11



Make the report presentable

ENGINEERING COLLEGE

(*Continued from page* 28)

our worthy St. Patrick, it was deemed advisable that the question of his origin and his life should be definitely and forever settled, and

WHEREAS, The investigation has proved eminently successful, the result of which was to establish beyond any doubt or council that St. Patrick was an Engineer, it is therefore

RESOLVED, That it is the sacred duty of each and every engineer to observe in a manner most fitting the glorious memory of our most beloved disciple, and it is further

RESOLVED, That every engineer, senior, junior, sophomore and freshman, do each year on the day of St. Patrick refrain from all duties and attendance upon classes and spend the day in observing the memory of our pioneer brother. It is therefore

RESOLVED, That each year in the Department of Engineering, on the day of St. Patrick a holiday is declared.

Signed: Senior, Junior, Sophomore, Freshman."

The reader will recall that at the time it was customary to have Chapel in the library every morning. Inasmuch as St. Patrick was to be their Patron Saint the Engineers went to Chapel. That was the first time most of them attended the service.

After Chapel the hundred or so students participating gathered at the columns amid a great deal of yelling and cheering. A few students brought band instruments and joined in the noise making. Finally, President Jesse came charging down the steps from the President's House and declared that the holiday was illegal and the students taking part would be disciplined. Meanwhile the band had started toward the Eighth Street entrance to the campus. President Jesse ended his harangue by stating that gentlemen would return to their classes and rowdies would follow the band. Most of the engineers followed the band up-town. They also visited the two girl's schools, Christian and Stephens College. The originators, incidentally, got an additional "holiday" of one week.

The Grand Kowtow of 1905

The 1904 St. Patrick doings were organized and directed by the 1905 class, then juniors. Professor Green, who had taken the demonstration of the previous year as a personal affront, threatened to fail any student in his classes who was not present on March 17. Many seniors who were taking his mechanics course for the second time could not afford the flunk.

Months before March 17, 1905 the engineering students began to lay plans for the celebration. It was decided that St. Patrick himself would appear and receive the homage of his followers. That morning the Engineer-

(*Continued on page* 34)

At David Sarnoff Research Center, Princeton, N. J., RCA tests one of loudspeakers used in new high fidelity "Victrola" phonographs.

RCA creates a new kind of high fidelity in the silence of this room

In this room you *can* hear a pin drop. The jagged walls absorb alien noise so that delicate instruments can make sure reproduced sound matches the original as closely as possible.

Thus a new kind of high fidelity is born—and brought to you for the first time in new RCA Victor Orthophonic "Victrola" phonographs. *Listen!* Here is distortion-free performance through the range of audible sound. Here is *more* music than you've ever heard before. Here is the ultimate in high fidelity.

The skill behind new Orthophonic "Victrolas" is inherent in all RCA products and services. And continually, RCA scientists strive to open new frontiers of "Electronics for Living"—electronics that make life happier, easier, safer.

RADIO CORPORATION OF AMERICA

Electronics for Living

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.

ENGINEERING COLLEGE

(*Continued from page* 32)

ing Department marched to Chapel in a body. St. Patrick was there in his regalia carrying a primitive level made from willow sticks. After the convocation the 'Guards' repaired to the Engineering Building where the grand 'Kow-Tow' was held. This formed the most impressive and imposing spectacle of the occasion. As St. Pat appeared the 'Guards' assumed an attitude of profound reverence —hats off, kneeling down, with noses deep in the sod — while St. Patrick holding his transit in a solemn benediction, dedicated and forever consecrated St. Patrick's Day as an Engineering Holiday for the observance of the ceremonies enacted and established on this occasion. Some enterprising photographer caught a fine rear view with all the student posteriors pointing skyward, St. Pat with his upraised cane and Professors Defoe, Williams, Shaw and other spectators in the background with amused smiles on their faces.

Possibly this ridiculous posture of the engineers in the Grand Kow-Tow served to divert the discipline committee from a position of sternness to one of amused tolerance. None of the engineers were disciplined this year and the St. Patrick's legend became firmly established.

In 1906 the "Blarney Stone" bearing the marks of evidence that St. Patrick was an engineer was "discovered" by Veit Aull Hain of the civil engineering class of 1906, during the excavations for the foundations of the engineering annex building. For this reason the festivities this year were more elaborate. A reincarnated St. Patrick arrived by airship which, well guarded, was exhibited with great pride by the engineering students. Posters printed in green announced the arrival of the good old patron Saint of the engineers. After the Grand "Kow-Tow" was performed, each senior came forward and as he knelt and kissed the Blarney Stone was properly dubbed a Knight of St. Patrick. The ceremony was concluded with the singing of the well-known Missouri Engineer's song.

The first issue of The Shamrock appeared at the 1906 celebration as a pamphlet in a green cover (about 4" x 7") and printed in green ink. It was dedicated on the flyleaf "To St. Patrick the perfect integral whose first derivative was an engineer."

The high point in the 1907 celebration was that Professor Arthur M. Green, Jr., who had so fiercely resented the affairs of 1903 and 1904, was dubbed as a Knight of St. Patrick, Honorary, summa cum laude, the first to receive this honor. President Jesse had so far relented by 1907 that he not only approved the March 17 holiday for the engineering students, but he granted the whole University an hour recess during the morning ceremony on the campus.

The students who started the celebration in 1903 as an unscheduled frolic did not suspect that there was a perfectly legitimate reason for making March 17 a holiday. But perhaps the reader will recall that it was on March 17, 1863 that the endowment of land for a College of Agriculture and Mechanic Arts by the Federal

(*Continued on page* 36)

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

STANDARD

910 South Michigan Avenue, Chicago 80, Illinois

ENGINEERING COLLEGE

(*Continued from page* 34)

government was unanimously accepted by the General Assembly of Missouri. It was appropriate, therefore, to celebrate this date in a fitting manner.

The setting aside of March 17 as Engineer's Day and the observing of St. Patrick traditions from year to year fostered a wholesome and enthusiastic spirit of cooperation among the students and faculty. It was this fine energetic spirit that enabled the College of Engineering of the University of Missouri to attain a position of prominence among the technical institutions of the Middle West.

With the establishment of the Engineering Experiment station July 1, 1909 through the efforts of Dean Shaw the College was better able to serve the state and its citizens. Research work was organized on a more satisfactory basis and bulletins were published describing the research projects.

A department of agricultural engineering was established in 1917 to be administered jointly by the divisions of agriculture and engineering. Its curriculum was planned to prepare the student to design, make, and operate farm machinery, to superintend irrigation, drainage and errosion control projects, and design and construct farm buildings.

Continued expansion and progress was halted by the great depression of the early 30's when many of the students and faculty were forced to leave the campus. The physical plant of the College and the laboratory equipment deteriorated because of lack of maintenance. But with the return of industrial activity and the aid of federal grants the College of Engineering began to progress.

The new Engineering Laboratories Building was constructed and has since received new additions. New equipment and experimental materials were obtained. As new products are invented and produced, the College of Engineering keeps abreast with or ahead of the new trends, often aiding in their development.

A well-equipped communications laboratory had been installed through the generosity of the American Telegraph and Telephone Company and its subsidiary, the Southwestern Bell Telephone Company, and as one of the results the College of Engineering has trained and developed scores of top communications engineers. It may be significant that four out of the twenty major presidencies in the AT&T and Bell System are held by engineering graduates of the University of Missouri, including the presidency of the parent Company.

World War II was another severe set-back to the College of Engineering as it was to all other colleges, but in the post-war expansion enrollment jumped to an all-time high of more than 1,500 students on the Columbia campus and more than 2,700 in the University's School of Mines and Metallurgy at Rolla. Enrollment has dropped back to the near-normal of 675 students in engineering at Columbia and 1,100 at Rolla.

During the war the College participated in the University's training of service personnel and also estab-

(*Continued on page* 39)

NEWSTUFF

(*Continued from page* 21)

PERMANENT CURL

A permanent curl for chicken feathers to give bulking qualities comparable to goose down has recently been developed. The aim is to substitute plentiful chicken feathers for the expensive, scarce water-fowl feathers and down currently imported from Eastern Europe and Asia.

The U. S. Army Quartermaster Corps has long sought an economical insulator of domestic origin for sleeping bags, life jackets and cold weather clothing. If chemically treated chicken feathers provide the answer, a profitable use will have been found for an estimated annual surplus of 200,000,000 pounds of feathers.

The new chemical treatment is based on glyoxal. After being washed, the feathers are swelled and curled in a trisodium phosphate solution. The keratin in the feathers is then reacted with glyoxal to produce a stabilized bond which permanently fixes the curl.

An additional advantage of the glyoxal-treated chicken feathers is the complete absence of odor at high humidity. The glyoxal treatment also imparts water repellency, resiliency, and springiness previously lacking in the chicken feathers.

HIGH SCHOOL BUILDING

Progressive schools know few bounds when it comes to the development of stimulating projects in the science field. Oceanside High School, Oceanside, New York, for instance, has started to construct an experimental cyclotron, one of the first such projects to be undertaken by a public high school. Many persons are promoting the activity; the local board of education; the principal; a science faculty member who coordinates the work of his own department's divisions as well as that of the mathematics, mechanical drawing and industrial arts departments; and to top it off, Dr. Kenneth Green, director of developmental research of Brookhaven National Laboratory, who acts as chief consultant.

NEW, SUPER-SONIC

A highly sensitive dust-recording instrument, believed to be the fastest of its kind, has been developed in Kodak Research Laboratories as part of the company's continual campaign for purity of air in film manufacturing.

The new instrument is so fast it gives an accurate measure of dust conditions within seconds. It also provides a continuous record of dust levels.

It is sensitive enough so that if a few thousandths of an inch of fine dust on the head of a pencil are dispersed through an average room, 8 by 10 by 15 feet, the recorder will detect its presence.

The instrument has a general resemblance to a vacuum cleaner for household use. But, unlike the cleaner, the dust recorder sucks in air through a narrow tube and blows it at supersonic speed against a thin, plastic sheet.

Dust in the air is deposited in a narrow strip on the plastic sheet. Then a photoelectric "eye" reads the

(*Continued on next page*)

ENGINEERING COLLEGE

(*Continued from page* 36)

lished and operated a special diesel training school for enlisted personnel of the U. S. Navy producing more than 5,000 graduate diesel engineering specialists for Navy service. In addition the College participated in the Government's Engineering, Science and Management War Training program setting up an extension program under which it trained more than 3,600 war industry workers in special production jobs.

Since the war the activities of the Engineering Experiment Station have been greatly expanded and the College of Engineering has developed a greatly expanded extension and adult education program through cooperation with the University's Adult Education and Extension Service, providing scores of special schools, short courses, conferences, clinics, and other educational programs and refresher courses for practicing engineers and industrial workers. Several thousand persons are served annually under this public service.

Yet, the primary obligation of the College of Engineering is to its students; to give them a thorough knowledge of the fundamental principles of their profession and the know-how to attack engineering problems. Each student as he assumes his position of an alumnus is an individual measure of the success of the College.

Acknowledgment: Portions of this article are based on "The University of Missouri" by W. J. Menteer and "Engineering at The University of Missouri" by M. P. Weinbach.

NEWSTUFF

(*Continued from page* 38)

dust track for instrument measurement of its density. The resultant record of the dust level is traced on graph paper for a permanent record. The device is also fitted with a microscope.

With this additional attachment, a scientist can also make a swift examination of the dust trail by eye. He can make a preliminary judgment, for

(*Continued on page* 40)

NEWSTUFF

(*Continued from page* 39)

example, as to whether the magnified dust is lint or metallic in origin.

More complete chemical or microscopic analysis of the dust can be made later, over a period of several hours, by regular laboratory methods.

The dust recorder proves useful also to check the effectiveness of air filtering systems. Samples of air taken ahead of the filters and behind the filters in a system, quickly indicate on the dust recorder how much the filters are removing from the circulating air.

One early finding with the new equipment is something long suspected by engineers — and some housewives. This is that sometimes the dust level tends to rise in the area of a clean-up effort and may then subside to the same rather than to a lower level.

MIZZOU MEMOS

(*Continued from page* 24)

Mechanical Engineering Department at the McCormick Works.

In 1946, while working with a special committee studying machine loads and plant capacities, the Manufacturing Research Department which was then being organized requested his services and he became a part of that activity. During the process of organization and development of the Research Department he served as an Assistant Mechanical Engineer and Assistant General Supervisor of Plant Engineering Research. In 1953, he became General Supervisor of the Materials Handling Section, Manufacturing Research Department of International Harvester. This activity has provided contacts with all phases of Harvester production, distribution and sales.

He is on the Board of Directors for the Society of Industrial Packaging and Materials Handling Society, member of the American Society of Mechanical Engineers, chairman of the American Standards Association Committee B-69 — Standardization of Pallets, member of the American Materials Handling Society and on the packaging council of the American Management Association.

The Wiley's have three children, Neil 18 years old, in his second semester at the University of Illinois - Commerce School; Nancy 13 years; and Gale 10 years old.

Their present home address is 12202 - 73rd Avenue, Palos Heights, Illinois.

Harvey Friede, E. E. '12 has been practicing law since the depression though he has done engineering work. His current address is 2585 Idlewood Road, Cleveland Heights, Ohio.

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

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

Leigh S. Icke, EE, '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.

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.

Jeanette A. Livasy, Ch.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.

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.

Boeing engineers find rewarding jobs in Wichita, Seattle

This model of a supersonic airplane design was dropped at extreme altitude from a B-47 Stratojet. Telemetered data revealed the characteristics of its supersonic flight to destruction at the earth's surface. This is just one example of Boeing-Wichita's continuing development of advanced aircraft and associated system components.

At Wichita research and development programs are expanding rapidly. Laboratory space has been quadrupled and many other new engineering facilities have been added to keep pace with increasing emphasis on technical development. At both of the company's plants, Seattle and Wichita, the increased scope and magnitude of this development effort is creating additional and excellent career opportunities for all types of engineers.

This means that if you are an electrical engineer, a mechanical engineer, a civil or an aeronautical engineer or a physicist or mathematician with an advanced degree, there is a real challenge for you in one of Boeing's design research or production engineering programs. You would work in a tight-knit team where there is plenty of room for self-expression and recognition.

Boeing engineers are working now on future airplanes and missiles that will maintain the standard of technical superiority established by the B-47 medium bomber, the B-52 intercontinental bomber, the BOMARC IM-99 pilotless interceptor, the 707 jet transport and the KC-135 jet tanker-transport.

Recognition of professional growth is coupled with career stability at Boeing — twice as many engineers are now employed by the company as at the peak of World War II. They enjoy a most liberal retirement plan. How would *you* like a satisfying, creative job with the pick of the engineering profession? There may be one waiting for you in the progressive communities of Wichita or Seattle.

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

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

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

BOEING

Aviation leadership since 1916

SEATTLE, WASHINGTON WICHITA, KANSAS

BULLARNEY

By DUNK

"How was your first semester at college?"

"Wonderful," said the co-ed. "But the first day I was there the authorities made a silly mistake. It seemed they assigned me to a men's dormitory."

"Good heavens. How did they make an error like that?"

"Who knows? I never went back to find out."

♣

The moon was full, the night was warm and the car radio was playing romatic music.

"Kiss me," pleaded the boy.

"No!" said the girl. "Drive to another place."

So he drove for a few minutes and parked again. This time the girl launched the offensive. When the boy came up for air he asked the girl why she'd changed her mind.

"Oh, I knew what I wanted," said the girl. "I just don't believe in love at first site."

♣

"Did you complete the inspection, Sergeant?"

"Yes, sir. It wasn't easy, though—they all griped like hell. I had to pull rank on them before they'd agree. But I thoroughly inspected all fifty of them. They're in good shape."

"Fine, Sergeant. They'll just have to get used to an occasional kit inspection. But I thought there were only twenty-five WACs in that barracks?"

"Oh," said the sergeant, "*kit* inspection!"

♣

During an art exhibition, two extremely respectable ladies were reviewing offerings of a modern artist.

"You don't mean to tell me that you posed for that shocking portrait," said one to the other.

"Certainly not!" the second replied. "He must have drawn it from memory."

"Gosh, you have a lovely figure."

"Oh, let's not go all over that again."

♣

Joe: "I'm tired. I was out with a nurse last night."

Jack: "Cheer up. Maybe your mother will let you go out without one, sometime."

♣

"You're without doubt the most ignorant grammar school children in St. Louis," snapped the teacher. "Johnny, I'll bet you don't even know what state you're in right now."

"Misery," said Johnny.

"It's pronounced *Missouri*," corrected the teacher.

"Have it your way," said Johnny, "I've been missourible since the time you started talking."

♣

Did you ever hear about the Egyptian girl who didn't know right from wrong? Now she's a mummy.

♣

Once upon a time there was a boy penguin and a girl penguin who met at the Equator. After a brief charming interlude the boy penguin went north, to the North Pole, and the girl went south, to the South Pole. Later on, a telegram arrived at the North Pole stating simply, "Come quickly—am with Byrd."

♣

"I've been married two years," confided Walter, "and I'm fed up with the woman. I can't get a divorce—she's got all the money. I've been trying to figure out a way to murder her without being caught."

"Well," said Joe, "I did hear of one guy who made love to his wife all day and all night until her health gave way and she died . . . "

"Don't say another word!" said Walter, "I'm way ahead of you."

Six months later Joe called on his friend. To his surprise he found Walter's wife in the bloom of health, running back and forth across the lawn pushing a heavy lawnmower and whistling cheerfully. Walter was sitting hunched up on the porch, his body emaciated, his face grey and gaunt. He beckoned Joe over to him with a trembling hand. "Look at her!" he cackled. "Little does she know her days are numbered!"

♣

The reason for the amber light on traffic signals has finally been revealed: It gives the Scotchmen a chance to start their engines.

♣

It seems this salesman had a lot of trouble locating one Colonel Sexhauer in the Pentagon. After a while, he started telephoning various departments. No success. Finally he tried one last number.

"Hello?" he said eagerly, "Do you have a Sexhauer in your office?"

"No, sir," said a girl's voice. "We don't even have a coffee break!"

♣

The Theta, excited about having been pinned by a fraternity man the night before, dressed hurriedly and was walking towards the Student Union when she came upon a group of male friends. Stopping in front of them, the girl proudly thrust out her chest and commanded happily, "Look!"

But in the excitement, she had forgotten to wear the pin.

♣

Prof: "I say there, you in the auto—your tubular air container has lost its rotundity."

"What?"

Prof: "I said the cylindrical apparatus which supports your vehicle is no longer symmetrical."

"Huh?"

Prof: "The elastic fabric surrounding the circular frame whose successive revolutions bear you onward into space has not retained its pristine roundness."

Bewildered look.

Little boy: "Hey bud, you gotta flat tire."

♣

Webster says that "taut" means tight. I guess the guys at college are taut a lot after all.

SHAMROCK SEZ

We feel that students should occasionally indulge in introspection — that is to say; one should look into one's own mind and record the thoughts observed therein. Obeying this impulse the writer spent one complete afternoon interviewing himself. As you will see if you persist in reading the schizophrenia which follows, his mind was blank for a good part of that afternoon and polarized for the remainder. The chief difficulty which arose was in distinguishing between the questioner and the answerer (er . . .). To cope with this we shall refer to myself asking as "A" and myself answering as "Z". Here it is; the complete unabridged account of "How I Qualified For Headshrinking".

A: "Do you feel that the engineering building needs to be modernized?"

Z: "Yes, as a matter of fact, I do. I think it needs air conditioning, plumbing on the first floor, a *cold* water fountain in the basement, a private office and a beautiful secretary for each student."

A: "I certainly appreciate the value of your first suggestions, but why a private secretary?"

Z: "It's quite simple—you see, engineering students are too busy writing reports to spend much time with the fair and the beautiful. Consequently, they are unable to acquire a true appreciation and knowledge of same. If each student has his own private secretary, some understanding is bound to result."

A: "Where would you obtain these secretaries?"

Z: "We could hire them from the B&PA school for a pittance."

A: "Do you think the secretary would benefit in any way?"

Z: "Certainly. Aside from her salary, she might learn a bit of engineering and associated natural phenomena."

A: "How do you feel about the use of moving pictures to present classroom lectures?"

Z: "An excellent idea—some of the professors have given the same lecture since Davy Crockett was a little boy. We could film their lecture and then place the professor in a deep freeze or other suitable container. After each filmed lecture we could have a preview of coming attractions and then a 'short', possibly a Mighty Mouse cartoon."

A:"What would you describe as a 'suitable container'?"

Z: "We could put them on a raft and set them adrift on the Hinkson. When they returned, they could write a book called 'The Cruise of the Konticky'."

A: "What is your feeling in regard to laboratory courses?"

Z: "The law of diminishing returns operates here."

A: "Could you clarify that statement?"

Z: "Indeed—according to that law the efficiency of production increases as units of production are added, then reaches a peak and begins to decline as further units are added. By the time ten unshaven, sleepy units of production (sans breakfast) have conglomerated about one tiny piece of lab equipment we have reached the point on the law of diminishing returns at which great moguls of industry leap from their penthouse portico, leaving an unfinished Martini (with olive) on the rail."

A: "If this is your opinion of the courses, what do you think of those who conduct them?"

Z: "Frustrated greasemonkeys."

A: "How do you feel about the younger instructors?"

Z: "Poorly."

A: "How do you feel about the older instructors?"

Z: "Poorly—er."

A: "Poorly—er? Would you define that word?"

Z: "Certainly. You know how poorly you feel when an after dinner speaker has droned on for hours?"

A: "Yes."

Z: "Poorly—er is how you would feel if he finally said 'And now I will introduce the main speaker of the evening'."

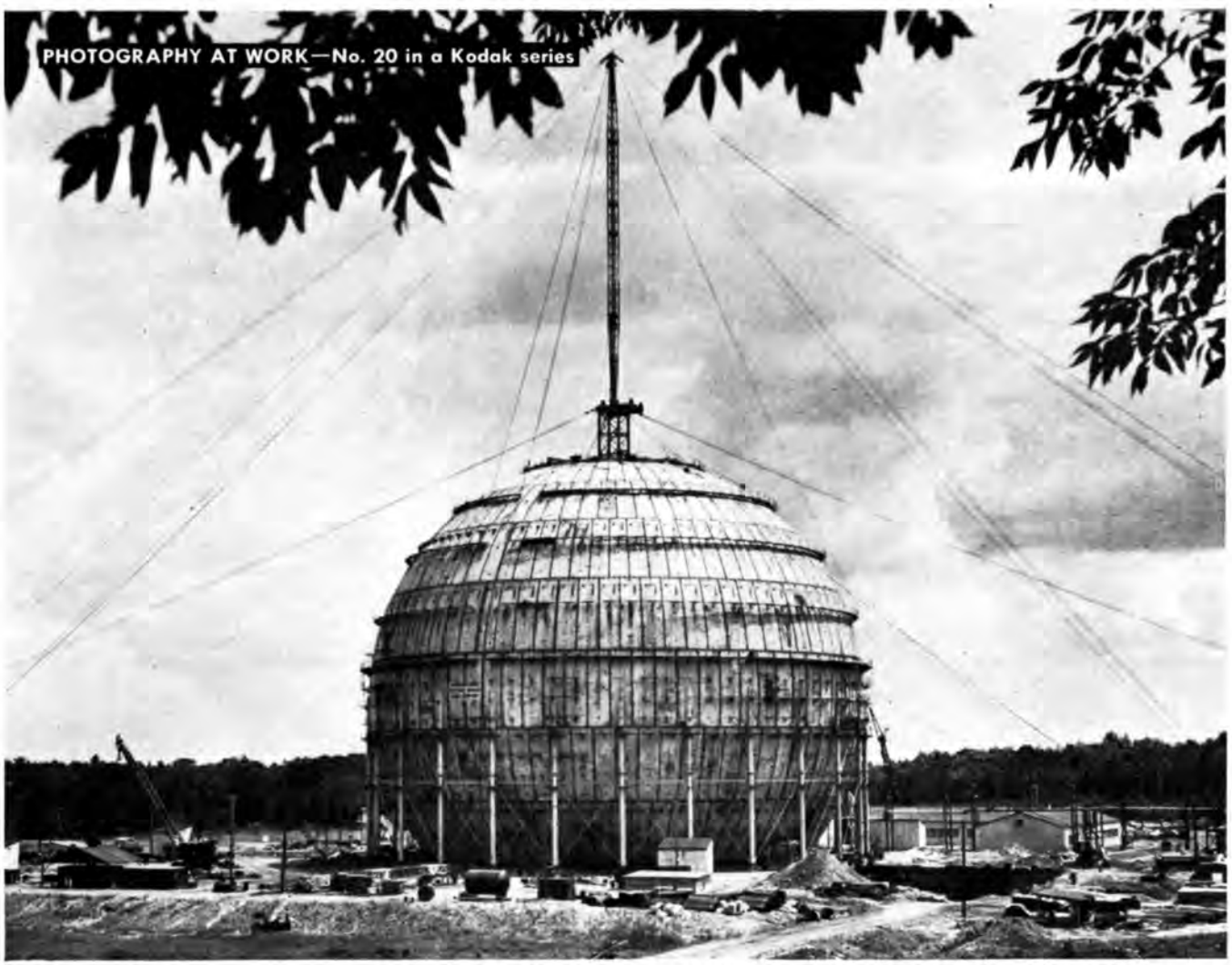
A: "An interesting definition—tell me, do you think an instructor gets easier or harder on students as he grows older?"

Z: "Definitely harder. Consider the youthful instructor's first teaching assignment; having recently been one of them, he takes pity on the poor student and gives far too many high grades. Then he spends the rest of his teaching career trying to make up for the mistakes of his youth."

A: "Let's change the subject. Tell me, how do you feel about girls?"

Z: "I usually start by holding their hands."

At this point A decided that the interview should terminate. He was able to overcome Z's objection only due to the fact that he had greater will power resulting from his higher position on the periodical table of the alphabet.



"Atom Apple," a 225-foot sphere of steel plates welded into virtually one piece.

An egg built to hatch miracles

–and x-ray photography searched every seam in its shell

To test America's nuclear wonders, the Knolls Atomic Power Laboratory uses history's largest steel sphere—with each weld proved sound by x-rays and photography.

This huge steel sphere, ten times larger than man has ever built before, houses the prototype power plant of America's nuclear submarine, Sea Wolf, designed and constructed by the General Electric Co. for the Atomic Energy Commission.

As a safety measure, every seam was welded, making the sphere virtually one piece. And to be positive every weld was sound, it was x-rayed—with proof of its internal bonds recorded on film.

Radiography like this is working today for welders large and small—and for foundries interested in providing flawless castings. And photography in other forms is working for all kinds of business and industry. It is helping solve design problems, increase production, train salespeople, speed up office routine.

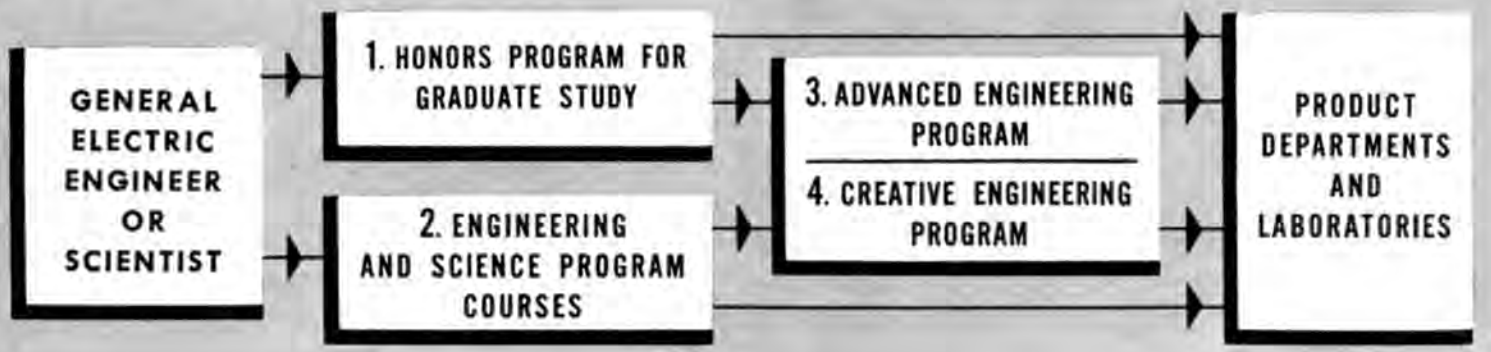
Behind the many photographic products becoming increasingly valuable today and those being planned for tomorrow lie intriguing and challenging opportunities at Kodak in research, design and production.

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.

Kodak
TRADEMARK

Eastman Kodak Company, Rochester 4, N. Y.

G.E. announces new Honors Program: latest addition to advanced-study opportunities



Further formal education as you learn and earn at General Electric

(1) Honors Program

G.E. selects qualified employees and reimburses them for tuition, fees, and books in connection with graduate study at universities located near G-E operations. You may participate in the tuition refund plan in one of two ways in selected G-E plant locations; by taking individual graduate courses while working a normal 40 hour week, or by carrying approximately one-half an academic load while working a reduced 20-hour week. You work full time and receive full pay during the summer months, unless time for thesis work is required.

(2) Engineering and Science Program Courses

Covering a variety of subjects—from engineering and production problems to product design and advanced physics—these G-E courses are the stepping stones to either the Advanced, or Creative Engineering Programs.

ADVANCED TECHNICAL COURSE consists of actual engineering problems in areas such as dynamics, electromagnetic fields, fluid flow, heat transfer, servomechanisms.

ENGINEERING DESIGN COURSE provides a background in materials, methods, and manufacturing processes, with instruction tailored to improve the engineer's design ability.

You may also take any of the numerous Specialized Technical and Departmental Courses that are continually offered.

(3) Advanced Engineering Program

To select and train technical leaders, this program combines extensive class and home assignments, with a 36-hour work week in association with Company technical leaders. The program is rigorous but the hard work pays off, for since its founding in 1923, 75% of its graduates have become engineering specialists and managers. Selection for the program requires either a Masters Degree or graduation from the Advanced Technical Course.

(4) Creative Engineering Program

This course is designed to help you make maximum use of your imagination and resourcefulness in solving problems and contributing new ideas. The number of patents registered by graduates of this program is almost double that of other engineers in General Electric. The one-year graduate-level Company course presents the latest techniques in creative engineering. Problems are worked on an individual basis or team basis. Complete facilities are available for construction of models and prototypes needed to demonstrate and develop any ideas.

For complete information write Mr. W. S. Hill, Engineering Services, Bldg. 36, General Electric Company, Schenectady 5, New York.

956-6

Progress Is Our Most Important Product

GENERAL ELECTRIC

G.E.'s CLARENCE H. LINDER, Vice President—Engineering, defines the challenge of technology.

ENGINEERS IN INDUSTRY

Industrial progress hinges on the engineers' ability to apply amazingly complex technology to the problem of creating new goods and services. It is vital that the engineer at G.E. be given every opportunity for self-development in his chosen field, and so the far-reaching educational programs described on this page are designed to satisfy three specific needs.

The Team Approach

The team approach to complex technical projects is extremely important in industry today. It brings together competent men with a wide variety of training and experience to blend their abilities in the solution of problems. To be prepared to work as a member of a team, the engineer must develop appreciation and understanding of the work and contribution of the other members. Recognition of this need is the basis of teaching philosophy all through the programs.

Importance of Supporting Sciences

Many of the problems facing engineers in modern industry are not found in the principal engineering sciences, but have shifted into areas which have been thought of as supporting sciences. An engineer working principally in aerodynamics, for example, may find the main roadblocks in his work are the limitations of the materials which are available. By working closely with experts in the field, the engineer must in fact influence the development of new and better materials.

Broad Technical Backgrounds

The solid core of industry's engineering effort is a body of men thoroughly grounded in the fundamentals of basic science. With the explosive increase in technology, the engineer and scientist need to keep abreast of all allied areas. G-E advanced-study programs give this opportunity.

SSOURI
SHAMROCK
APRIL, 1956

FEATURES:

Product Design
by Digital Computers

Rear Suspension
Prediction

Robert T. Blake, Class of '49

speaks from experience when he says,

"At U.S. Steel, the opportunities are unlimited."

Bob Blake had his first experience in steel mills working there during summer vacations from college. After receiving his B.S. degree in Electrical Engineering, he became an operating trainee in U.S. Steel's Irvin Works. During his training program, his background and versatility were used by the Training Division to develop a training program for Electrical Maintenance employees. By the end of 1951, Mr. Blake had become a Foreman with experience in both Cold Reduction Maintenance and the Galvanizing Department.

Effort is made to have young engineers obtain varied experience before devoting themselves to one field. Mr. Blake feels that, "An engineering graduate has practically no ceiling provided he has the right attitude and is willing."

Promoted again in 1954, Mr. Blake is now Foreman—Electric Shop in Central Maintenance. Supervising a crew of 40 men, he is responsible for electrical construction work, maintenance and crane wiring. Mr. Blake feels he is in "an interesting and challenging field of work." He has found that "U.S. Steel is a highly desirable employer in this most basic of all industries."

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

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

UNITED STATES STEEL

AMERICAN BRIDGE . . AMERICAN STEEL & WIRE and CYCLONE FENCE . . COLUMBIA-GENEVA STEEL . . CONSOLIDATED WESTERN STEEL . . GERRARD STEEL STRAPPING . . NATIONAL TUBE
OIL WELL SUPPLY . . TENNESSEE COAL & IRON . . UNITED STATES STEEL PRODUCTS . . UNITED STATES STEEL SUPPLY . . *Divisions of* UNITED STATES STEEL CORPORATION, PITTSBURGH
UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY

Gaylord E. Moss expects to receive his B.S. in Electrical Engineering from Tufts College in 1957. His interest in electronics was aroused, in part at least, by summer work in Du Pont's Photo Products Plant at Parlin, N. J. But Gaylord's interest in technical work goes much farther back. He received the Bausch and Lomb Science Award at his high-school graduation.

"Gay" Moss wants to know:

At what location would I work for Du Pont?

Clayton B. Hill, Jr., joined Du Pont's Jackson Laboratory at Deepwater, N. J., in 1940 and left for the Air Corps in 1942. After military service he obtained a B.S.Ch.E. from Pennsylvania State University (1949), and returned to Jackson Laboratory. Clayton was assigned to Du Pont's Atomic Energy Division for a period before transferring to the Personnel Division. As a representative of this Division, he currently visits many colleges and universities.

Clayton Hill answers:

Where would you *want* to work, Gay? The choice isn't quite so wide as that reply indicates, but if you have good reason for preferring a given area, and Du Pont has an opening there for which you're qualified, your choice will certainly be considered. We have 69 plants and over 70 research and development laboratories scattered through 26 states. So the odds are pretty fair that you can work in an area you like.

Most of the Du Pont units are situated east of the Mississippi, but some of them are as far west as the Pacific Coast. Right now, new plants are under construction in Michigan and California, providing even wider choice in those two states.

Of course, a man may be transferred after a time. The chemical industry is a growth industry, and transfers are generally associated with progress and promotions.

So you see, Gay, the geography of the United States is pretty much an open book for Du Pont professional men, adding a lot to their interest and enjoyment on the job.

WANT TO KNOW MORE about where you'd work with Du Pont? Send for a free copy of "The Du Pont Company and the College Graduate." This booklet contains a complete listing of plant and laboratory locations, by state, and describes work available. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington 98, Delaware.

DU PONT

REG. U. S. PAT. OFF.

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

Enjoy "Du Pont Cavalcade Theater" on Television

Boeing production engineering—precision on a big scale

This Boeing B-52 wing jig is one of a battery of four. Each one is 90 feet long and weighs more than 1,000 tons. Yet many of its tolerances are within 1/1000 of an inch — as close as a fine watch! Almost-absolute accuracy on a tremendous scale like this means that Boeing production engineers face some of the most stimulating challenges in engineering today.

These production engineers are of many types. And, because of steady expansion, Boeing needs more of them: industrial, civil, mechanical, electrical and aeronautical engineers.

There is "growing room" for topnotch production engineers at Boeing's Wichita and Seattle plants. Big programs are now under way on the airplanes and guided missiles of a few years hence. And Boeing production engineers are responsible for the high quality and continuous development of such industry-leading airplanes as the B-52 — famous "Long Rifle" of Strategic Air Command — and the 707 — the world's first jet tanker-transport.

At Boeing, production engineers find individual recognition in tightly integrated teams in design-analysis, test, and liaison-service. They find that Boeing is an "engineers' company," with a long-standing policy of promotions from within the organization.

Career stability and growth are exceptional at Boeing, which now employs more than twice as many engineers as at the peak of World War II. Boeing engineers enjoy a most liberal retirement plan. And life for them is pleasant in the progressive, "just right" size communities of Seattle and Wichita.

There are opportunities at Boeing in design and research, as well as in production. If you want job security, satisfaction and growth, it will pay you to investigate a Boeing career *today*.

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

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

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

BOEING

Aviation leadership since 1916

SEATTLE, WASHINGTON WICHITA, KANSAS

Ocean Laboratory—here at its big Kure Beach, N. C., Testing Station, Inco exposes thousands of metal specimens to the corrosive effects of salt spray, salt air, salt water.

How hard can the sea bite? This is no secret to Inco Corrosion Engineers. For over thirty years, they have been collecting data on the corrosive and erosive effects of sea water on many different kinds of metal.

In Inco's "Ocean Test Tube" and associated laboratories, Inco Corrosion Engineers have the facilities and apparatus to study all phases of marine and atmospheric corrosion.

How International Nickel finds out what the wild waves are saying

The sea's a killer of many metals. Some it corrodes or rusts. Some it wears away. Some it destroys by eating up one of the alloying elements. Some it makes so "allergic" to connecting metals that corrosion is speeded up.

To hunt this killer down, International Nickel has made the ocean into a test tube. At Harbor Island and Kure Beach, North Carolina. Here, Inco Corrosion Engineers study the corrosive effects of salt water, salt spray, salt air, water velocity, marine growths, coupling methods.

To help you plan Inco Nickel into your future, International Nickel Company has collected data from almost a quarter of a million individual tests on the behavior of metals and various other materials under all sorts of corrosive conditions.

"Corrosion in Action" is an Inco-prepared film in full color. It shows how corrosion acts and how it can be controlled. Prints loaned to engineering classes and student technical societies. Write, The International Nickel Company, Inc., Dept. 126e, New York 5, N. Y.

INCO TRADE MARK **International Nickel**

Producer of Inco Nickel, Nickel Alloys, Copper, Cobalt, Tellurium, Selenium and Platinum, Palladium and Other Precious Metals

On the Cover: See "Newstuff," Page 16.

Frontispiece (Page 8). See "Newstuff", Page 17.

MISSOURI
SHAMROCK

VOL. XXII APRIL, 1956 NO. 7

CONTENTS

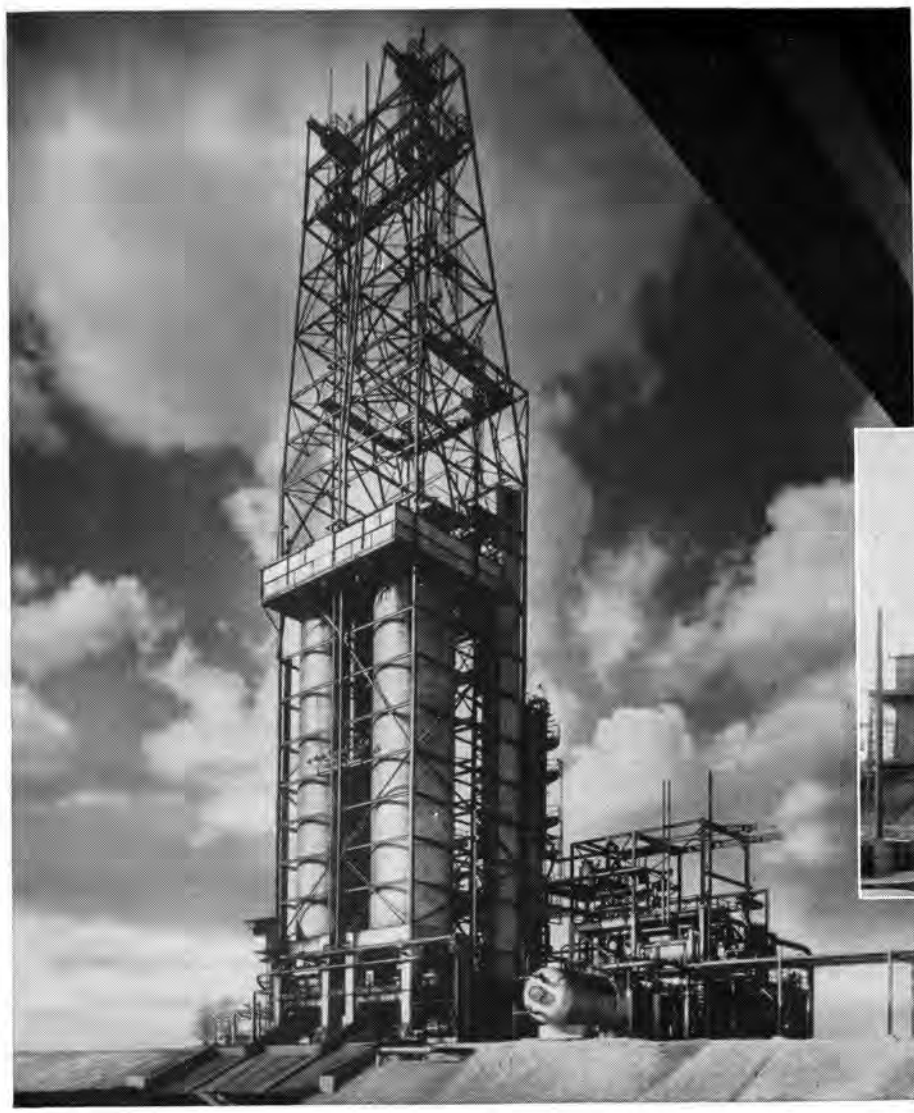
FEATURES:

DEPARTMENTS:

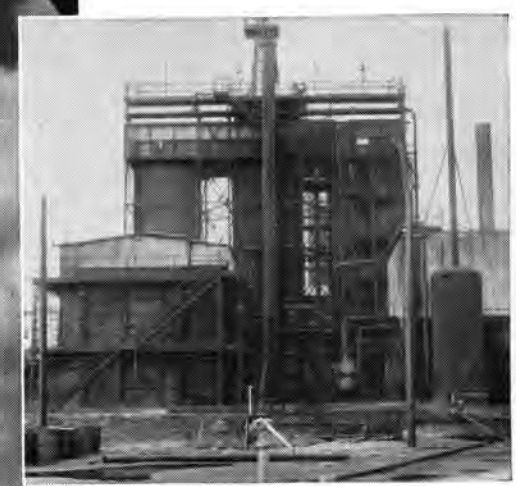
MEMBER
ENGINEERING COLLEGE MAGAZINES
ASSOCIATED

Chairman, Merk Hobson, University of Nebraska
Publisher's Representative, Littell-Murray-Barnhill, Inc., 101 Park Avenue, New York 17, New York, and 605 Michigan Avenue, Chicago, Ill.

Published monthly except June, July, August, September, by Board of Publications of Engineers Club, University of Missouri. Office of Publication: Room 233 Engineering Building, University of Missouri, Columbia, Missouri. Entered as second class matter at the post office at Columbia, Missouri under the act of March 3, 1879. Printed by The Missouri Farmer, Columbia, Missouri. Single copies 25 cents; subscriptions, $1.50 per year, $2.50 for 2 yrs.



This towering modern unit at the El Dorado, Ark., refinery of Pan-Am Southern Corporation, a Standard Oil subsidiary, produces 700 tons of coke daily.



Standard's original delayed coking unit at Whiting recently celebrated its 25th birthday "on stream" and going strong.

How to make an exception prove a rule

TECHNOLOGICAL PROGRESS is rapid in the petroleum industry. Few processes have a chance to "grow old" on the job. Most are killed off through the combined efforts of thousands of scientists working constantly to improve everything we do, make or use in our business.

Every now and then, though, we experience a happy exception to this rule. That occurs when a new development not only meets the immediate need but also provides the right answer to situations yet unforeseen.

Twenty-five years ago last August a process known as "delayed coking" was invented. The new process made a quicker, cleaner job of converting heavy residual oil into gasoline, gas oil, and coke. It paid off spectacularly when catalytic cracking was invented and these giant new units began calling for feed. It paid off again when the diesel locomotive came along to put the heavy oil burning steam locomotive out of business.

Dr. Robert E. Wilson, chairman of the board of Standard Oil today, was the inventor of delayed coking. Almost all of the young scientists who worked with him in its development are still with Standard too, in responsible positions requiring their special skills.

Young scientists in research and engineering at Standard Oil today find it satisfying to see their creative efforts translated into valuable product and process improvements.

Standard Oil Company

STANDARD

910 South Michigan Avenue, Chicago 80, Illinois

Editorial

Student extra-curricular activities usually fall far short of having full support from the students. Why is this? Are students so intrigued by their assignments that they can do nothing but sit at home and admire them? Or is it possible that they have had so much of their field of study during the day that they just can't arouse themselves to go to a meeting that night and hear more about the same subject. Let's take a hypothetical situation and see if it throws any light on the difficulty.

The American Society of Pottery Engineers has a meeting. Joe Doaks, a freshman in the Narrow Necked Vase option of pottery engineering, decides to go to it. The speaker of the evening is Mr. Dishley C. Turningwheel, a very distinguished engineer in the field of blue plate design (for blue plate dinners). Mr. Turningwheel expounds at length on his work, using synonyms, antonyms, and even pseudonyms to drive home his point. Joe is slightly impressed for the first fifteen minutes, getting depressed during the next thirty minutes and feeling definitely harassed for the remainder of the talk. Does Joe go to the next meeting? Perhaps so (with the look of a martyr on his face) but probably not—he sees enough pottery during class time to suit even his avid interest in the subject.

Is it the speaker's fault that Joe didn't enjoy the meeting? Probably not. More likely, the blame must be attributed to that unknown quantity called, for the lack of a better name, "human nature". It is human nature for the student leader of Joe's pottery society to feel that he should present pottery topics at his meetings. It is human nature for Joe to get bored when he hears more about pottery.

Let's return to our hypothetical situation. This time, instead of Mr. Turningwheel, our speaker is Professor Deepthoughts of the Psychology Department of the University. Joe is profoundly shocked when the Professor is introduced. What has he to do with pottery engineering? It soon becomes apparent that he has practically nothing to do with pottery engineering. Instead, he is concerned with the human element of engineering. This is a rather new concept to Joe and he soon finds himself deeply interested in what the Professor is discussing. After the meeting, he continues the discussion with some of the other students. In addition, he decides to go to the next meeting and see who they have for a speaker.

The point is this: College students are generally intelligent enough to be interested in a great deal more than their specific field of study. They are more likely to remain interested in an organization which provides a variety of stimulating topics, rather than a steady diet of "Pottery Engineering".

P.D.G.

Product Design by Digital Computers

MARSHALL MIDDLETON, JR.
Analytical Department
Westinghouse Electric Corporation
East Pittsburgh, Pennsylvania

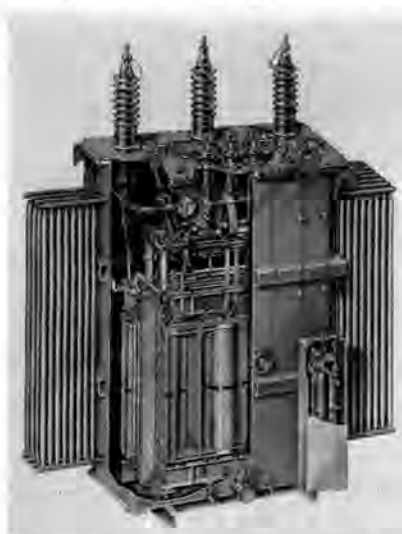
Industrial and consumer product designs that require days, weeks, or even months to complete may soon be designed in a matter of minutes. At the same time, tremendous improvements will be made in the quality of the product. The savings in engineering man-hours and the quality improvements will be made possible by the introduction of modern high-speed digital computers into the design work. These computers have proved themselves invaluable in every design problem to which they have been applied, and show promise of completely face-lifting many future design operations. Their application, however, requires laying a great deal of groundwork before designs can be attempted.

Although small- and medium-powered digital computers have been used for years in product design, they did not greatly affect established procedures. Engineers still used manual methods. Digital computers were used only to calculate physical characteristics of certain parts of a complete design. For instance, in the design of a motor or generator, the computer was used only to calculate the critical speed of the rotating system. The engineer used this result as a criterion for modifying his design. Because of the limited storage capacity of the early computers and their inability to make logical decisions, components of a particular design could only be analyzed one at a time. While this computer-manual design produced a better-engineered product, the basic design methods were not appreciably affected.

The modern high-powered digital computer, by virtue of its extremely high speed and practically unlimited storage capacity, is causing a major change in the present design methods. The complete design of a product, from customer specifications to shop manufacturing information could be performed by computers. The computer would calculate many variations of the same design, and select the best from the standpoint of performance, cost, etc. Alternate proposals for customer quotations could be obtained quickly. All of these would result in a shorter delivery time for a better-engineered product, at a lower cost.

Programming

Before a digital computer is capable of designing equipment, the design engineer and a computer consultant must convert the design methods and associated data to a form that the machine can accept. This conversion process is called *programming*. In general, a digital computer designs equipment using the same design philosophy as that followed by an experienced engineer. Starting with the customer's specifications, a set of initial input parameters are calculated by means of empirical formulas based on previous models. These parameters are used in the design method to determine a set of performance characteristics. The calculated characteristics are compared with performance characteristics specified by the customer and manufacturing codes. If the calculated characteristics fail to meet the guarantees, the input parameters are modified and the process repeated.



Typical power transformer that has been programmed for automatic design by digital computers.

In organizing the design method and associated data for the computer, the design engineer and programmer must develop a flow chart and a complete step-by-step mathematical outline of the method. The flow chart is a graphical representation in block form of the design procedure. First, a general block flow chart is constructed that illustrates the major accomplishments of the computer program and any iterative loops; then a block flow chart for each major accomplishment is constructed that graphically represents every operation and logical decision described in the mathematical outline. The step-by-step mathematical outline must contain the mathematical relationships of all equations, curves, etc. to be used in the design method. Also, the designer must record in logical sequence all the decisions made during the course of a design. Fulfilling this last requirement is no simple matter. The design engineer must rely on all his ingenuity and design intuition to develop a set of rules for modifying the input parameters whenever certain calculated performance characteristics fail to meet the guarantees. Based on a specific performance-guarantee disagreement pattern, the designer must determine which input parameter to change and in which direction. This requires an extensive study of the design process, but is essential if the computer is to design a product over the entire range of possible product ratings.

The programmer uses the flow chart and mathematical outline to convert the mathematical relationships and logical decisions of the design method into the basic machine operations. Actually, a high-powered digital computer is only capable of performing simple logical and arithmetical operations. Its tremendous

advantage stems from its ability to perform these simple operations at incredible speeds. Hence, complex lengthy mathematical equations that are expressible in terms of the basic arithmetical operations — subtraction addition, multiplication, and division —can be solved in a reasonable length of time.

After the program has been written for all the design equations and their associated logical decisions, this information is read into the computer.

Basically, any high-powered computer consists of four main components: input, output, storage, and arithmetic units. Information can be read into the computer on paper tapes, punched cards, or magnetic tapes. Results of a computation can be obtained from the computer on paper tapes, punched cards, magnetic tapes, a cathode ray tube screen, or printed on paper. Data and instructions can be stored in the computer in magnetic cores, on magnetic drums, or magnetic tapes. Because of the high speed with which information can be read to and from the magnetic-core storage, it is used in conjunction with the arithmetic unit. Programs are stored in block form on the magnetic drums and tapes and are read in this form into the magnetic-core storages whenever the computer is required to execute that particular program. High-speed storage registers, instruction register, multiplier-quotient register, and the accumulator combine to form the arithmetic unit. The high-speed storage registers hold the information involved in the current calculations. The multiplier-quotient register contains the multiplier in any multiplication operation and is the register in which the quotient is developed during a division. The instruction register contains directions for the computer operation. The instructions are stored in sequential storage locations and are executed in the same fashion. The accumulator is an adding register in which the sum or difference of any two numbers can be obtained. It is also used to hold the dividend in division.

A modern high-powered digital computer is capable of performing over eighty simple arithmetic and logical operations. Each mathematical expression in every design equation must be reduced to these simple operations. If the mathematical expression involved is not included in the existing computer operations, it too must be further reduced. Certain mathematical expressions that fall into this category can be expressed in relationships involving only basic machine operations. For example, the design equation might require the square root of some number, say *A*. This expression is not included in the basic machine operations. However, it can alternately be expressed by the convergent iterative equation,

$$\sqrt{A} \longrightarrow N_{i+1} = \tfrac{1}{2}(N_i + A/N_i)$$

in which every operation in the equation is included in the machine operations. When this set of operations has been programmed, it is usually stored in some portion of the computer memory. Henceforth, whenever this same expression is required, use may be made of the existing program. Such a program is called a *subroutine*.

The square-root subroutine will clarify the meaning of the flow chart and the functions a programmer must perform to reduce a mathematical operation to the basic machine operations.

While digital computers can execute a program in a matter of minutes, programming is sometimes a tremendous task. Once written, however, programs can be used for years with occasional revision.

Digital-Computer Design of Transformers and Motors

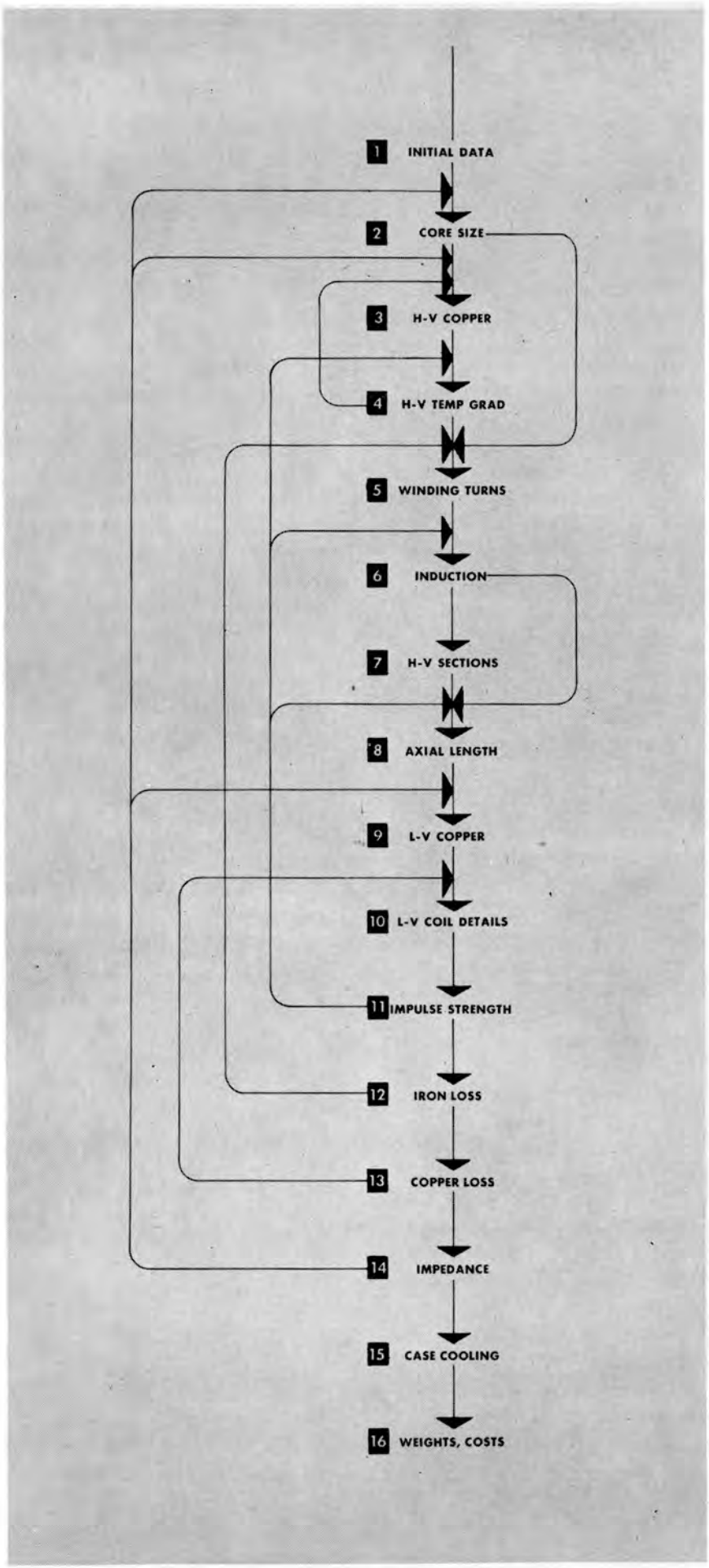
Large standard-line core-form transformers and induction motors are currently designed by digital computers. Transformers have been designed over a range of 750 to 20000 kva, with basic impulse levels up to 350 kv. Induction motors have been designed with ratings from 200 to 2000 hp, at line voltages up to 6900 volts.

Transformer Design — The digital computer designs transformers using the same philosophy as that followed by an experienced engineer. Once the input information, such as kva rating, basic impulse level, temperature rise, etc., has been entered into the machine, the computer initially selects or assumes certain design parameters necessary to calculate performance characteristics. These characteristics are then compared with the specified guarantees. If calculated values exceed those guaranteed, the initial assumptions are revised and the process repeated until a favorable design is produced.

A total of 16 subroutines are used by the computer to design a transformer. Their relative operational position in the computer program is illustrated by the transformer flow diagram (Fig. 2). The first subroutine includes all items generally specified by the customer, such as maximum temperature rise, winding connections, impulse levels, etc. Subroutines two through ten deal with design parameters, which are the quantities to be varied in order to produce an acceptable design. Subroutines 11 through 14 represent the test criterions based on the specified guarantees. Subroutine 15 calculates the type and amount of external cooling equipment required to maintain the operating temperature of the transformer below the allowable maximum. Subroutine 16 calculates the weight and cost of the transformer.

The computer begins a transformer design by first selecting a core size by means of empirical formulae based on kva ratings and the basic impulse level. High- and low-voltage windings are selected to complete the initial transformer design (subroutines 1 through 10, Fig. 2). The design is checked for impulse strength (step 11 in Fig. 2). If the initial design fails to meet the impulse-strength criterion, corrective changes are made in the proper design parameter and the test applied again. The operation is repeated until the impulse-strength criterion is satisfied. The iron and copper losses are then calculated. The maximum allowable iron loss for a given core size can be obtained by programming to obtain the maximum allowable induction. The copper loss is varied by increasing or decreasing the size of the wire in the proper

(*Continued on page* 12)



DIGITAL COMPUTERS

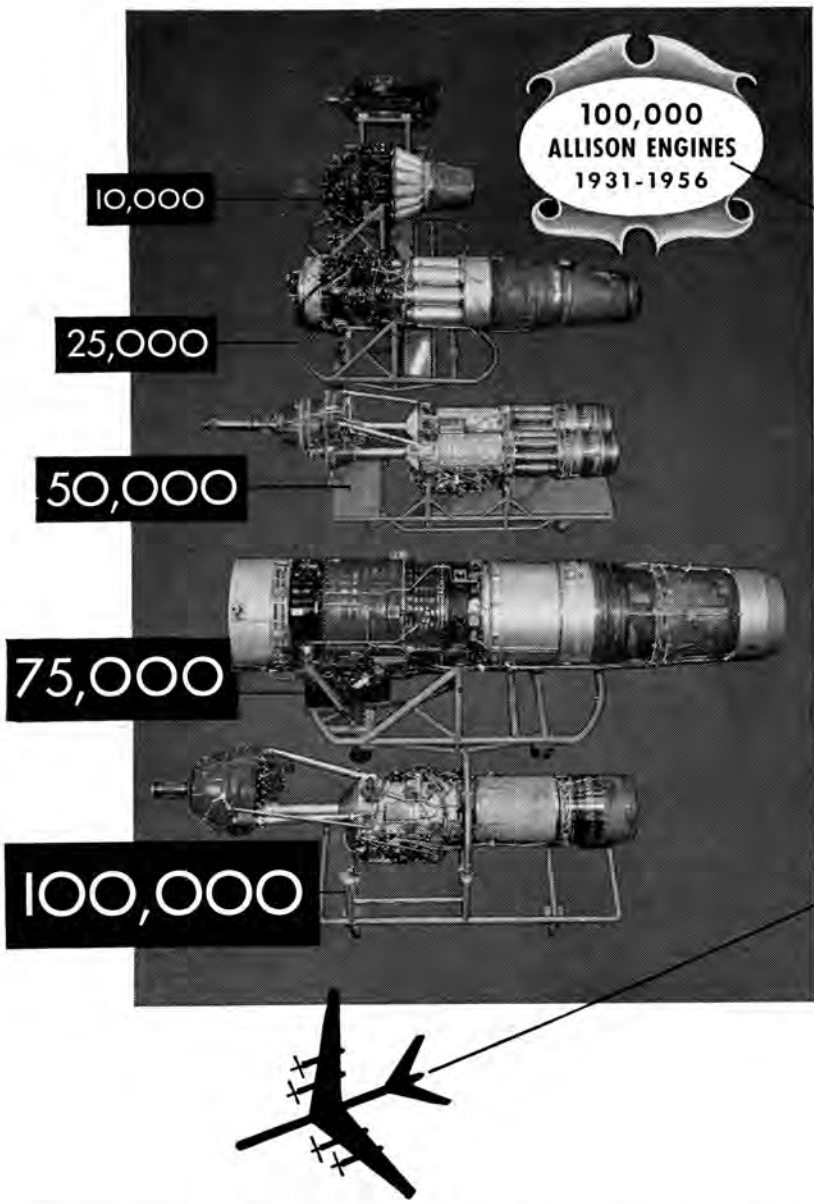
(*Continued from page* 11)

winding. When these two results satisfy the guarantees, the impedance is calculated (subroutine 14.) If the calculated impedance does not correspond to the guarantee, the physical proportions of the existing design may be changed or a new core size selected. The latter alternative means that an entirely new design must be made. After the proper impedance has been obtained, cooling, weight, and cost are calculated to complete the transformer design.

Induction-Motor Design—Thus far, only large standardline induction motors are being designed by computers. This line consists of a discrete number of frame sizes that have definite stator and rotor diameters, slot dimensions, air gaps, etc. Again the trial-and-error process is employed. The computer first determines an initial D^2L value from an empirical equation based on horsepower and pull-out torque. (Diameter squared times length is an arbitrary design parameter used to obtain a first approximation of machine size.) The computer assumes a diameter starting with the smallest frame size, and obtains a length based on the calculated D^2L. If the determined length lies outside the range or lengths specified on that particular frame size, the next frame diameter is selected and the process repeated. When an acceptable rotor length is obtained, the temperature rise of the rotor during starting is calculated. This determines if sufficient slot volume exists to prevent the damper bars from overheating during starting. The length is increased by small increments until sufficient volume is obtained. With a suitable diameter and length established, the associated machine constants (such as the iron depth below rotor and stator slots, the iron area between adjacent rotor and stator teeth, etc.) are calculated for use in the various performance equations. At this point, a flux density is calculated

(*Continued on page* 30)

Fig. 2—Flow diagram for designing power transformers.
Typical power transformer that has been programmed for automatic design by digital computers.



PIONEERING NEVER ENDS AT ALLISON

Today's powerful turbo-jet and turbo-prop engines are a far cry from the aircraft engines of a mere 10 years ago.

But we've hardly scratched the surface. We're still pioneering.

Sure, the sound barrier's been cracked. But, who knows, perhaps in the next 10 years we'll be flying at speeds 2 or 3 times the speed of sound. Newer, more complex, more powerful engines ARE in the offing. There'll be new fields to conquer. For instance, the thermal barrier!

Allison, a pioneer in the design, development and production of aircraft engines, now is working on advanced design turbine engines to meet future requirements . . . whatever they might be. Proven features of engines like the Allison J71 and T56 may be adapted to the engines of tomorrow. Allison engines of the future will be backed up with worlds of experience gained in the development and production of its first 100,000 aircraft engines.

Now, Allison is in the midst of a $75 million expansion program in engineering research and development facilities. Completion of the program will give Allison one of the world's most complete, best-equipped, centers for the development of new, high performance turbo-prop and turbo-jet aircraft engines. This opens new and unlimited opportunities for young graduate engineers, for the program—financed by General Motors—creates an immediate need for a 40% increase in engineers.

☆ ☆ ☆

Want to know more about YOUR career opportunities at Allison? Why not arrange now for an interview with our representative on your campus. Or, write for information about the challenging work awaiting you at Allison: Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

By JERRY HERDAN, M.E. '57

MISSOURI HONOR AWARDS

Five outstanding American engineers were presented the Missouri Honor Award for Distinguished Service in Engineering at the Engineering Convocation in Jesse Auditorium, Saturday, March 17.

The five Honor Award recipients were: Dr. J. Brownlee Davidson, famed professor of agricultural engineering at Iowa State College, Ames, Iowa; William Grant Purdy of Baltimore, brilliant young scientist noted for development of rockets and guided missiles; Louis Harry Winkler of Bethlehem, Pa., noted metallurgical engineer and leader in steel manufacture; George A. Delaney of Pontiac, Mich., prominent automotive engineer known for leadership in the field of standardization; and Procter Thomson of Cincinnati, noted for his work in quality control as well as for pioneering in the application of statistical methods to chemical engineering problems.

The five, four of whom are graduates of the University of Missouri, received the symbolic bronze medals and copies of their citations from Dean Huber O. Croft of the College of Engineering.

In his introductory remarks on the Honor Awards, Dean Croft told the 1,200 engineering students and hundreds of distinguished guests attending the convocation that "The contributions which these men have made are intimately involved in the present and future of this great civilization, which is Amercia. They were once, not many years ago, students such as the young men in the audience, and we hope that in this centennial senior class that there may be at least five men who may become as distinguished as these medal recipients we honor here today."

Dr. Davidson, a native of Nebraska who holds B.S. in Mechanical Engineering, Agricultural Engineer, and Doctor of Engineering degrees from the University of Nebraska, was cited by Dean Croft for his "outstanding achievements in the field of agricultural engineering and engineering education."

The Iowa educator was lauded in the citation for his vision, leadership, and pioneer work in the application of engineering to agriculture, his service to the whole American economy in development of college instruction in agricultural engineering, and his promotion of high professional standards through his work in professional societies.

Dr. Davidson was experienced in farm work from boyhood, but during his college years spent his summers as machinist in locomotive shops, as a draftsman in construction, and as a service man and a research assistant with farm machinery manufacturers. After obtaining his first degree, he served as an instructor in farm mechanics at Nebraska, and later became professor of agricultural engineering at Iowa State College, then the University of California, and finally, in 1919, back to Iowa State College where he again headed the department of agricultural engineering.

Author of many important books and scores of bulletins and special articles in his field, member of numerous professional and honorary societies, and recipient of numerous honor awards, medals, and citations for distinguished service, Dr. Davidson has served often on governmental committees, research survey groups, war production, advisory and consultant boards of the United States government, and as advisor to several foreign governments.

William G. Purdy, latest of the four Missouri graduates in today's honor group, is director of all engi-

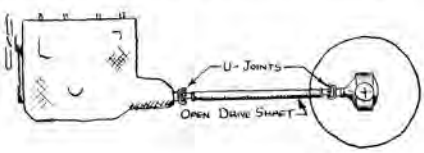
(*Continued on page* 28)

Rear Suspension Prediction

by SAM BELL, M.E., '56

With the exception of the Nash and Buick cars, the American passenger car is suspended with a Hotchkiss type rear end. Nash and Buick use the torque tube. It is the purpose of this article to predict a change in suspension and to list the reasons for that change.

The Hotchkiss suspension, strangely enough, was first used on the 1905 Hotchkiss car. It is therefore one of the most recent schemes, being pre-



Hotchkiss Drive: Driveshaft is not enclosed and does not resist torque about rear axle center line.

ceded by both the torque tube and the De Dion types. The swing axle types are all more recent, yet.

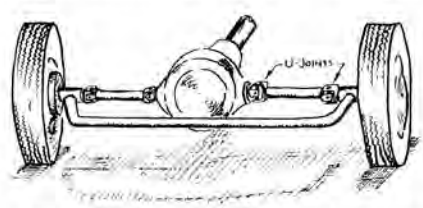
The first successful use of the Hotchkiss drive was on the 1912 and 1913 Peugeot cars, which were run successfully at Indianapolis. The system became very popular in succeeding years and actually displaced the torque tube drive in popularity.

The biggest disadvantage to the Hotchkiss and torque tube drive is the placement of the differential weight on the rear wheels. Eventually two excellent designs were produced with the differential weight on the rear wheels.

The 35C Bugatti suspension was not strictly a Hotchkiss drive car because the accelerating force was not transferred through the springs. Instead, radius rods were used with the open propeller shaft, and the unit was suspended with quarter elliptical springs. This effected an appreciable reduction in unsprung weight when used with the unit wheel and brake drums of Bugatti design. The success of this car in sporting events has not been surpassed, in spite of the fact that it had an engine of a particularly crude design. The inferior lateral stability of the Hotchkiss system was completely corrected in this design.

The P-3 Alfa Romeo was also of excellent design, having the differential mechanism mounted at the rear of the transmission and drive to the rear axles by twin drive shafts turning in similar directions. While the over-all weight of this system would possibly be more, the unsprung weight would be reduced considerably. Another unique feature of this suspension was the provision for shackles on both ends of the springs, thus isolating the frame from impact loadings due to wheel kick. This was possible due to the very rigid construction of the axle in the dual drive mechanism.

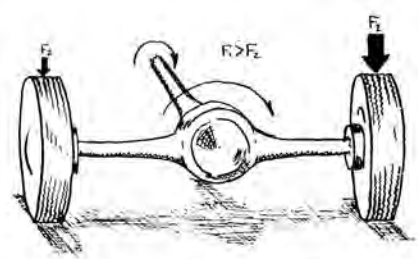
A third improvement in the Hotchkiss suspension was in a post-war Alfa Romeo, which reduced the weight transfer on the rear tires due



The DeDion rear end. Wheels are kept parallel by a rigid "dead" axle. Unsprung weight is reduced by mounting differential on body of car.

to propeller shaft torque by using double reduction gears in the differential. The racing type Jaguar car used a system of levers to accomplish this same reduction in weight transfer. Both of these methods resulted in a decided reduction in wheel lifting and wheel hop, factors that are beginning to plague American passenger cars due to the increased low gear torques and the decreased rear axle ratios. One American passenger car manufacturer has attempted to reduce this wheel hop by raising the rear roll resistance with outrigger springs. The advisability of this scheme is dubious because of the reduced cornering power that results when compensations in the front suspension are made to effect the required understeering characteristics. The balanced torque differential, new this year in the United States, is a more advisable method of reducing wheel hop and the features of this improvement include greater tractive power under variable road conditions.

These improvements and modifications to the non-suspended differential rear ends, while very ingenious, are only stop gap measures, and eventually the automotive industry will run out of rope. The question of what they will do then is this article's conclusion. Since any improvement must primarily have advertising value, some type of hydraulic or pneumatic springing system is indicated. In conjunction with a weightless suspension system, balanced torque differential and suitable bracing will put the American passenger car rear end on a par with the Bugatti 35C. Its characteristics will be that of (1) reduction in wheel hop (2) slight reduction in unsprung weight (3) improved lateral stability and cornering power, and (4) possible reduction of wheel kick impact. These improvements, however, are only mediocre compared to the improvements possible with some type



Wheel Hop: As the car accelerates F_1 is greater than F_2 due to driveshaft torque. The "F_2" wheel slips, then "grabs" the ground, resulting in a "hopping" effect.

of sprung differential system, i.e., (1) reduced frame deformation, if transmission is moved rearward, (2) reduced propeller shaft problems, if transmission is moved rearward, (3) increased polar movement of inertia, especially if transmission is moved rearward, resulting in sizeable reduc-

(*Continued on page* 24)

NEWSTUFF

By DANIEL R. CAPPS, B.S., E.E., '56

EMPIRE STATE BUILDING TO LIGHT UP THE SKY

(See Cover)

The Empire State Building will light up the skies of much of the northeast through the addition of four mighty searchlights. Installed just above the observation platform, 1,092 feet above the streets of New York City, these beacons will be powerful enough to be seen under ideal conditions as far away as Boston and Baltimore.

Heart of the searchlights will be the lamps manufactured by the Westinghouse Electric Corporation. These 2,500-watt short-arc mercury lamps, in conjunction with the highly polished reflectors, will produce 450,000,000 candle power of light per beacon. Combined, the four beacons will provide almost two billion candle power of light and are reported to be the brightest continuous man-made source of light.

Originally, the searchlight units were carbon arc lights used as anti-aircraft searchlights during World War II. They have been specially modified to house the Westinghouse lamps.

Temperatures within the searchlights will reach as high as 1500 degrees Fahrenheit. To withstand these extremely high temperatures, the bulbs are made of quartz rather than glass. The quartz is also required to withstand high internal pressures of more than 300 pounds per square inch.

One of the five-foot beacons will point straight up. The three others on the world's tallest building will be directed outward at an angle of five degrees above the horizontal. They will revolve counterclockwise at the rate of one revolution per minute from sundown to midnight.

HOT SAFE

What is probably the world's "hottest" safe—and one which no burglar would want to crack—has been devised by General Electric Company atomic experts here for storing and studying radioactive materials.

The safe is a 15-ton, cylindrical installation that operates much like a soft-drink dispensing machine. It suspends up to 780 "hot" samples on large horizontal discs mounted one above the other inside a six-foot vertical cylinder. These samples are test pieces of uranium which have been subjected to chain reaction in plutonium-producing reactors at the Hanford plant, operated by G.E. for the Atomic Energy Commission.

The floor vault can store materials with as much radioactivity as exists in eight pounds of radium, more than the total amount produced in North America before World War II.

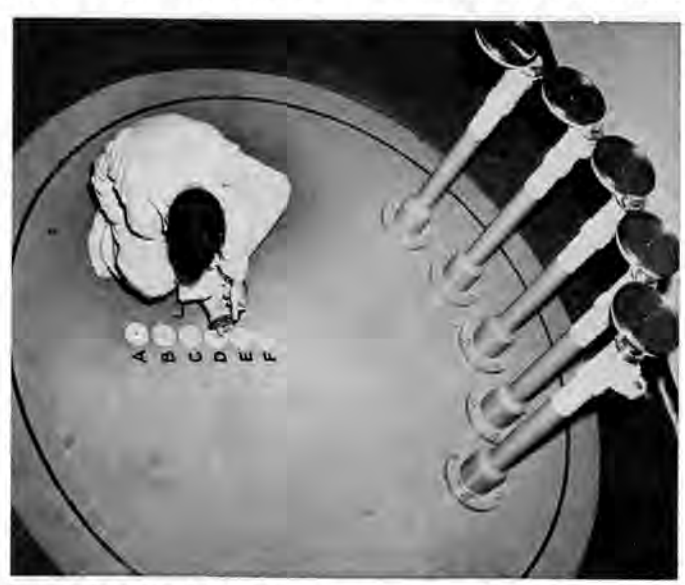
The top of the storage cylinder, located at floor level, is a steel disc, 10 inches thick and eight feet in diameter. It is located in the Hanford radiometallurgy laboratory and was designed as a vital, supporting tool for research into nuclear bombardment effects on fissionable fuel.

To insert or remove a sample, technicians remotely rotate the discs below the floor level until desired specimens are lined up under access holes in the discs above. Samples needed can be inserted or extracted without having to remove any other sample in storage. This arrangement minimizes the escape of radiation.

To remove a sample, the technician on duty lifts a plug from the cylinder top, places a one-ton lead cask over the opening and turns a wheel to line up the wanted sample.

Once the sample has been properly positioned, a claw mechanism is lowered through an opening in the heavy cask to lift it into the cask. After that it can be transported safely to the main laboratory for study.

Samples that are the "hottest" radioactively are stored on the lowest



HOTTEST SAFE—Highly radioactive canned uranium is stored in a safe that works like many soft drink dispensers. Samples hang from five steel disks located below floor level that are positioned by hand wheels at right to bring them into position for removal. Used at the Hanford, Washington, Atomic plant operated by General Electric for the AEC, the safe keeps radioactivity from escaping into the plant's metallurgy laboratory.

disc, six feet below the laboratory floor. This puts 18 inches of steel between them and the working area.

During insertion or removal of samples, a vacuum system sucks air from the laboratory into the safe, through a filter and out an exhaust stack to prevent loose radioactive particles from escaping into the laboratory.

BEHEMOTH

The world's largest adjustable rail milling machine, weighing 1,230,000 pounds, will soon be installed here in the General Electric Company's Large Steam Turbine-Generator plant.

The giant is being built by the Ingersoll Milling Machine Co., Rockford, Ill. Purchase of the machine as well as the special construction of the foundation to support it will represent a total investment of more than $1½-million.

The machine will be 120 feet long, stand 35-feet 2-inches high, and will be 42-feet 1-inch wide. It will be capable of machining work pieces up to 18 feet wide and 16-½ feet high.

Four G-E 100-hp motors will drive the individual milling heads. Two 17½-feet-wide work tables, one of them 22-feet and the other 34-feet long, will operate on a 112-foot-long bed. Use of the two tables separately will allow setting up or unloading one work piece while another work piece is actually being milled on the other table. For very large work, the tables can be joined and used as one.

There is a span of 18-feet between the spindle noses, and a height of 16½-feet from table to the rail head spindle noses.

It is estimated that this machine can do work equivalent to three 16-foot planers.

Two 56-foot chip conveyors, one on either side of the table, will carry off chips to a 20-foot cross-conveyor at one end of the table. This latter unit will remove the scrap to containers.

Some 847-cubic yards of fill as well as 600-cubic yards of concrete were removed to allow construction of the machine's base.

Once the floor-area was excavated to a seven foot depth, some 44 steel "H" bearing piles were driven down on 4-foot centers some 100-feet to bed rock. Thus with the original piles, a total of 85 steel piles will form the support of this machine's foundation.

BEHEMOTH—Two huge pieces are being machined here in tests of the world's largest adjustable rail milling machine, which will soon be shipped to General Electric's Large Steam Turbine-Generator plant in Schenectady, N. Y. from the Ingersoll Milling Machine Co. of Rockford, Ill. The machine is 120 feet long, 35 feet high and 42 feet wide. It will handle pieces up to 18 feet wide and 16½ feet high. Four GE 100-hp motors will drive the individual milling heads.

The excavation is of irregular size with a center depth of 16-feet and a depth of 8-feet 6-inches at the ends, 126-feet in length and 40-feet maximum width. A total of 1150-cubic yards of concrete and 40 tons of reinforced steel rod will be laid atop the piles to form the foundation. All of the work on the machine's base took place inside the factory over a period of several months without interrupting production.

Present plans call for the machine to be in operation by mid-1956.

WORLD'S LARGEST POWER SHOVEL

(See Frontispiece)

The largest power shovel in the world—half again the size of any other power shovel—recently began coal stripping operations for the Hanna Coal Co. at Cadiz, Ohio. Built by the Marion Power Shovel Co., the monster is powered and controlled with General Electric Equipment.

It carries a 60 cubic yard dipper and is capable of moving 90 tons of rock and earth at each pass. The new machine over-shadows all previous large shovels in reach and power much more than it does in dipper capacity.

The 150 foot boom and the 100 foot dipper stick are about 40 per cent larger than those on the largest shovels heretofore used. The resulting long reach and high lift will handle correspondingly deeper over burden economically. This will make available for single cut, open pit mining, many thousands of tons of coal which could not be stripped economically by smaller machines.

This machine is one hundred times larger than the average "neighborhood" power shovel. The boom tip stands 145 ft. above the ground and it is capable of working economically in a 90 foot bank.

Power is transmitted to the shovel through a 250 mcm, type sh-d, rubber armored, 3 inch diameter, trailing cable at 6.9 kv from a 5000 kva, 69000-6900 volt, portable substation. This marks a new development in power distribution to large shovels. The voltage almost universally used in large open pit mining operations is 4.16 kv. The large amount of power involved in the operation of the new shovel makes the use of the higher distribution voltage imperative.

Two motor generator sets supply d-c power under Ward Leonard control for the main motion motors. The larger set is driven by a 3500 hp, 3500 kva, .8 power factor, 1200 rpm, synchronous motor. This motor drives four 400 kw, 250 volt, d-c hoist generators each having a no load voltage of 600 volts and a stalling current of 3200 amperes. This large set also includes a 330 kw, 500 volt, d-c gen-

(*Continued on page* 22)

World's most powerful production aircraft engine

The J-57 axial-flow jet engine with afterburner, designed and developed by Pratt & Whitney Aircraft.

McDONNELL F-101 — The Voodoo, an Air Force supersonic fighter that has two J-57 engines with afterburners, is the most powerful jet fighter yet built.

BOEING 707 — The Stratoliner will usher in commercial travel in the jet age. It is the counterpart of the KC-135, a military tanker-transport powered by four J-57 engines.

BOEING B-52 — Eight J-57 engines, mounted in pairs, power this all-jet, heavy Air Force bomber.

CHANCE VOUGHT F8U — Powered by a J-57 with afterburner, the Crusader is the Navy's fastest carrier-based fighter.

The best airplanes... are designed around the best engines

Today's most valuable military aircraft, capable of supersonic or intercontinental flight, include various Air Force and Navy fighters, bombers and transports. Among these are nine types that have a significant feature in common. They all fly on one type of engine — the J-57 turbojet.

Also entrusted to the efficient, dependable operation of Pratt & Whitney Aircraft's jet engines will be the commercial jet transports soon to travel along the air lanes of the world.

The excellence of the J-57 is attributed to the engineering team that has determinedly maintained its leadership in the field of aircraft powerplants. Effort is now being directed toward the improvement of advanced jet and turboprop designs. Still to be anticipated is mastery of current technology's most provocative problem — the successful development of a nuclear aircraft engine.

Many engineering graduates would like to be concerned with the air power of the next generation. One way to fulfill that ambition is to pursue a career alongside the Pratt & Whitney Aircraft engineers who have consistently produced the world's best aircraft engines.

World's foremost designer and builder of aircraft engines

PRATT & WHITNEY AIRCRAFT

DIVISION OF UNITED AIRCRAFT CORPORATION

EAST HARTFORD 8, CONNECTICUT

MIZZOU MEMOS

By SHELTON EHRLICH, M.E. '56

Career Sketch: *Charles K. Rieger*

Charles K. Rieger is a vice president of the General Electric Company and General Manager of its Appliance and Television Receiver Division at Louisville, Kentucky.

After graduation from the University of Missouri in 1936 with a B.S. degree in electrical engineering, Mr. Rieger joined General Electric as a student engineer, working first in Detroit, Michigan, and then in Schenectady, N. Y.

In 1937 he was transferred to the G-E fractional horsepower motor plant at Fort Wayne, Indiana, as sales engineer. There he gained experience in developing programs to coordinate engineering, manufacturing, and sales.

For two years during the war, he was assigned to Wright Field in Dayton, Ohio, in charge of General Electric work there, returning to Fort Wayne in 1944 as proposition engineer.

In January, 1946, Mr. Rieger went to Bridgeport, Connecticut, as assistant commercial engineer for the Home Laundry Division. In August of the same year, he was promoted to commercial engineer.

In 1947 he was appointed manager of the company's Heating Device and Fan Division, and in 1950 he became manager of the Household Refrigerator Division.

In 1951 the General Electric appliance business, all of which had been grouped in an Appliance and Merchandise Department, was separated into two new groups, the Major Appliance Divisions. Mr. Rieger was appointed General Manager of the Small Appliance Division. In January of 1953 he was elected a vice president of the Company and in May of the same year he was appointed General Manager of the Major Appliance Division.

Mr. Rieger was born in Kansas City, Missouri, September 23, 1915. He is married to the former Dorothy Geary of Fort Wayne. They have two children, Sally, 13, and Susan, two.

Berney Harris, M. E. '22, is the proud father of Nancy, whom he tells us is the only junior woman in the University to receive her letter "M" so far this year. She is majoring in physical education and is senior sponsor at Johnston Hall. He says he and his wife come up regularly to football, basketball, and baseball games. He was pleased to hear from Stankowski of the fine extra-mural program. Berney is a security salesman with the Scherck-Richter Co., St. Louis.

Leigh Samuel Icke, E. E. '30, is staff assistant in the production administration department of Beech Aircraft, Wichita, Kansas.

Lt. Rex Barnes, M. E. '55, is taking pilot training at the Malden (Mo.) Air Base.

Charles Lee Parish, Ch. E. '47, has been appointed superintendent of the chlorine area of the Columbia-Southern Chemical Corporation. He joined the company right after his graduation as an operations engineer, and during plant expansion he became acting foreman. He and his wife with their two children, Richard and Carolyn, live at 171 Summit St., Wadsworth, Ohio.

Samuel L. Nevins, Ch. E. '20, corporate vice-president of the plant food division of the Olin Mathieson Corp., was awarded an honorary degree at the January commencement of the University of Arkansas for his outstanding contribution to the state. He has long been one of the South's leading scientists in the development of plant fertilizers. He moved to Little Rock in 1937 as general manager of the Arkansas Fertilizer Company, which became part of the Olin Mathieson Corp. He pioneered in the development of high analysis pelletized fertilizer, and also developed the process by which elementary sulphur is recovered from the sour gas wells of south Arkansas, a discovery which led to the extensive industrial development in that area.

Hal Miller, E. E. '55, received a call to active duty as a lieutenant in the Air Force. He reported at Andrews Air Force Base, Maryland in January.

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.

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.

Arthur H. Lippit, M.S., Ch.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. Lippit 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.

Ira A. Cohn, M.E. '44 is a sales engineer for Schwarz and Cohn, Inc. of Brooklyn, N. Y. His family has moved to a new home at 843 Jefferson St., Woodmere, N. Y.

Young engineers making news at Western Electric

Richard C. Shafer, B.S. in mechanical engineering at Lehigh, was one of 16 engineers assigned to one of Western Electric's toughest post-war projects — developing manufacturing techniques for mass-producing *(with great precision!)* the tiny but amazing transistors which are already causing a revolution in electronics.

Western Electric's primary job — which goes 'way back to 1882 — is to make good telephone equipment that helps Bell telephone companies provide good service. It's a very big job — and a very important one — which calls for the pooling of varied types of engineering skills.

New manufacturing processes and methods are constantly required to produce better telephones, better central office equipment, better wires and cables, new types of electronic equipment to keep pace with the nation's ever-growing need for more and better telephone service at low cost.

In addition to doing our job as manufacturing unit of the Bell Telephone System, Western Electric is busy producing many types of electronic equipment for the Armed Forces. Here again, young engineers of varied training are doing important work in connection with the manufacture of radar fire control systems, guided missile systems and special military communications systems.

Paul J. Gebhard, B.S. M.E. at the University of Maryland, was one of a team that helped develop Western's new electroforming process for coating steel telephone wire with copper, lead and brass in one continuous operation. His job: to develop conductor resistance-annealing equipment and electrolyte filtration and circulating systems.

Bobby L. Pettit (at right), an E.E. from Texas A. & M., is one of several hundred members of Western Electric's Field Engineering Force. These F.E.F. men can be found all over the world — working most closely with the Army, Navy and Air Force — advising on the installation, operation and maintenance of complex electronic equipment made by W.E.

NEWSTUFF

(*Continued from page* 17)

erator for supplying power to the two crowd motors connected in series. The ceiling voltage on this generator is 110 volts and the stall current is 1350 amperes. A smaller set consists of a 1000 hp synchronous motor driving two 330 kw, 500 volt, d-c generators for supplying power to the four swing motors. These generators will have 1100 volts no load, 1350 ampere stall characteristics.

The hoist motion on this machine is powered by four 425 hp motors giving a maximum hoisting effort of approximately 4000 hp. There are four vertical swing motors totaling 750 hp and two crowd motors each 187½ hp. All of the main driving motors are of the heavy duty, armored, mill type construction with forced ventilation by individual, motor mounted, induction motor driven, centrifugal blowers.

The control equipment is of the amplistat - amplidyne - Ward Leonard type for each of the three motions. This results in maximum control of acceleration, deceleration, current, torque and power peaks and plugging. Extreme flexibility in adjustment of the operating characteristics is provided, yet all adjustments are accomplished easily and readily due to the simplicity of the adjustment circuits.

Special type motor field control equipment is provided for the 3500 hp synchronous motor to give it extremely high torque characteristics under heavy loads and to provide leading power factor characteristics for the improvement of mine voltage conditions under heavy loads.

For the hoist motion a special type of motor field excitation is provided to vary the motor torque characteristics smoothly and in correct ratio to suit the different phases of the operating cycle.

Another feature setting the new shovel above its predecessors is an independent propeller traction drive powered by four 250 hp wound rotor induction motors with special steering control.

The total equivalent power of the installed electrical equipment on this machine is in excess of 12,000 hp. However, since all of the main motors and generators are actually capable of operating continuously at twice the nameplate capacity, the actual electrical content is almost 20,000 hp.

In the large diameter, hollow center pin of the machine there is an automatic, apartment type house elevator with controls for stopping at three levels. This is for carrying personnel and visitors from the ground level to the main machinery deck or on up to the gantry, some seven stories high. Conventional machines provide an intermittent series of ladders for this purpose. The size of the new machine makes the use of an elevator a highly desirable safety feature.

FLIGHT TESTING PLANES THAT WERE NEVER BUILT

An airplane, complete with engines, that is still in the idea stage can now be quickly given an automatic simulated flight test on an electronic calculator as a result of an achievement at the General Electric Company's jet engine plant here.

The new use for the electronic calculator could mean a savings of millions of dollars in time, materials, and effort, according to the engineers who developed the technique that made it possible.

The system consists of a special method of transferring airframe and engine performance information onto computer cards and a method of setting up the calculator so that it can digest the information on these cards. With the new system all the cards are combined and fed into the calculator and desired information on the performance of the proposed airplane is obtained automatically in a very short time. One answer on the airplane's performance can be obtained in as short a time as 20 seconds.

The system is especially valuable in saving engineering, testing, and manufacturing time during the first stages of developing a new airplane, explained Dr. H. R. J. Grosch, manager of the plant's computing section. He said the system could save millions of dollars of development money since faulty design features or mismated air frames and engines can now be detected on a calculator before an airplane is actually built.

Another advantage of the new system is that it is an estimated 30 times faster than any other system previously used for calculating combined engine and air frame performances, according to G-E engineers.

Time required to put data on computer cards and to make the simulated flights will vary according to the complication of each airplane. It may take three weeks to transfer air frame and engine information onto computer cards, but at most only a few hours to get all the answers to the proposed airplane's performance.

The new system is a refinement of one announced earlier this year by G.E. With the old system, a set of computer cards describing air frame performance and a set describing engine performance had to be fed alternately into the calculators, and operators had to stop each time to transfer by hand air frame performance onto the engine cards and engine performance onto the air frame cards.

The new system, designed by J. C. Richter, supervisor of the engines and components unit of the computing section, allows the set of cards representing engine performance and the set of cards representing air frame performance to be fed into the calculator at the same time. Then the calculator, guided by directions on the two sets of computer cards, calculates the performance of the proposed airplane. During this process the machine draws on engine performance information whenever it is directed to do so by the set of air frame performance cards.

There is more choice in getting the type of answers desired with the new system. Designers seek such answers as engine power, operating limits, and rate of fuel consumption at any airplane speed and altitude. The new system will save engineers many thousands of hours that were previously spent in calculating answers manually.

The system was developed on an advanced electronic calculator that can make computations in a fraction of a second. Dr. Grosch said the sys-

(*Continued on page* 26)

INVENIEMUS VIAM AUT FACIEMUS: "We shall find a way or we shall make one."
—Memorial Gate, University of Pennsylvania

Investing in young America . . . a progress report

"To HELP deserving young men and women obtain a college education . . . to give financial support to a cross-section of American colleges . . ."

FOUR YEARS AGO, the Union Carbide Scholarship Plan was established with those objectives.

Today, the plan provides the complete cost of tuition and fees for 400 four-year scholarships at colleges and universities throughout the country. As an important part of their education, the scholars are encouraged to gain valuable experience in their chosen fields by obtaining jobs in industry during summer vacation.

50 TECHNICAL SCHOLARSHIPS are also available in specific fields of study. They cover the student's tuition and fees for the senior year. In addition, to assist graduate students and to support academic research, Union Carbide offers 66 fellowships and grants-in-aid to universities.

THE PEOPLE OF UNION CARBIDE regard these scholarships as an important contribution to the future and to two of America's priceless assets—its educational system . . . and its youth.

TO LEARN MORE *about the Union Carbide undergraduate scholarships and the colleges and universities in which they have been established, write for Scholarship Plan booklet X.*

UNION CARBIDE
AND CARBON CORPORATION
30 EAST 42ND STREET UCC NEW YORK 17, N. Y.
In Canada: UNION CARBIDE CANADA LIMITED, Toronto

UCC's Trade-marked Products include

LINDE Oxygen · EVEREADY Flashlights and Batteries · NATIONAL Carbons · ACHESON Electrodes · UNION CARBIDE Silicones
PYROFAX Gas · SYNTHETIC ORGANIC CHEMICALS · PRESTONE Anti-Freeze · UNION Carbide · Dynel Textile Fibers
PREST-O-LITE Acetylene · ELECTROMET Alloys and Metals · HAYNES STELLITE Alloys · BAKELITE, VINYLITE, and KRENE Plastics

REAR SUSPENSION

(*Continued from page* 15)

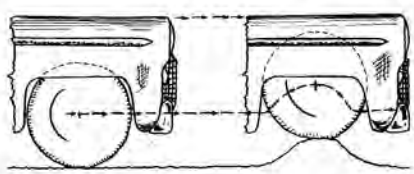
tion in pitching problems, (5) elimination of wheel weight transfer and wheel hop, (6) a remarkable decrease in unsprung weight, especially if brakes are moved inboard, and (7) excellent lateral stability with resultant increase in cornering power.

The usual objection to the differential type of suspension is the increase in cost that results from this construction. This objection is evidently unfounded when one considers that the Peoples car has such a system and has had it since it was designed in 1922. The cost of this car is about $1100 in Germany and England.

The method of wheel suspension is not subservient to the sprung differential. Several types have been successfully employed and there is little to choose between them. The much advertised DeDion suspension is essentially a non-independent suspension as it uses a solid axle. The BRM and Mercedes Grand Prix racing cars claimed the use of the DeDion system, but the modifications that were incorporated put both of these designs into the theoretical classification of the swing axle. Swing axle designs have many variations and usually are independent types. The three most successful types are those used on the Porche, Lancia, and Mercedes. The first two are quite similar, differing only in detail. Both give variations in camber and toe-in with bump and rebound and a variation in camber with roll of the automobile, which results in very high cornering abilities. The Volkswagon design is similar to the successful Porche. The roadability of the Porche and Lancia automobiles' rear suspension was forcefully demonstrated by the roadability they achieved on the very rough sections of the Mexican road race, the toughest test of suspension known. The Mercedes type suspension differs in that there is no camber variation with the roll of the car and that no variation in toe-in is encountered due to absolute vertical movement of the axle during bump and rebound. This is accomplished by a watt linkage. This car has had great success with very high speed corners and has been equally successful at low speeds.

Good examples of the DeDion suspension are the 1925-26 Miller Indianapolis cars and the Formula II Ferrari racer of 1953. These types are essentially the same as employed on the DeDion steamer of 1895. The main advantage of the DeDion type is the reduction of gyroscopic effects. A further possible advantage would be the apparent ease of mass production and adaptability to unit body construction.

The "A" frame type of suspension is a possibility, as almost any characteristic can be obtained by proper choice of dimensions. The limitation



Wheel Kick: As the wheel goes over a bump it must travel farther than the automobile. To do this it must rotate faster. Because of its inertia it cannot instantly increase rotational speed and so transfers an impact load to the suspension system.

on this type would be manufacturing and servicing difficulties.

The Prediction

Two or three years will see the hydraulic or pneumatic springing with extensive use of rubber bushings for shock absorbtion in suspension members. Standard unsprung differentials will be retained with the balanced torque differential gaining in popularity. Seven or more years will be required before the standard passenger cars will have rear mounted transmission differentials, possibly one year less for the so-called American sports cars. The most popular suspension system will be the DeDion type, arranged similarly to the 1949 Formula I Ferrari. The brakes will be moved inboard. The simplicity of disk brakes will dictate their use with no self-energizing mechanism. Power brakes and level ride control will be standard equipment. No shock absorbers will be required except where torsion bars are used. As these rear end modifications appear, it will be

(*Continued on page* 26)

All over the world technical "Minute Men" of the RCA Service Company assist the U. S. Army, Navy, Air Force.

How RCA "Minute Men" give added strength to our Armed Forces everywhere

In Northern Japan, in Florida, in Guam—all over the world, the technical "Minute Men" of the RCA Government Service Department are assisting our Armed Forces.

These "Minute Men"—experts in electronic installation, maintenance, and training—are backed by the RCA organization that provides a wide range of complete electronic services and systems to the nation. Behind them stand RCA's 37 years of experience in communications; more than 70,000 RCA employees in manufacturing plants stretching from coast to coast; plus the fullest research facilities devoted to electronics that industry has ever known.

In all these ways, the RCA Government Service Department has proved its ability to give added strength to our Armed Forces.

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

REAR SUSPENSION

(*Continued from page* 24)

possible to change to a higher pressure tire using smaller dimensions. This change will necessitate a kick shackle on the front wheels.

The result of these modifications will be a reduced weight in chassis of 500-700 pounds and a relocation of the engine toward the front. The inside dimensions of the car will be increased accordingly.

NEWSTUFF

(*Continued from page* 22)

tem is another step toward the automatic design of weapons systems which he believes will be possible in the not too distant future.

"NEW LOOK" IN SKYSCRAPERS

The Henry C. Beck Building, newest and tallest office building in Shreveport, Louisiana, has brought the "new look" in skyscrapers to that part of the South, as well as the rest of the world. It is the world's first welded skyscraper with a colored aluminum exterior curtain wall.

One of the outstanding structures of its type, the Beck Building has an aluminum and blue exterior "skin" over a steel frame of all-welded structural joints—a combination that is being used to good advantage in the current multi-story building boom. The recently completed, 20-story Beck Building, according to The Lincoln Electric Company, is among the world's tallest welded buildings. Experience with welding in multi-story structures has indicated that savings up to 20% in steel tonnage required can be realized.

♣

In the dark of night two safe-breakers entered a bank. One approached the safe, sat down on the floor, took off his shoes and socks and started to turn the dial of the safe with his toes.

"What's the matter with you?" said his pal, "let's open this thing and get out of here."

"Naw, it'll take only a minute longer this way, and we'll drive them fingerprint experts nuts."

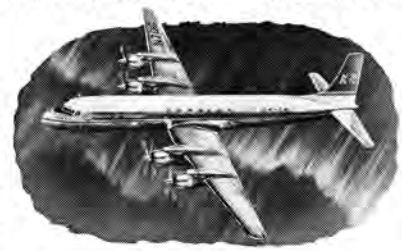
F4D, "SKYRAY"—only carrier plane to hold official world's speed record

A4D, "SKYHAWK"—smallest, lightest atom-bomb carrier

RB-66—speedy, versatile jet bomber

A3D, "SKYWARRIOR"—largest carrier-based bomber

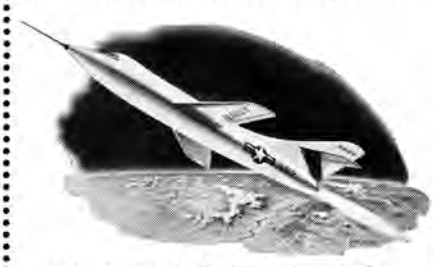
C-124, "GLOBEMASTER"—world's largest production transport



DC-7 "SEVEN SEAS"—America's finest, fastest airliner

Engineers: join this winning team!

"NIKE"—supersonic missile selected to protect our cities



D558-2, "SKYROCKET"—first airplane to fly twice the speed of sound

At DOUGLAS you'll be joining a company in which the three top executive officers are engineers...you'll be associated with men who have designed the key airplanes and missiles on the American scene today! Nothing increases an engineer's ability faster than working with other engineers of top calibre.

Not only is Douglas the largest manufacturer of commercial aircraft in the world, but it also produces outstanding aircraft and missiles for *every* branch of the armed services! This diversity, besides giving you job security, provides unequalled opportunity for the engineer with an eye to the future.

Challenging opportunities now exist in the following fields:

Mechanical design
Structural design
Power plant installation design
Weapons delivery
Aerodynamics
Thermodynamics
Electronic computers
Systems analysis
Aircraft air conditioning
Hydraulics
Stress analysis
Servo mechanisms
Acoustics
Electronics
Mechanical test
Structural test
Flight test
Process engineering
Missiles

DOUGLAS
First in Aviation

Brochures and employment applications are available at your college placement office.

For further information relative to employment opportunities at the Santa Monica, El Segundo and Long Beach, California divisions and the Tulsa, Oklahoma division, write today to:

DOUGLAS AIRCRAFT COMPANY, INC.

C. C. LaVene, Employment Manager...Engineering General Office
3000 Ocean Park Blvd....Santa Monica, California

AROUND THE COLUMNS

(*Continued from page* 14)

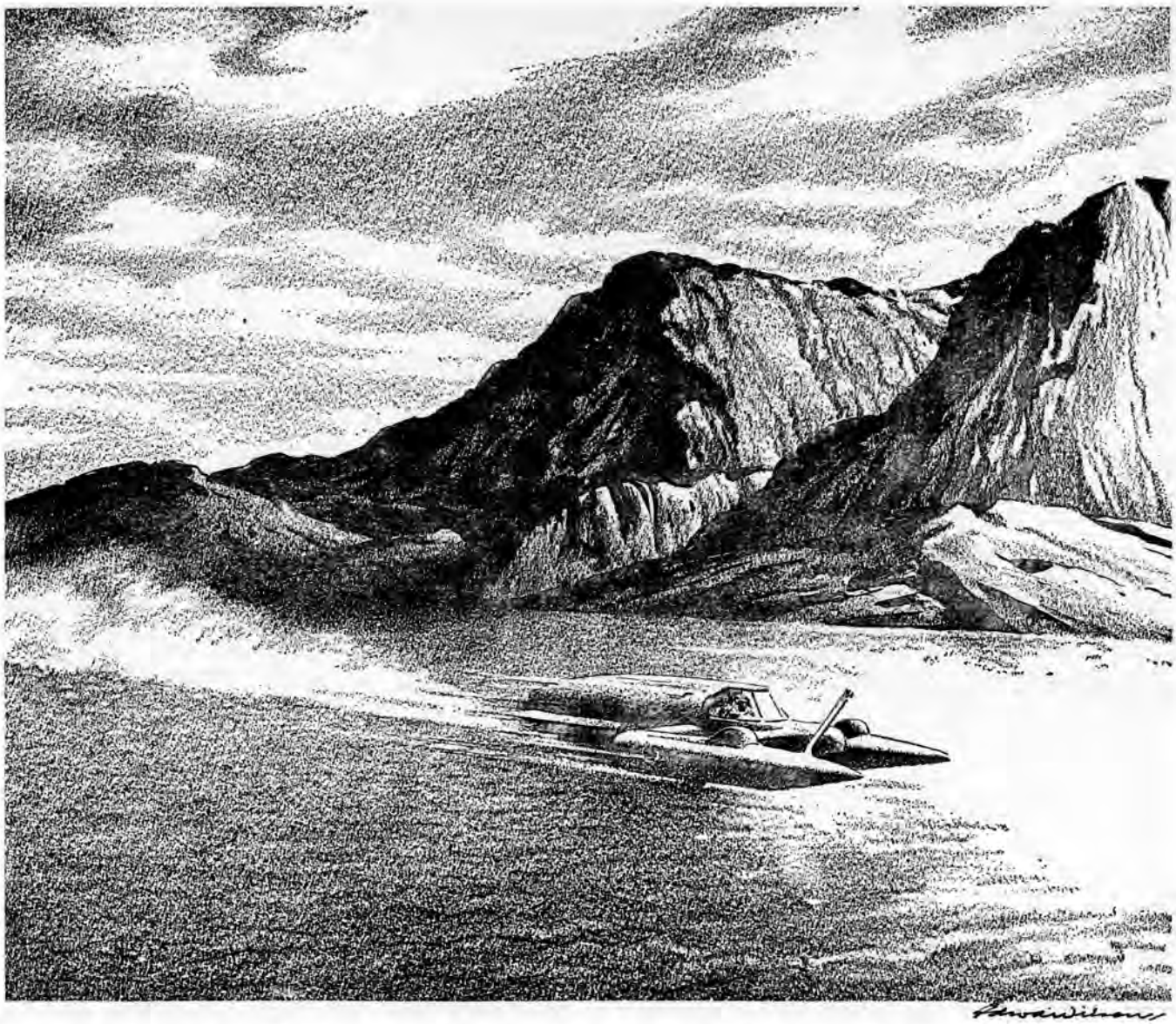
neering activity on a major weapons development program of the Glenn L. Martin Aircraft Company of Baltimore. He was assigned to this post last December after serving as supervisor of the Flight Test Instrumentation Laboratory at Martin's, and then, since 1947, to responsibility for the engineering efforts in development of the Viking Rocket. In mid-1954, he was assigned to responsibility for advanced engineering design activity on rockets and satellites.

Purdy was cited by Dean Croft "in recognition of his contribution to national defense and to space navigation; his rapid progress while still under 40 in the forefront of a new technology distinct from that of his specific educational background; his responsibility for development of the Viking Rocket, a foundation for our country's defense; and his upgrading to head engineering advanced design on rockets and satellities, and his recent assignment as director of all engineering activity on the major weapons development program of an outstanding aircraft corporation."

Mr. Purdy was born in 1917 near Harris, in Sullivan County, Missouri. He studied three years at Northeast Missouri State Teachers College at Kirksville, majoring in science and industrial arts, before enrolling in the College of Engineering here at the University. He received his B.S. in Civil Engineering degree here in 1941, and went to work immediately for the Martin Aircraft Corporation. According to Martin officials, he soon became known as "Mister Viking," among Martin and U. S. Navy personnel because of his close association with the development and testing of twelve upper-atmosphere Viking research rockets.

A member of Tau Beta Pi, national honorary scholastic society in engineering; of the American Association for the Advancement of Science; of the American Rocket Society; and of the American Ordnance Association, he is active in civic and church organizations. His hobbies, he says, are

(*Continued on page* 32)



Behind the Ships that Set the Pace...
a Master's Touch in Oil

World's fastest jet boat, Donald Campbell's Bluebird—216 miles an hour . . .

World's fastest propeller-driven boat, Slo-Mo-Shun IV—178 miles an hour . . .

All the Atlantic Blue Ribbon Winners, from the Mauretania to the S. S. United States . . .

Maiden voyage of the world's first atomic-powered submarine . . .

Two-fifths of all the world's freighters . . .

The race horses and work horses of the seas have one thing in common—SOCONY MOBIL'S *master touch* in lubrication.

Good reason! When the chips are down—when records are at stake—when schedules must be met—the men who know marine machinery look to SOCONY MOBIL for its protection.

★ ★ ★

Wherever there's progress in motion—in your car, your factory, your farm or your home—*you, too, can look to the leader for lubrication.*

SOCONY MOBIL OIL COMPANY, INC.

LEADER IN LUBRICATION FOR NEARLY A CENTURY

Affiliates: General Petroleum Corporation, Magnolia Petroleum Company Mobil Overseas Oil Company and Mobil Producing Company

DIGITAL COMPUTERS

(*Continued from page* 12)

by equating one of the performance equations to its guarantee. This density is then substituted into the remaining performance equations to determine the remaining characteristic of the particular motor. If the calculated density when substituted into the remaining equations fails to produce a result that meets the required guarantees, a new flux density is obtained and the calculation repeated. If there exists any one density or set of densities that satisfies all the performance guarantees, an acceptable design results. If no density satisfies all the performance criterion, the length is increased and the process repeated. When a suitable density is established, a winding is selected that will produce the required density at the proper line voltage.

This card-program-calculator installation is typical of the increasing use of computers in engineering departments. This computer is directed by information from punched cards as they are read into the machine.

Digital Computers and The Future

The number of digital computer applications and their ensuing advantages are almost infinite. Present computer auxiliary equipment now in use or being planned supplies a hint of the future potential of these devices. The first step toward remote control of computers has already been taken. By means of a transceiver and existing telephone circuits, information from cards located at one location can be punched onto duplicate cards at the computer site. These duplicate cards supply the computer with information, and the results are punched on another set of cards. Information is in turn relayed back to the originating station. Even the card handling involved in the computer area may soon be eliminated by switching control of the computer to the distant transceiver station.

Through standardization of computer components, one computer may soon be able to control the operations of several other computers. For example, output data from one computer could be supplied as input data to a second computer through interconnecting circuits. The first computer may instruct the second to perform a certain operation on the received data and return its calculated output to the first. This particular feature would create tremendous possibilities for integrated computer systems.

Consider the possibility, remote as it may seem now, of digital computers for controlling the daily flow of production in many industrial plants throughout the nation. The production schedule of every item to be manufactured and assembled in any plant could be calculated and stored in the memory of the computer. When the

(*Continued on page* 32)

"If I were back in high school . . ."

"Dear Bill,

"It was great hearing that you plan to study engineering too. I imagine you know the tremendous demand right now for engineers — twice as many jobs as there are graduates—and the high beginning salaries—36% higher than in 1949.

"Just look in the want ads of the paper, Bill, to see the terrific opportunities and future of an engineer. Why, there are over 30 phases of engineering in industry alone. And do you realize the interesting work of today's engineer? He does everything from rocket design and electronics, to food processing and production.

"But start preparing to be an engineer *now,* while you are still in high school. This is *most* important, Bill. If I were back in high school, I would take all the algebra, geometry, physics and chemistry I possibly could. You need a *background* in those subjects *before* you start your college training, if you really want to be an engineer.

"Go in and talk to your counselor, first chance you have, and ask him about the preparatory courses you will need for engineering. And urge Dick and Ralph and those other fellows who want to be engineers to go in with you. Your counselor can set up your programs and give you some excellent information on engineering.

"By preparing now, Bill, you will have the foundation you *need* to study college engineering. And after college graduation you'll be prepared for one of the most interesting, most rewarding careers today.

Your brother, Bob"

SPENCER CHEMICAL COMPANY, 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) • Cylinder Ammonia.

SPENCER®

America's growing name in chemicals

DIGITAL COMPUTERS

(*Continued from page* 30)

time arrives to begin the manufacturing cycle of any particular item, the computer automatically issues purchase orders for the required raw material. When the material is delivered, the computer could issue the necessary work slips to the section or sections involved in the manufacture of the item. If, for any reason, a work stoppage occurs in the system, this information is communicated to the computer and a new schedule obtained in a matter of minutes. Loading of the various shops for any period of time would be readily available from the computer.

Conclusion

In product design, digital computers will save engineering time and manufacturing costs. By the use of digital computers, extensive studies can be made of product performance characteristics, under the variation of one or more design parameters, in a reasonable length of time. Test data obtained on a new line of products can be quickly analyzed by digital computers to determine the best values of the design-formula parameters to be used.

Besides creating savings in time and costs, digital computers are producing a marked effect on the engineering profession. By removing burdensome routine computations from the design engineer, considerably more engineering time is being spent developing new methods and products, and engineers are able to do more creative work. Likewise, digital computers are helping to alleviate the shortage of engineers by relieving the existing engineers of their routine calculations. In the near future, a thorough knowledge of computer capabilities will be mandatory of every design engineer.

AROUND THE COLUMNS

(*Continued from page* 28)

woodwork, folk music, and work with youth groups. He and Mrs. Purdy, the former Mary Boss of Baltimore, have three sons and a daughter.

Louis H. Winkler, a native of Carthage, Missouri, is metallurgical engineer of the Bethlehem Steel Company in Bethlehem, Pa. An outstanding authority on railroad steel products and on wire rope, wire, and wire rods, and on steel tubular products, he has been chairman of the General Technical Committee of the American Iron and Steel Institute since 1946.

Mr. Winkler was cited by Dean Croft in recognition of his "leadership in the development of technical codes for the design, manufacture, and testing of steel rails, locomotive forgings, wire and wire rods, and tubular products," and for his "high ability to understand his fellow man, to provide effective and responsible technical leadership in the steel manufacturing industry."

Mr. Winkler graduated from the University of Missouri in 1907 with a degree in Mechanical Engineering. He was elected to Tau Beta Pi, the national honorary scholastic society in engineering, and also to Sigma Xi, honorary science fraternity. He joined the engineering department of the Cambria Steel Company at Johnstown, Pa., and was Assistant Metallurgical Engineer of that firm from 1909 until 1917, when he was promoted to Chief Metallurgist.

In 1923 the Cambria company was acquired by Bethlehem Steel, and it was not long until Winkler was named Metallurgical Engineer of the larger company, a position he still holds. He is a member of many technical and professional engineering societies, and has served as chairman of some of the most important and of various important committees, including the AISI Technical Committee on Rails and Joint Bars; the American Railway Engineering Association-American Iron and Steel Institute Joint Contact Committee on Railroad Rails;

(*Continued on page* 34)

AROUND THE COLUMNS

(*Continued from page* 32)

the American Petroleum Institute Standardization Committee on Wire Rope and Tubular Products; and Panel A of the American Society of Automotive Engineers.

George A. Delaney was born in Centerview, in Johnson County, Missouri in 1895, and graduated from the University College of Engineering in 1917. He also was elected to Tau Beta Pi; to Eta Kappa Nu, honorary professional electrical engineering society; QEBH, honorary service society; and Scabbard and Blade, honorary ROTC fraternity.

Delaney entered the first Officers Training Camp at Fort Riley, Kansas, immediately after graduation, and served as a 1st lieutenant in the 340th Field Artillery of the 89th Division during World War I. At the close of the war, he entered the automotive industry, in which he has remained.

Mr. Delaney was cited by Dean Croft for "his distinguished career in the science of automotive engineering; his technical leadership as chief engineer of the Pontiac Motor Division of General Motors Corporation; his productive service in the field of standardization as director of the American Standards Association; and his professional leadership as former chairman of the Technical Board of the Society of Automotive Engineers, and now as the current President of this society."

Mr. Delaney's first automotive engineering experience was with the automotive division of the Savage Arms Corporation at Sharon, Pa. After a year with that firm, he joined the staff of the Paige Detroit Motor Car Co., in Detroit as a project engineer, and remained with the company and its successor, the Graham Paige Company until 1934, when he joined Pontiac as an electrical engineer. He became Assistant Chief Engineer in 1939, and Chief Engineer in 1947. During World War II he supervised the aircraft engineering in General Motor's Fisher Body Division. He is a member of various professional societies, and is the current president of the Society of Automotive Engineers.

Procter Thomson is a native of Astoria, Oregon, but came to Missouri for his education. He received his B.S. in Chemical Engineering degree from the University of Missouri in 1912, was a member of Tau Beta Pi, the honorary scholastic society in engineering, and earned the coveted "M" in athletics as a member of the Tiger football squad.

Widely known for his work with translating the results of research and development into operating procedures and quality controls, Mr. Thomson was cited by his Alma Mater "in recognition of his notable achievements in the fields of standardization and quality control; his leadership in the application of statistical methods to chemical engineering problems; and his work in connection with the Process Standards Department of a large corporation with respect to translating the results of research and development into plant operating procedures and quality control."

After his graduation from the University, Thomson first worked for the Solvay Process Company, the Brunswick-Collender Company, and then Sears-Roebuck & Co., before joining his present firm, the Proctor & Gamble Manufacturing Company of Cincinnati.

He served for many years as Associate Director of the Process Standards Department of the Chemical Division, where he gained his fine reputation for translating results of research and development into production. Standardization and quality control, he says, received a great deal of his attention, and he was a pioneer in the application of statistical methods to chemical engineering problems.

Although he has turned much of this work over to younger men and is now devoting some of his time to the Patent Department of Proctor & Gamble, Mr. Thomson says he has not left all his standardization activities behind, and is still a member of the Chemist's Committee of the National Cottonseed Products Association and the Technical Committee of the National Soybean Processors Association.

Only twenty-one individuals and engineering corporations have received the Missouri Honor Awards since they were first presented by the University and the Engineering Foundation in 1951. The Engineering Foundation is an organization of prominent alumni of the College of Engineering supporting the advancement and progressive development of engineering education in general and of the University of Missouri College of Engineering in particular.

STUDENT HONOR AWARDS

Six students of the University of Missouri College of Engineering received honor awards at the Engineers Week Honors Convocation held Saturday March 17, in Jesse Auditorium.

Edwin Duane Luallin, Clinton, Mo., was the recipient of the outstanding sophomore award in chemical engineering.

Gordon Dale Scott, South Fork, Mo., received the Chi Epsilon sophomore award in civil engineering.

Roger Lee Pape, Concordia, Mo., received the award as outstanding freshman engineer for last year and was co-recipient of the Eta Kappa Nu sophomore award in electrical engineering.

Paul William Klock, St. Louis, Mo., was also a co-recipient of the Eta Kappa Nu award.

George Paul Huber, Affton, Mo., received the Pi Tau Sigma sophomore award in mechanical engineering.

Recipient of the American Society of Agricultural Engineers (ASAE) sophomore award was Roger Edward Garrett, Montreal, Mo.

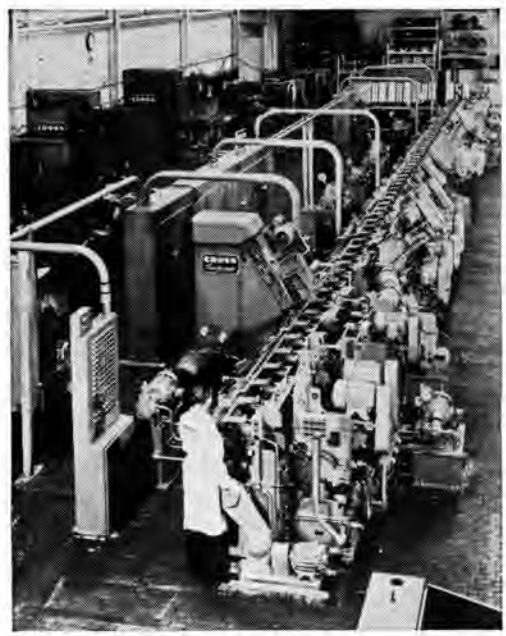
KNIGHTS OF ST. PATRICK

The colorful knighting ceremonies took place on the University campus near the Engineering Building at 10:45 o'clock Saturday, March 17, before an assembly of students, faculty, alumni of the College of Engineering, other students and townspeople of Columbia, and distinguished guests appearing here on the program of the Centennial of Engineering Education which closes with the traditional St. Pat's Ball Saturday evening.

Brig. Gen. W. E. Potter, Division Engineer of the Missouri River Division of the U. S. Army Corps of Engineers, recently appointed by President Eisenhower to be Governor of

(*Continued on page* 36)

Build your future on these 3 Growth Industries...



MANUFACTURING — There are 51 Allis-Chalmers motors in this lineup of machine tools designed for high automobile production.

CONSTRUCTION—Crushers like these from Allis-Chalmers process the enormous quantities of aggregate for the booming construction industry.

THERE IS much talk today about growth companies. Allis-Chalmers is one of them, supplying machinery for three basic industries—manufacturing, construction and power.

Therein lies an opportunity for you, since Allis-Chalmers builds many types of equipment.

. . . for a manufacturing industry that must increase output $3.5 billions by this time next year.

. . . for the construction industry that is destined to spend many billions of dollars on highways in the next ten years.

. . . for the electric power industry that will double its capacity by 1956.

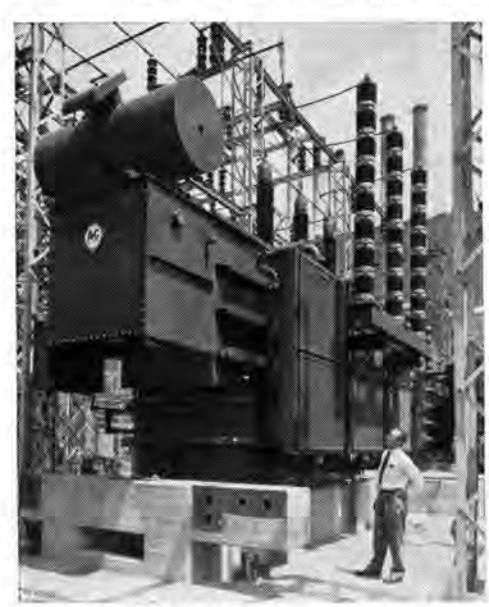
Here's what Allis-Chalmers offers to Young Engineers:

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.



POWER GENERATION—Allis-Chalmers is helping meet growing power demand with equipment such as this 150,000 kva transformer.

A-4684 **ALLIS-CHALMERS** A-C ALLIS-CHALMERS **Plants and Sales Offices all over the World**

BULLARNEY

By DUNK

A canny Scot was engaged in an argument with the conductor as to whether the fare was to be five or ten cents. Finally the disgusted conductor picked up the Scot's suitcase and tossed it off the train just as they were crossing a long bridge. It landed with a mighty splash.

"Hoot mon," screamed the Scot. "First you try to rob me and now you've drowned my little boy!"

♣

A lady buying tickets for her nine children explained to the station agent, "These three are all twelve years old and will take full fare; these three are all eight years old and will take half fare," then pointing to the youngest trio, "these three are all four years old and should go free."

The station agent looked at her in amazement and said, "Madam, do you mean that you have three every time you try?"

"Oh no," she replied, "lots of times we don't have any."

♣

Last summer at one of the ROTC summer camps in the deep South, one of the cadets was sent down to a stream near the camp to get some drinking water for the platoon, but had not been gone long when he came running back to camp empty-handed and panting.

"Sir," he exclaimed, "there's a big alligator in the stream, and I'm afraid to get the water."

"Don't worry, son," said the sympathetic officer, that alligator is probably four times as scared of you as you are of him."

"Well, sir," replied the cadet, "if that alligator's only half as scared as I am, that water ain't fit to drink."

♣

At the beginning of the Korean war an American lieutenant saw a South Korean riding along on a donkey while his wife, loaded down with bundles, trudged along behind. The young lieutenant was upset at the lack of chivalry.

"Why is it that you ride," he asked the Korean, "while your poor wife walks behind?"

"Custom," grunted the man and jogged on.

Several years later the lieutenant, now a captain, was in the same Korean town. He saw the same Korean riding his donkey, only this time the wife walked on ahead.

"You probably don't remember me," said the captain, "but I saw you when I first came here at the beginning of the war. You told me then that your wife walked behind the donkey because it was custom. Now I notice she's walking in front. Why the change?"

"Land mines," answered the Korean.

♣

If it's funny enough to tell, it's been told; if it hasn't been told it's too clean; and if it's dirty enough to interest an engineer, the editor gets kicked out of school.

♣

A young woman with adventure in her soul joined a circus. Anxious to do everything right, she asked her employer for a few tips.

"I don't want to make a lot of beginner's mistakes," she said.

"Well, for one thing," replied the manager, "don't ever undress around the bearded lady."

♣

A timberman on an early spring trip wandered unknowingly into the maple syrup district of Vermont. Taking a stroll into the woods one day he noted a lot of buckets hanging on the trees. "Gosh a'-mighty," he exclaimed in astonishment, "they sure have sanitary dogs around these parts."

AROUND THE COLUMNS

(Continued from page 34)

the Canal Zone, was a visiting speaker and became an Honorary Knight of St. Patrick.

Dr. Ralph A. Burton, assistant professor of mechanical engineering, and Dr. Ralph H. Luebbers, professor of chemical engineering here at the University, also became Honorary Knights and Miss Rose Wehrmann of Columbia, secretary in the office of Dean Huber O. Croft, received the magic touch of the wand of the ancient Irish saint making her a Lady of St. Patrick when the venerable monarch made his annual visit here on the anniversary of his birth.

Each year during Engineering Week, the bearded saint of Ireland makes a stately visit to the campus of the University on St. Patrick's Day to confer knighthood upon a select group of students in the College of Engineering who have achieved honors in scholarship and have rendered outstanding service to their School and to the University. Those students who have achieved exceptional fame or performed services above the exceptional may become Knights cum laude, or Knights magna cum laude.

Engineering students who become Knights of St. Patrick were: David L. Hansbrough, Columbia; Donny Ray McAdams, Jr., Moberly; Robert G. Combs, Kansas City; Jimmie Lee McCarty, Jefferson City; Shelton Ehrlich, Overland; Warren E. Rader, Conway; James A. Glass, Independence; and Harold Lee Weymuth, Warsaw, Mo. The seven students who became Knights cum laude were: Thomas A. Burns, Memphis; Myron D. Samuels, Kansas City; Glenn W. Kahle, Bunceton; Franklin Dee Harris, North Kansas City; Jens L. Wennberg, Columbia; Jesse L. Henson, Mountain Grove; and George H. Tomlin, Mt. Vernon, Mo. The five who received the magna cum laude degree were: Daniel R. Capps, Columbia; Alvin L. McGlothlin, Novelty; William L. Marshall, Ash Grove; Dail F. Stone, Bucklin; and Paul D. Gernhardt, Kansas City.

In the Arma Visual Computer, a single control selects the desired chart from as many as 700 photo slides. Each slide contains punched code holes which automatically tune in the corresponding Omni Bearing Distance station. The image of the plane is governed by a combination of the radio signals and the plane's gyro instruments.

Photography teams with electronics and adds new certainty to flight

Now a visual computer pictures a plane's precise position and heading on projected photos of aeronautical maps.

Arma Division, American Bosch Arma Corp., working with the Air Navigation Development Board and C.A.A., has developed a valuable new aid in air navigation using photography.

With it the pilot, high above the weather, flicks a switch and before him appears a map of the area he's over. On the screen a tiny shadow of a plane moves and shows exactly where he is, where he's heading and whether he's on course.

This spells added certainty. Even more! It can mean savings in time and money, too. For the flight can proceed by plan rather than by dog-legs on the beams.

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

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

This is why graduates in the physical sciences and in engineering find photography an important tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. If you are interested in these opportunities, write to Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N. Y.

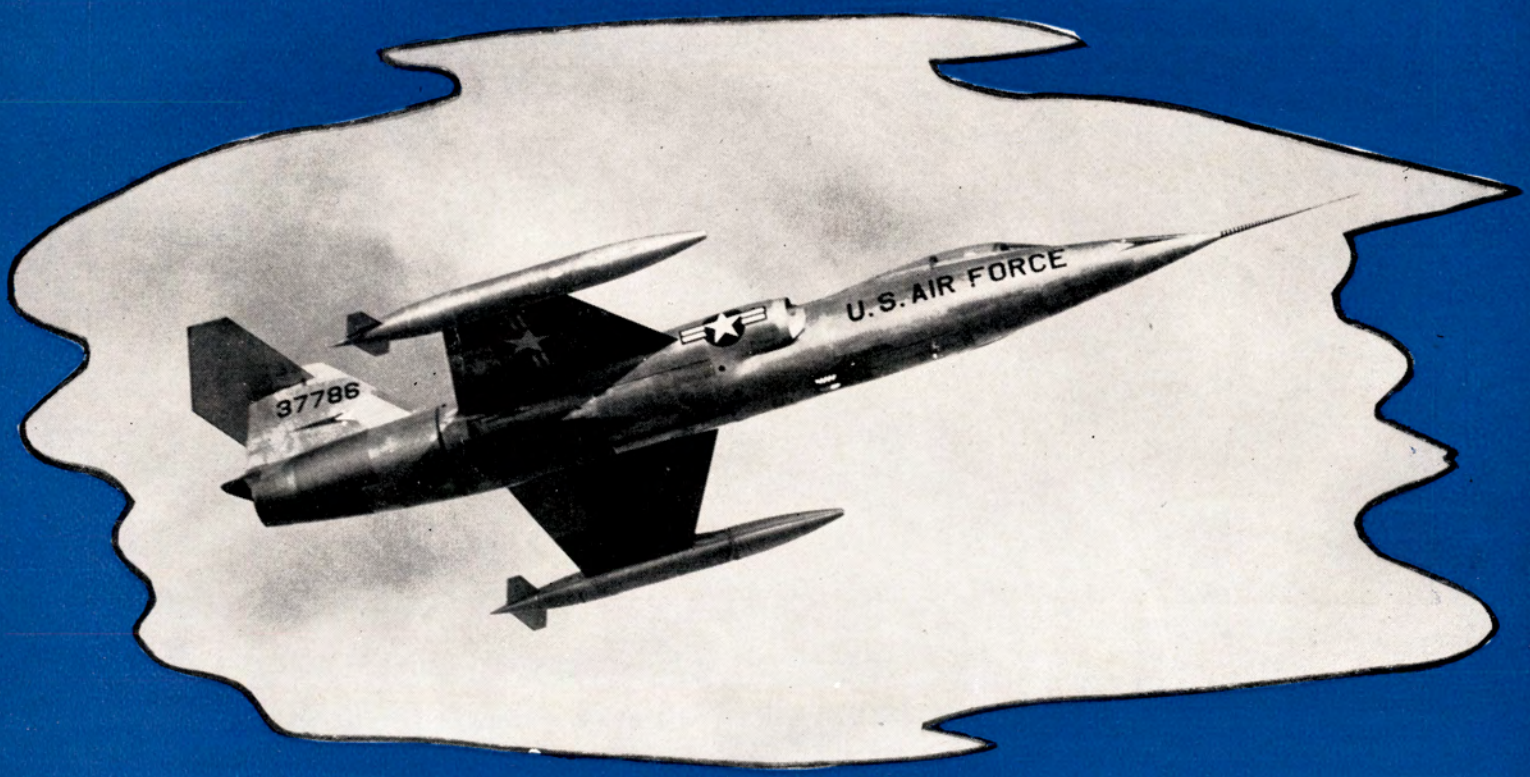
Eastman Kodak Company, Rochester 4, N. Y.

MISSOURI

SHAMROCK

MAY, 1956

C.3



FEATURES:

Starfighter
Beyond the Horizon
New on Faculty

25c

Edward J. Stolic, class of '48
speaks from experience when he says . . .

"With U. S. Steel, my future holds interest, challenge and reward."

From his graduation in 1948 with a B.S. degree in Mechanical Engineering, until November of that year, Edward Stolic worked as an operating trainee in the Irvin Works of United States Steel. Following his discharge from the Army in 1950, he returned to work at U.S. Steel. In just 18 months, Mr. Stolic reached a management position as Engineer-Lubrication.

By mid-year 1953, Mr. Stolic was promoted to Foreman-Instrument Repair and Sub-Station. In a recent interview he said: "Opportunities for rapid advancement are almost limitless in U.S. Steel." At 27, Mr. Stolic is supervising a force of 30 men in mechanical and electrical tests as well as instrument repair and maintenance of gas generators, compressors and water purification units. He feels that, "The engineer finds many places to apply the knowledge he garnered in school." The men under Edward Stolic are called on to trouble shoot in any part of the mill. This calls for a wide variety of talents and leads Mr. Stolic to say: "The steel industry has expanded greatly, and with it the need for good men."

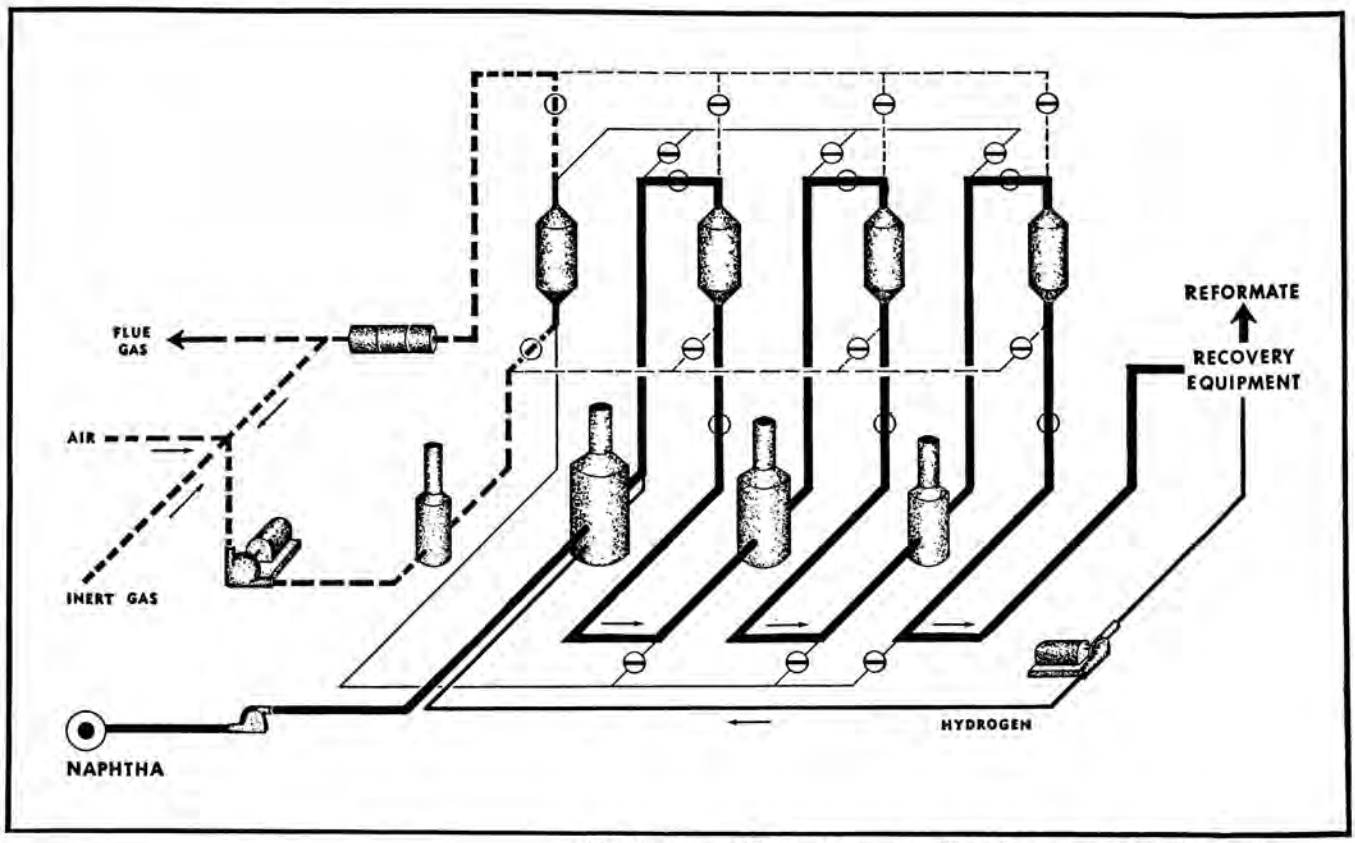
If you are interested in a challenging and rewarding career with United States Steel, and feel you are qualified, further information is available from your college placement director. Or, we will gladly send you our informative booklet, "Paths of Opportunity." Just write to United States Steel Corporation,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

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

UNITED STATES STEEL

AMERICAN BRIDGE . . AMERICAN STEEL & WIRE and CYCLONE FENCE . . COLUMBIA-GENEVA STEEL . . CONSOLIDATED WESTERN STEEL . . GERRARD STEEL STRAPPING . . NATIONAL TUBE
OIL WELL SUPPLY . . TENNESSEE COAL & IRON . . UNITED STATES STEEL PRODUCTS . . UNITED STATES STEEL SUPPLY . . *Divisions of* UNITED STATES STEEL CORPORATION, PITTSBURGH
UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY

6-02



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.

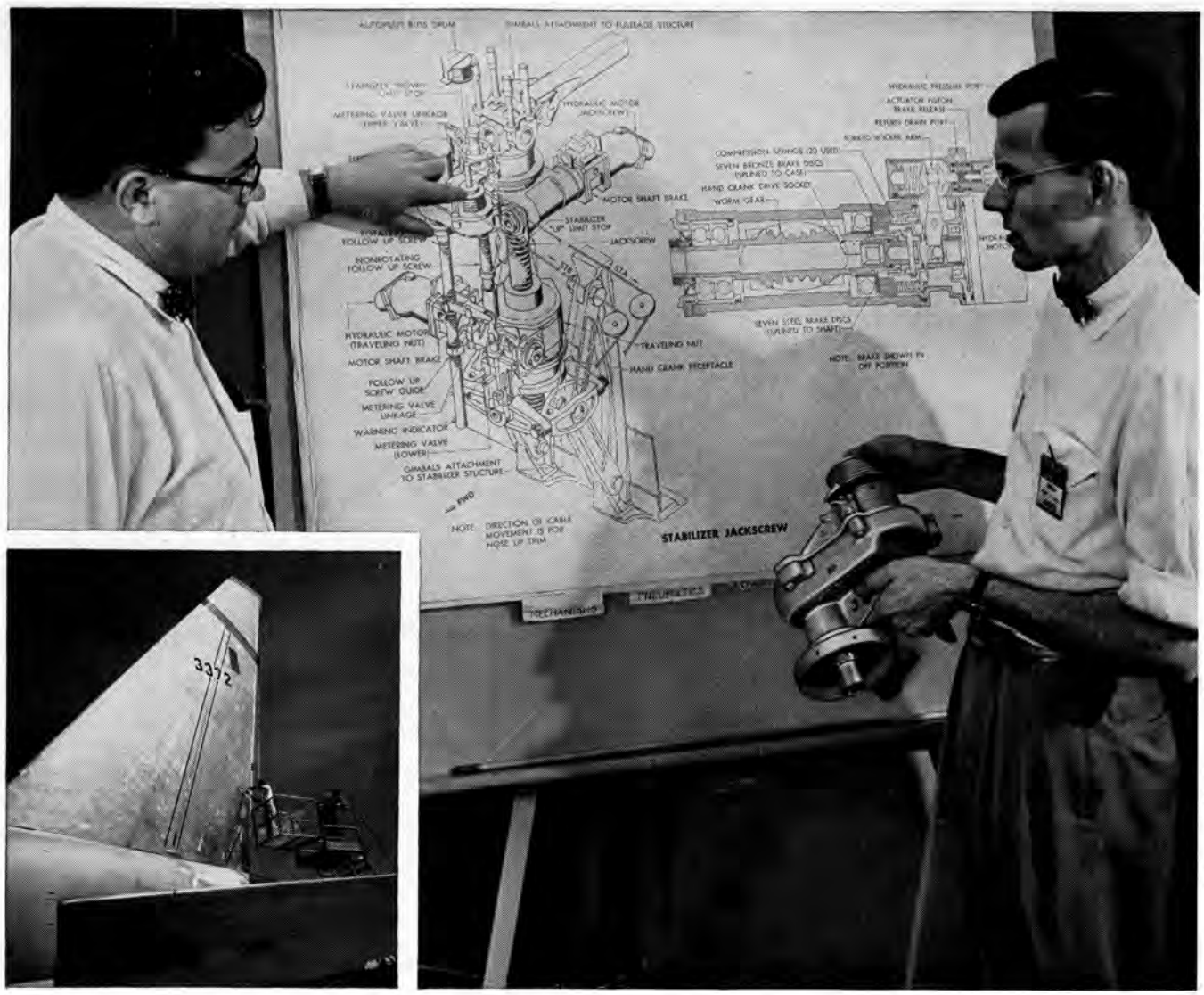
ULTRAFORMING also gives high yields of by-product hydrogen. The hydrogen can be used in upgrading other oil products. Or, it can be reacted with nitrogen from the air to make ammonia.

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

Standard Oil Company

STANDARD

910 South Michigan Avenue, Chicago 80, Illinois



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.

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

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

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

BOEING

Aviation leadership since 1916

SEATTLE, WASHINGTON WICHITA, KANSAS

ON THE COVER:
The Lockheed F-104A "Starfighter"
See Article, Page 11

MISSOURI
SHAMROCK

VOL. XXII MAY, 1956 No. 8

CONTENTS

FEATURES:

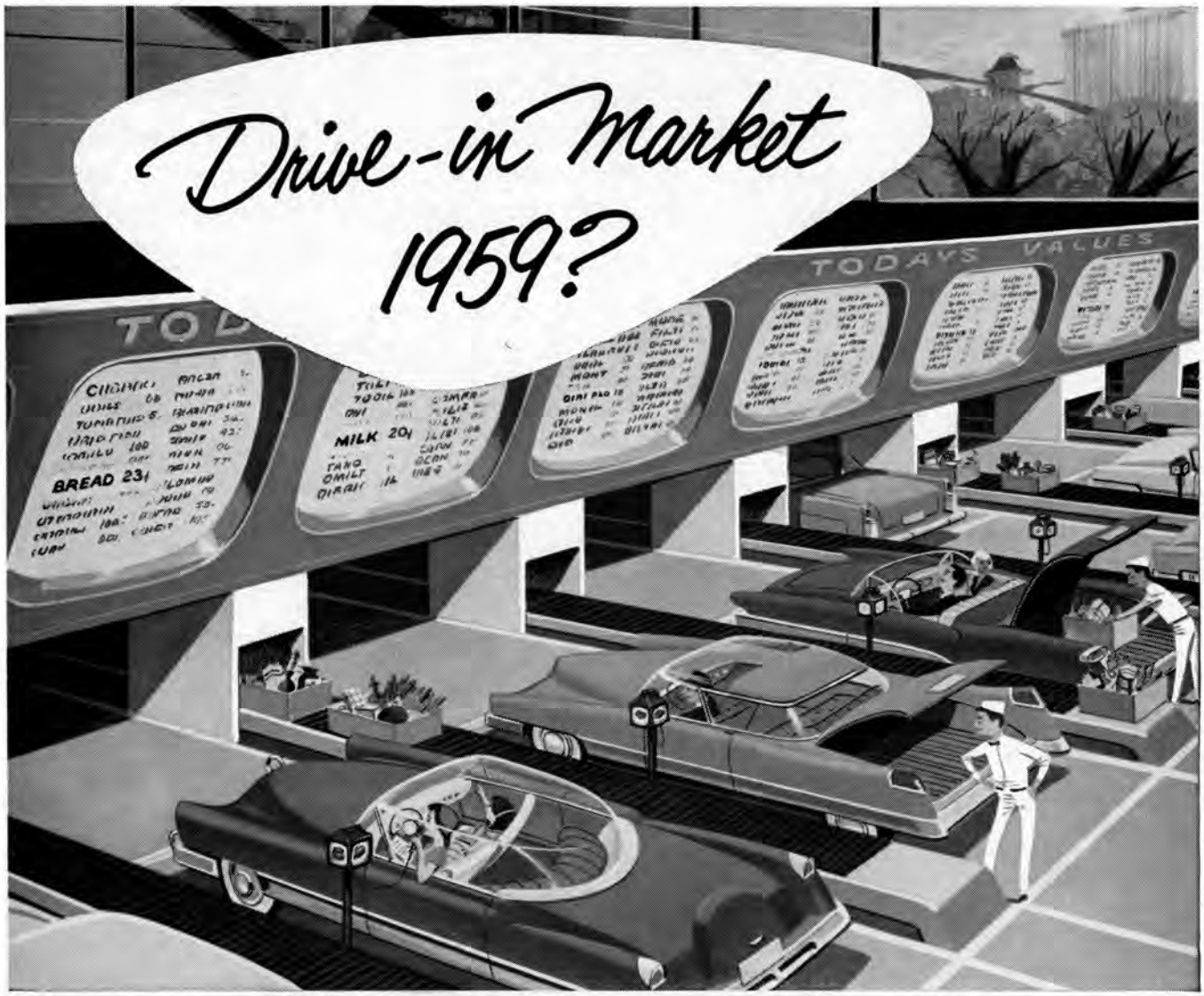
DEPARTMENTS:

MEMBER
ENGINEERING COLLEGE MAGAZINES
ASSOCIATED

Chairman, Merk Hobson, University of Nebraska
Publisher's Representative, Littell-Murray-Barnhill, Inc., 101 Park Avenue, New York 17, New York, and 605 Michigan Avenue, Chicago, Ill.

Published monthly except June, July, August, September, by Board of Publications of Engineers Club, University of Missouri. Office of Publication: Room 233 Engineering Building, University of Missouri, Columbia, Missouri. Entered as second class matter at the post office at Columbia, Missouri under the act of March 3, 1879. Printed by The Missouri Farmer, Columbia, Missouri. Single copies 25 cents; subscriptions, $1.50 per year, $2.50 for 2 yrs.

NEW DEPARTURES OF TOMORROW

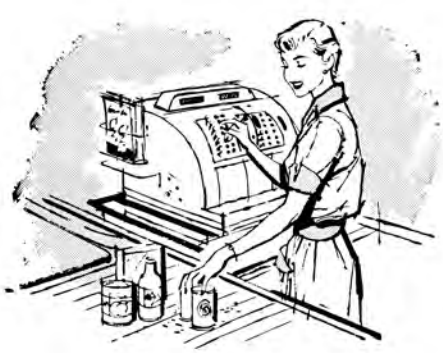


TOMORROW: Choose items from the monitor screen; electronic impulses select, assemble, deliver your order, total your bill and return your change.

A week's shopping in minutes! And you haven't moved from your car. It's that simple at the Drive-In Market of tomorrow. **Just select your items from the monitor screen; electronic impulses select, assemble, deliver your order, total your bill and return your change.**

It's just a dream away! And when it takes shape, look for New Departure to provide the proper bearings to keep all moving parts functioning smoothly. New Departure ball bearings keep parts in perfect alignment, support loads from any angle and require little or no maintenance.

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT



TODAY: New Departure ball bearings in today's business machines keep intricate moving parts functioning smoothly, quietly within precision tolerances. Accuracy is maintained even after long use.

NEW DEPARTURE
BALL BEARINGS

NOTHING ROLLS LIKE A BALL

Herschel Loomis asks:

What are my chances for advancement in a large company like Du Pont?

Herschel H. Loomis, Jr., will receive his B.S. degree in electrical engineering from Cornell University June 1957. Herschel is a member of the freshman and varsity rifle teams, an associate member of Octagon, a dramatic group, and belongs to Theta Chi Fraternity. Like many other students, he's making employment plans early.

Peter J. Meshkoff joined Du Pont at the Jackson Laboratory in 1941, after obtaining a B.S.Ch.E. from the University of Detroit and an M.S. from the University of Michigan. He has had a wide range of Du Pont experience, from chemist in the Dye Works to chief supervisor and works engineer at several plants, with many opportunities to observe Du Pont personnel policies. Today Pete Meshkoff is works engineer at Du Pont's new Film Plant at Circleville, Ohio.

Peter Meshkoff answers:

Your question is a natural one, Herschel—one we hear quite often. Du Pont is unquestionably a large company in total number of employees and in all its operations. But, actually, Du Pont is made up of ten independent departments, almost as if it were ten companies under one management. And it is a fundamental policy at Du Pont to promote from within and on merit only.

That produces many opportunities for new men, but in addition there are proportionately more promotions at Du Pont each year—by reason of expansion and retirement—than you would find in most smaller companies. I say "proportionately more" because Du Pont has grown at an average rate of seven per cent a year for the past 153 years—a record that few companies can match.

And Du Pont is still growing rapidly. Take your field, electrical engineering. A host of novel and challenging problems have to be faced, both in new construction and in maintenance. There are plants to design with features that have never been applied before; there are new equipment-control problems to work out, and new engineering processes to pioneer. So, to answer your question in a word, Herschel, I'd say your chances of promotion on merit are extremely good at Du Pont!

WANT TO KNOW MORE *about the opportunities for growth touched on by Pete Meshkoff? Send for a free copy of "The Du Pont Company and the College Graduate," which discusses many of the employment policies and activities of DuPont in detail. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington 98, Delaware.*

DU PONT

REG. U. S. PAT. OFF.

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

WATCH "DU PONT CAVALCADE THEATER" ON TV

Editorial

In the majority of courses the most important source of information a student has is his textbook. It is also the only tangible reminder of the subject material covered after the student has graduated. Because of this one might expect that the textbook would always be of a high quality. Unfortunately, this is not the case.

The writer can recall one textbook which should have been ideal. It was very small and handy to carry, an excellent example of condensed knowledge. The only difficulty was in understanding it. The pages that were missing were exceeded only by the explanations that were missing. Another textbook was well written but suffered from poor arrangement. In the course of reading it one was constantly referred to graphs, diagrams and examples which were strewn throughout the book. For example, in reading chapter ten one might be required to refer to a diagram in the third chapter. The material was all there, however—if you had time to search for it. A Thermodynamics text solves this problem quite well by repeating figures from one page to the next if the written material still refers to the figures.

There are many good textbooks which serve as proof that a good textbook can be written. Why does an occasional bad one occur? It is always a temptation to condemn the author. Certainly he should bear some responsibility, but there are other people who may be equally responsible. Consider a book which has been used for a considerable length of time, despite the complaints of students. Is it the author's fault? Hardly. More likely the blame must be attributed to the faculty involved.

Who is qualified to judge the merits of a textbook? We believe that a most satisfactory choice would result from a joint appraisal by faculty and students. The faculty must decide what will be taught and choose books that provide the proper material. On the other hand, the only person who is really able to judge the effectiveness of presentation is the student who is ready to take the course.

In remedying our shortage of engineers, we can increase the number and we can improve the quality of our graduates. We believe that better textbooks are one way to better engineers.

P.D.G.

FRONTISPIECE: the jet fuel about to be taken on by this B-47 will be accurately measured by a new flowmeter designed to handle some 600,000 pounds of fuel per hour under the highly variable conditions encountered in operation.

to the well too often

There are easier ways to get a drink.

And engineering graduates will be called upon to develop them. They'll have to help supply and distribute the billions of gallons of water needed daily by homes and industry. Water that will be increasingly hard to find.

But when they find it, they can rely on cast iron pipe to carry it. Practically every city in America—large or small—uses it for water and gas mains. In over 70 public utilities cast iron pipe has served for a century or more. No other pipe can point to such a long and useful record of service to the nation.

CAST IRON PIPE RESEARCH ASSOCIATION

Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

®

CAST IRON

CAST IRON PIPE SERVES FOR CENTURIES

Starfighter

A NEW CONCEPT IN FIGHTER DESIGN—THE LOCKHEED F-104 A

By J. D. COVER, E.E. '57

In February 1954, an experimental fighter took off on its maiden flight. It was far different in appearance from any plane then in operation and its configuration was kept secret for over two years.

By April 1956, the Curtis Wright J-65 powered Lockheed XF-104 had developed into the General Electric J-79 powered F-104A. With tiny razor-blade wings, a gross weight about half that of other fighters, and one of the most powerful jet engines in the world, the F-104A is the world's fastest fighters. It can climb as fast as it can fly in straight and level flight and operates above 60,000 feet.

Like the Lockheed F-80 Shooting Star, which was the basis for the Air Force's T-33 and F-94 series, the F-104A Starfighter is a versatile aircraft. It is adaptable for ground attack, intercept and tactical support use. An F-104B two place fighter has been developed and is in production for the Air Force.

As the F-80 was different from operational fighters when it was introduced in 1944, the F-104 also has many novel features, including the J-79 engine, an integrated electronics system and downward pilot ejection. The design of the plane is something entirely new, employing a small, light airframe, short, thin wings located about two-thirds of the way back on the fuselage, and a "T" shaped "flying tail".

The General Electric J-79 engine is interesting in that it is designed for both subsonic and supersonic speeds. At subsonic speeds the engine acts as a conventional turbo-jet used by present operational aircraft. At top speed, however, the engine with afterburner develops half of its thrust as a ramjet. The ramjet engine is the most efficient engine which can be used at high sonic speeds below speeds where rocket power is required. Although top speed has not been released, it is over the record recently set by a British airplane. C. L. Johnson, vice-president of Lockheed's research and development, mentions Mach numbers of 2 in describing the engine operation.

An example of the design simplicity applied to the Starfighter is a new "integrated electronics system" devised by Lockheed. By repackaging the various communications and navigation components, it was found that they could be installed as a series of interconnecting and self-sustaining units. The separate units can be quickly plugged in place, or unplugged, to provide the airplane with only the electronics equipment needed for a specified mission. Unnecessary weight is thus eliminated.

Another innovation of the F-104A is the downward ejection system in fighters. Although downward ejection is used on bombers, the Starfighter is the first fighter to eject the pilot without the possibility of his colliding with any part of the airplane following ejection. To eject himself, the pilot has only to pull a handle to start an automatic chain of events: (a) the cockpit is depressurized and the stick pops forward out of the way: (b) the parachute shoulder harness snaps onto the pilot, his legs are pulled close to the body by "mechanical straps," and ankle clamps hold the feet in place: (c) an explosive cartridge releases the escape hatch and jettisons the seat downward and outward: (d) the pilot's seat belt unsnaps, freeing him from his seat, and at a pre-set altitude the parachute opens.

The downward ejection also serves another purpose. By removing the escape hatch underneath the cockpit, the entire seat installation can be slid down and out, thereby providing stand-up working room for a technician.

Another feature of the plane does not help the technician, rather he must be protected against it. This is the sharp leading edge of the ultra-thin wing. When the plane is on the ground the leading edges of the wings are covered with felt to protect the maintenance crews. The leading edges of the wings have a radius of .016 inches. This is only one of the many new concepts embodied in the wings.

Other peculiarities of the wings are the short wingspread, low aspect ratio, and negative dihedral.

The wings measure just 7½ feet from fuselage to wingtip. The reason for the short wings was given by C. L. Johnson as, "the speed region in which it operates, coupled with the F-104's high thrust-to-weight ratio make the low aspect ratio necessary. And, in order to make the wing thin it had to be short. This is an aerodynamic must."

The wings are straight like those of slow piston engine planes. This design was arrived at after extensive tests including desert tests of wing models on 5" rockets. The thin wings have flaps on both the leading and

(*Continued on page* 26)

ENGINEERS...
LOOK TEN YEARS AHEAD!

A Douglas engineer lives here

Will your income and location allow you to live in a home like this...spend your leisure time like this?

They can...if you start your career now at Douglas!

Take that ten year ahead look. There's a fine career opportunity in the engineering field you like best waiting for you at Douglas.

And what about the Douglas Aircraft Company? It's the biggest, most successful, most stable unit in one of the fastest growing industries in the world. It has giant military contracts involving some of the most exciting projects ever conceived...yet its commercial business is greater than that of any other aviation company.

The Douglas Company's size and variety mean that you'll be in the work you like best—side by side with the men who have engineered the finest aircraft and missiles on the American scene today. And you'll have every prospect that ten years from now you'll be where you want to be career-wise, money-wise and location-wise.

Brochures and employment applications are available at your college placement office

For further information about opportunities with Douglas at Santa Monica, El Segundo and Long Beach, California and Tulsa, Oklahoma, write today to:

DOUGLAS AIRCRAFT COMPANY, INC.
C. C. LaVene, 3000 Ocean Park Blvd.
Santa Monica, California

DOUGLAS **First in Aviation**

BEYOND the HORIZON

By LESLIE R. AXELROD, EE., '56

The year—1976. The place—a typical American home. Henry and Alice Jones are watching television on their 3-D, natural color, 31-inch console. The picture on their screen is a live presentation from Pretoria, South Africa. Keeping up with these Joneses would be quite a feat for us back here in 1956. It is not uncommon for Henry and Alice to see a bullfight in Madrid, a ski tournament in Copenhagen or a street festival in Tokyo—all in a single night's TV viewing. Lest you think that this is too farfetched, let me remind you that TV pioneer Allen B. Du Mont, president of Du Mont Laboratories, said recently that there is now no electronic reason why nearly all the world should not watch the same TV program at the same time. When he made this statement, Mr. Du Mont had in mind an exciting new development in the field of long distance communications which could make all the world a TV stage: he was thinking of scatter propagation.

Also known as "beyond-the-horizon" transmission, scatter propagation is a means of transmitting radio signals in a manner very much like ordinary reflection. You know that on a cloudy night the beam of a powerful searchlight is reflected from the clouds and can be seen a great distance away. In a similar manner, the radio signals from a powerful transmitter, reflected from the upper atmosphere, can be received hundreds of miles distant. Unfortunately, even the electronics experts and communications engineers are unable to agree on exactly what causes this reflection of signals from the upper atmosphere. Although they don't agree on the causes, the experts do agree on the effects.

The experts have known for years that low frequency radio signals can be used to send messages across the oceans because they are reflected downward from the ionosphere — a zone of electrically charged particles above the stratosphere — and follow the curve of the earth. Some of these signals, occurring in the broadcast band, can be picked up on any home radio between 500 and 1700 on the dial. The numbers refer to the frequency of the radio signal; thus, when a radio is tuned to 500, it is able to receive a signal of 500 kilocycles (thousands of cycles) per second. Unfortunately, these frequencies are too low to be used for television, mainly because they don't provide enough elbow-room for the tightly packed television signals. It is necessary to use frequencies 100 to 1000 times as high as the low frequencies just described. The new groups of frequencies, known as the VHF (very-high-frequency) and UHF (ultra-high-frequency) bands, are measured in megacycles (millions of cycles) per second, just as the broadcast band is measured in kilocycles per second.

It has been discovered that as frequencies approach the VHF and UHF bands they quit following the curve of the earth and tend to travel in a straight line like a beam of light. Such signals seem to pass right through the ionosphere and keep moving out into space. It has become common to consider these frequencies as usable only when the transmitter antenna and the receiver antenna can "see" each other; they are known as the line-of-sight frequencies.

During World War II, however, as output powers increased and as antennas became more sensitive, strange reports came sifting back to the Federal Communications Commission. Radar sets in both the VHF and UHF frequency bands were picking up targets far beyond the line of sight. The official verdict: unusual weather conditions, similar to an optical mirage. Still the reports came in. Communications equipment working in the VHF band reported reception at extraordinary distances. The official verdict: unusual weather conditions. Still the reports came in.

Finally, in 1948, the FCC released the results of two series of tests. After a careful examination of the ranges obtained in both the lower and upper portions of the VHF band, the FCC concluded that distances greater than those to be expected had occurred too often to be blamed on the weather. The FCC's tentative theory was that the signals received their tremendous range by being reflected from many small gaps in the atmosphere.

This new phenomenon gave the FCC a good case of jitters. The public was clamoring for more TV; companies in all parts of the country, organized to construct new stations, were demanding the go-ahead from the

(*Continued on page* 14)

BEYOND THE HORIZON

(*Continued from page* 13)

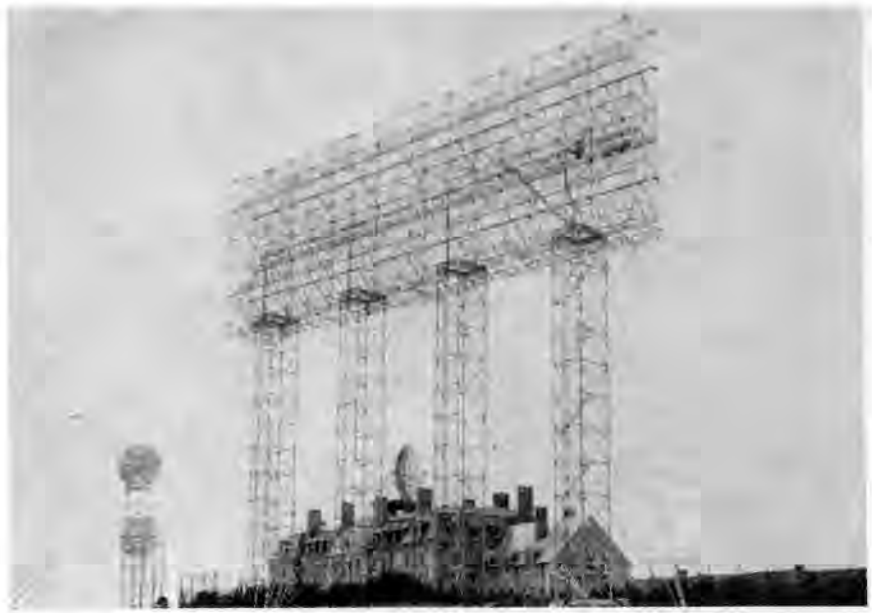
FCC. What were they to do? If all permits were granted hundreds of new VHF stations would be on the air. The recently discovered exceptional range characteristics of VHF seemed to promise that many TV stations would cause interference with others as far away as 500 miles. So the FCC played it safe by declaring a "freeze" on new TV construction while the problems of interference could be worked out. As a matter of fact, interference was the only aspect of scatter propagation that received any serious consideration until late 1949.

When it was discovered that signals in the VHF and UHF bands could be received consistently and reliably at distances greater than 300 miles, a highly secret research program was established to examine fully this new phenomenon. The National Bureau of Standards, Bell Telephone Laboratories, Lincoln Laboratory of M. I. T., Collins Radio Co. and many others cooperated to investigate the usefulness and reliability of beyond-the-horizon transmission.

Progress was slow. A single test program might take several months and cost a lot of money; high power was required, as were extremely sensitive antennas. But some of the mystery was being cleared up. In the summer of 1955 the government finally declassified much of the basic work in this field and for the first time permitted scientists and engineers to discuss freely the theories and techniques they had developed.

Many of the experts are of the opinion that signals in the UHF band are scattered by "blobs" — turbulent regions located high in the troposphere (that part of the atmosphere blanket which is below the stratosphere). Hence, these signals are said to be tropospherically propagated. Opposing the blob school is a group of equally well-qualified experts who say that partial reflection from a smooth upper atmosphere would yield the same results as reflection from a blob. Neither side has been able to obtain definite proof of its theory because the mathematical relationships involved are extremely difficult to solve.

VHF scattering has been explained by the same two theories that explain UHF scattering. A third group of experts maintains, however, that neither of the other two theories applies in the case of VHF. They believe that VHF signals are scattered by reflection from meteor trails located in the ionosphere; the meteors, ranging in size from 6 inches in diameter down to the size of a grain of dust, pass through the ionosphere at a rate of about 10 billion a day, leaving behind columns of electrically charged particles that act as reflectors for VHF signals. Thus, VHF is said to be ionospherically propagated.



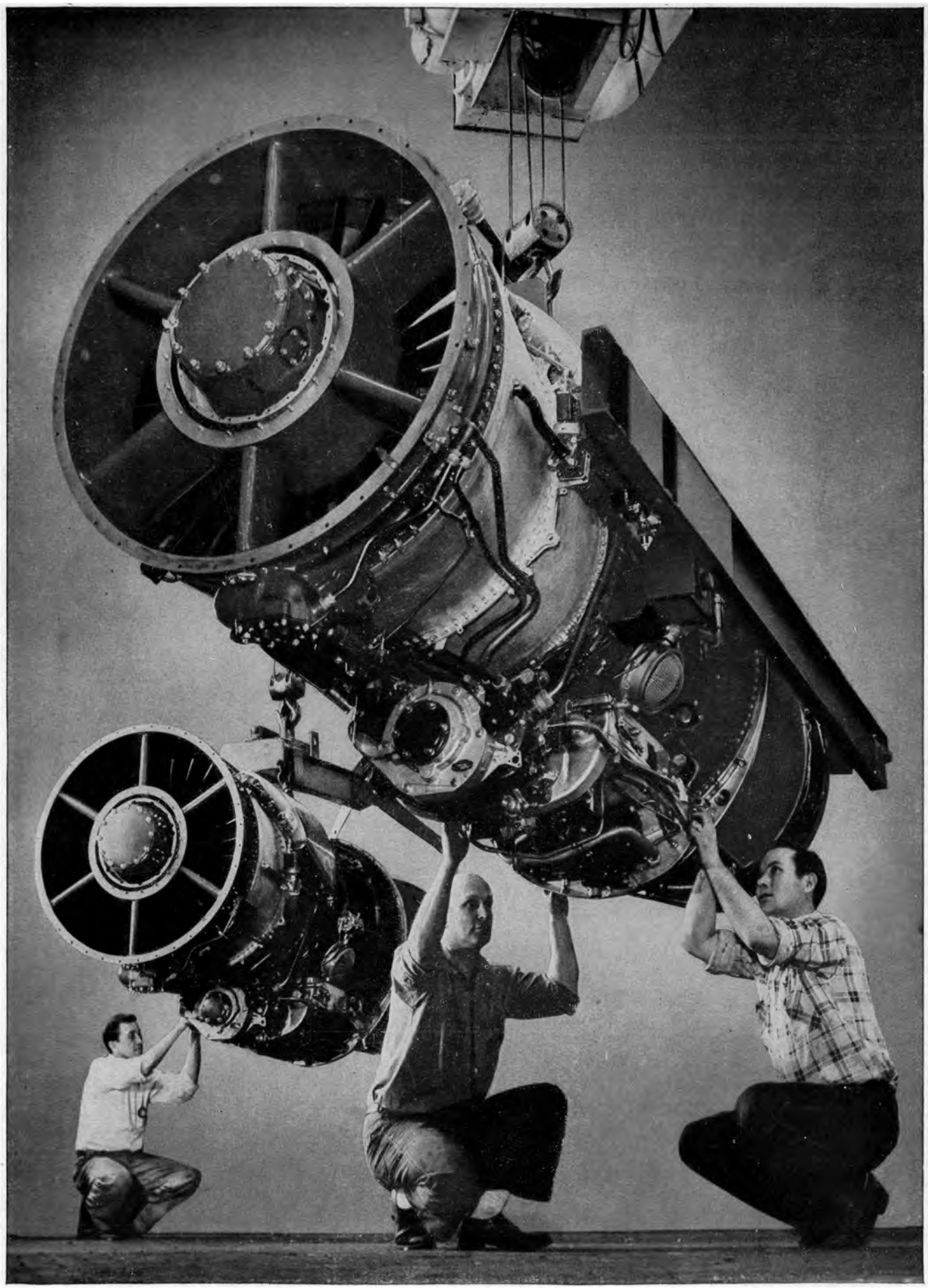
1,100-Mile Transmitter at South Dartmouth, Mass.

The equipment devised to use effectively beyond-the-horizon transmission staggers the imagination. An ordinary VHF or UHF transmitter sends out into space about 50 watts of power — enough to light a small desk lamp. But transmitters for scatter propagation send out into space about 50,000 watts—sufficient to power an aircraft beacon. Even more impressive than the transmitters are the antennas. (See picture.) The box-like structure in the front of the picture is a transmitting antenna capable of sending a VHF signal a distance of 1100 miles using 50,000 watts. It stands 130 feet tall—all antenna, and as high as a ten-story building. In the center of the picture, mounted above the house, is a receiving antenna shaped like a deep saucer. Parabaloids, the engineers call them. These giants, about 60 feet in diameter, are so sensitive that they can receive radio signals 600 to 10,000 times weaker than those picked up by an ordinary home radio antenna. It has been found more efficient to set up two receiving antennas several miles apart rather than to use just one, as sensitive as it is. Space diversity reception this is called; it increases tremendously the reliability of scatter propagation.

Actually, it is this reliability that makes the communications experts so enthusiastic about scatter propagation. Signals transmitted by this method do not fade; they laugh at sun spots and completely ignore magnetic storms. As a result, they are ideally suited for communications in the Arctic, where ordinary radio reception is only about 60 per cent reliable. The U. S. Air Force has already started. Project Bitter Sweet, a VHF teletype circuit between Limestone, Maine, and Thule, Greenland, was recently established. More VHF links will be forthcoming soon.

The civilian uses of scatter propagation are equally promising. Worldwide television can become a reality. An international network, using relay stations about every 500 miles, could link the world by video. Economies in installation and maintenance would result if the telephone companies used, instead of coaxial cable, scatter propagation circuits over deserts, forests,

(*Continued on page* 28)



The J-57, in the 10,000-pound thrust class, is the most powerful turbojet engine now in production. A new generation of U.S. air power has been designed around this mighty new Pratt & Whitney Aircraft engine.

North American's F-100 Super Sabre, fastest Air Force jet fighter, is powered by Pratt & Whitney Aircraft's J-57 engine.

First all-jet heavy U. S. Air Force bombers are the huge Boeing B-52s, powered by eight J-57s mounted in pairs.

The Douglas F4D Skyray, fastest Navy jet fighter, will be powered with the big J-57 engine.

The Douglas A3D, the Navy's most powerful carrier-based attack airplane, has two J-57 engines.

Blazing the Way for a New Generation of Air Power

The most powerful turbojet engine in production is blazing the way for a whole new generation of American aircraft.

That engine is Pratt & Whitney Aircraft's J-57, the first turbojet to achieve an official rating in the 10,000-pound thrust class.

But the J-57 provides far more than extreme high thrust. Its unique Pratt & Whitney Aircraft design, achieved after years of intensive research and engineering, offers as well the low specific fuel consumption so vital to jet-powered bombers and future transports, plus the additional important factor of fast acceleration.

The importance of the J-57 in America's air power program is clearly shown by the fact that it is the power plant for three of the new "century series" fighters for the U. S. Air Force—North American's F-100, McDonnell's F-101 and Convair's F-102—as well as Boeing's B-52 heavy bomber. The Navy, too, has chosen the J-57 for its most powerful attack aircraft, the Douglas A3D, the Douglas F4D fighter and for the Chance Vought F8U day fighter. And the J-57 will power the Boeing 707 jet transport.

The J-57 is fully justifying the long years and intensive effort required for its development, providing pace-setting performance for a new generation of American aircraft.

Engineering graduates who can see the challenge in this new generation, might well consider a career with the world's foremost designer and builder of aircraft engines.

PRATT & WHITNEY AIRCRAFT
DIVISION OF UNITED AIRCRAFT CORPORATION
EAST HARTFORD 8, CONNECTICUT

MIZZOU MEMOS

By SHELTON EHRLICH, M.E. '56

Career Sketch: *Dave Moore*

As Chief of the Industrial Economics Division at Battelle Institute, Dave Moore (Class of '36) coordinates the research efforts of a team of 18 experienced specialists in engineering, economic, and business problems. This team is an integral part of the broad program of "research for industry" initiated over 25 years ago by Battelle which since has grown into one of the world's largest independent industrial research centers.

Dave's team conducts market studies for industry to find new markets for old products or outlets for newly developed ones, analyze corporate resources to advise on diversification, recommend methods of developing geographical areas, and survey raw material resources for potential industrial locations. Dave himself has participated in economic studies dealing with turpentine, Gilsonite, fertilizers, petroleum, railroad electrification, and the resources of several geographic regions. He has also been a contributor to studies on fuels and energy, including an extensive technical and economic study on the problems of preparing fuel gas from coal.

More recently, Dave was co-author of a comprehensive and widely acclaimed report on the comparative economics of open-hearth and electric-furnace production of low-carbon steel. The report was based upon a study supported by the bituminous coal industry and a group of public utility companies.

A native Missourian from Dexter, Dave attended the Missouri School of Mines before coming to the University of Missouri for his bachelor of science degree in chemical engineering. He began his engineering career by working for several oil companies in Kansas, Texas, and Oklahoma.

Shortly after the outbreak of World War II, the Army bid for his services and Dave found himself commanding an amphibious company. His three-and-a-half year tenure garnered him the Purple Heart, a unit citation of the Croix de Guerre with Palms, and Bronze Arrow for his part in the landings in North Africa, Sicily, and on D-Day in France. In rank, he had risen to Major and battalion commander.

Dave Moore

Returning to civilian life, and the petroleum industry, in 1946, Dave joined the Socony-Vacuum Company in Augusta, Kansas, as a corrosion engineer. By 1948, he had decided that research was the field of work he preferred, particularly the economics of plant operation. He has been on the Battelle staff ever since.

Dave married a former University of Missouri coed, Harriett Elizabeth Patterson, a Pi Beta Phi, in 1939. The couple, now living at 1056 Elmwood Avenue, Columbus 12, Ohio, has two daughters, Cynthia, 15, and Kirtley Ann, 12.

Dave is a member of the American Chemical Society and the American Petroleum Institute.

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

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, South Carolina.

Harvey W. Balzer, Eng. '30, has been named senior project engineer in the Product Design Section of Automatic Electric Company, Chicago, the organization that originated the dial telephone. In his new assignment, Harvey is responsible for telephone central office equipment circuit design planning and scheduling. He is married to the former Vesta L. Hackley of Fayette, Missouri. They make their home at 4616 Highland, Downers Grove, Ill., a Chicago suburb, and have three children.

NEWSTUFF

TRANSISTORS PROGRESS

Although the development of transistors is not yet at the stage where industrial applications are widespread, control engineers are now finding applications where the transistor's properties can be utilized to unique advantage. Two experimental designs by Westinghouse engineers give an indication of future possibilities.

In the metal-working industry, many instances require a device with the ability to sense the presence of hot metal. A new hot-metal detector utilizes a photo-transistor as an infra-red sensing device, and also uses transistors in the amplifying circuit. It can be used in any application where a metal object at 700 degrees F or more must be detected and a signal transmitted to indicate that presence.

One example is in the rolling of steel tubing: with a specified volume of metal to start with, and a constant outside diameter, the thickness of the tube wall can be determined by tube length. If the pipe is rolled with too thin a wall the pipe will be longer than average, and conversely, if the wall is too thick, the tube will be shorter. Wall thickness can thus be determined from tube length. By placing several hot-metal detectors at specified distances apart, the length of the pipe can be measured and thus the wall thickness is determined.

Advantages of such a transistorized hot-metal detector over previous photo-electric equipment are its increased sensitivity to infra-red radiation and its inherent ruggedness in such applications.

An experimental constant-current motor control uses static, semi-conductor elements, mainly transistors and silicon diode rectifiers. Such a control might be used for maintaining constant horsepower on a steel mill reel drive. In an experimental model developed by Westinghouse a ¾ horsepower d-c shunt motor is used as a driving motor. The voltage drop across a shunt in the d-c armature circuit provides a signal proportional to armature current. This signal is fed to the regulator, which automatically adjusts the shunt field of the d-c motor to maintain constant armature current and thus constant horsepower. In addition to the advantages that accrue because of the all-static nature of this control, the regulator is also extremely small and has very rapid response. The experimental model, while it utilizes a ¾-hp motor, has sufficient capacity for motors up to 3 hp. The same basic regulator could also be used for speed control. While still in the development stage, this application indicates that semi-conductor devices have a promising future in industrial control applications.

HONEYCOMB FOR JETS

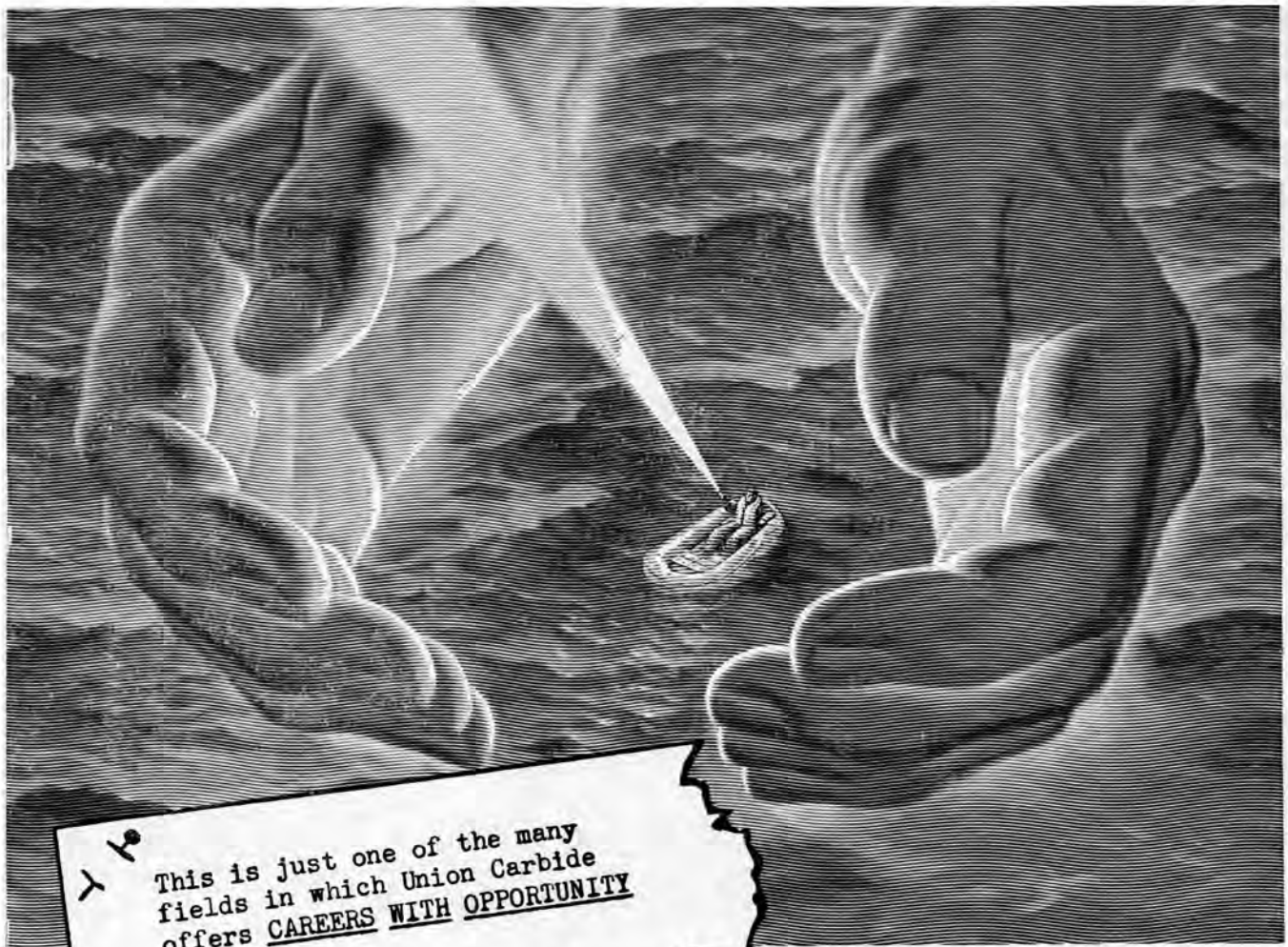
The General Electric Company's Aircraft Gas Turbine Division will produce "honeycomb sandwich" material for jet engine structure utilizing alloys and brazing techniques developed by General Electric.

JET BEE-HIVE—This honeycomb will be used as the core of future jet engine parts. The result of new alloys and brazing techniques developed by General Electric's Aircraft Gas Turbine Division, a "honeycomb sandwich" part is a good insulator, can withstand temperatures of 1800 to 1900 degrees Fahrenheit, and is almost 80 per cent lighter than solid structural members. The "sandwich" part, brazed at extremely high temperatures, is composed of a stainless steel skin .010 inch thick with a honeycomb core one-quarter inch thick.

The division is planning to use the honeycomb materials in components for new jet engines because of its lightness and strength. It is a good insulator, can withstand temperatures of 1800 to 1900 degrees Fahrenheit, and is almost 80 per cent lighter than solid structural members.

According to AGT engineers, the "honeycomb" has been used for turbine and compressor casings, tailpipes, and reheat nozzles during experimental tests, and have operated very successfully.

(*Continued on page* 20)



To save a life

Portable packages of electricity help make our lives safer and more enjoyable

THE BRIGHT BEAM of a flashlight in the hands of an airman down at sea . . . the untold comfort of an almost invisible hearing aid . . . the pleasure of listening to your favorite music over a portable radio.

THESE INGENIOUS DEVICES have one thing in common—they all get their electric power from dry-cell batteries. Each day millions of us depend on these portable packages of power for greater safety, comfort, and pleasure.

LARGE BATTERIES furnish power for signalling and communications systems. Hearing aid batteries are now so tiny that they can hide under a dime. Other dry-cells supply power to everything from toys to Geiger counters.

OVER 60 YEARS AGO, the people of Union Carbide produced the first commercial dry-cell. From this beginning, they developed the great variety of EVEREADY batteries that now serve dependably in so many applications.

SCIENTISTS of Union Carbide are constantly working on new, improved methods of producing packaged power. Their goal is to make dry-cell batteries do even more work for all of us.

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

UNION CARBIDE
AND CARBON CORPORATION
30 EAST 42ND STREET UCC NEW YORK 17, N. Y.
In Canada: UNION CARBIDE CANADA LIMITED, Toronto

UCC's Trade-marked Products include

EVEREADY Flashlights and Batteries · Dynel Textile Fibers · SYNTHETIC ORGANIC CHEMICALS · PREST-O-LITE Acetylene · PRESTONE Anti-Freeze · ELECTROMET Alloys and Metals · HAYNES STELLITE Alloys · UNION Carbide · LINDE Oxygen · UNION CARBIDE Silicones · BAKELITE, VINYLITE, and KRENE Plastics · NATIONAL Carbons · ACHESON Electrodes · PYROFAX Gas

NEWSTUFF

(*Continued from page* 20)

Brazed at very high temperatures, the honeycomb sandwich is composed of a stainless steel or other types of high temperature alloy skin .010 inch thick with a light weight honeycomb core one quarter inch thick. Because of its ability to withstand very high bending loads, it has many possible industrial applications.

TURBINE FOR 'COPTERS

General Electric's T58 small gas turbine engine is in advanced stages of development for the Navy's Bureau of Aeronautics and is rated in the "1000 horsepower class," it was revealed by a Company official.

Guy C. Shafer, General Manager of G.E.'s Small Aircraft Engine Department, Lynn, Mass., announced that the engine will undergo extensive helicopter rotor tests at the Company's Flight Test Center in Schenectady, N. Y. in the near future.

In discussing the new engine's features, H. T. Hokanson, Manager of the T58 Project, who is in charge of the engine development program stated that its light weight and small size are results of G.E.'s advanced design techniques. He also stated that the engine incorporates the "free" power turbine design, which provides increased stability of operation due to its favorable torque-speed characteristics, and permits greater flexibility in the selection of rotor speeds for greater efficiency.

"The benefits which will accrue to military users will be available to commercial operators as well," Mr. Hokanson said. "They can look forward to heavier payloads, higher flight speeds, and better fuel economy."

Other advantages claimed for the new gas turbine powerplant include installation flexibility and ease of maintenance. According to Mr. Hokanson, an important factor in designing for these features has been the wealth of gas turbine experience G-E has realized from the millions of operating hours logged by the Company's J47 jet engines in military aircraft.

GAS TURBINE FOR 'COPTERS—In advanced stages of development is General Electric's T58 small gas turbine engine. Developed for the Navy to power helicopters the baby engine, despite its small size and light weight, is rated in the 1000 hp class. Company engineers state it has exceptional torque-speed characteristics and great flexibility in selection of rotor speed because it is designed with a free power turbine. A T58-powered helicopter is expected to stay aloft 50 per cent longer than a comparable one with a piston engine, and carry 100 per cent more payload.

Fuel versatility, another T58 advantage, was gained by incorporating special design features which allow many types of fuel to be used, easing the supply problem and resulting in lower operating costs, Mr. Hokanson said.

He added that studies of anti-submarine warfare, utility and cargo helicopter missions made by Department engineers show the T58 superior to equivalent piston engines in endurance, payload, range, speed, durability and reliability.

"For example," Mr. Hokanson said, "in an anti-submarine warfare mission where endurance is an important factor, a given T58-powered helicopter could stay aloft 50 per cent longer than a piston engine powered helicopter. If the ability to carry payload a given distance is the prime consideration, as in a cargo helicopter, the T58 promises a two-fold increase in ton-mile capacity."

Mr. Hokanson expects the T58 to enable a utility helicopter to carry 100 per cent more payload than a piston engine powered helicopter.

The turboshaft T58, with some modification, can be converted to a turboprop or turbojet.

The Department is also developing a small turbojet engine, designated MX2273, for the Air Force.

DATA DIGESTER

An advanced measurement technique, now being used at the General Electric Company's jet engine plant near Cincinnati, is proving useful in understanding mechanical and aerodynamic phenomena in jet engines and in perfecting designs of advanced propulsion systems.

Called a magnetic tape recording and data reduction system, it is used in the Materials Laboratory of the Company's Aircraft Gas Turbine Development Department. Total recall of data is made possible by magnetic tape storage, and subsequent reduction and analysis is effected electronically.

With the system, multiple channels

(*Continued on page* 24)

At David Sarnoff Research Center, Princeton, N. J., RCA tests one of loudspeakers used in new high fidelity "Victrola" phonographs.

RCA creates a new kind of high fidelity in the silence of this room

In this room you *can* hear a pin drop. The jagged walls absorb alien noise so that delicate instruments can make sure reproduced sound matches the original as closely as possible.

Thus a new kind of high fidelity is born—and brought to you for the first time in new RCA Victor Orthophonic "Victrola" phonographs. *Listen!* Here is distortion-free performance through the range of audible sound. Here is *more* music than you've ever heard before. Here is the ultimate in high fidelity.

The skill behind new Orthophonic "Victrolas" is inherent in all RCA products and services. And continually, RCA scientists strive to open new frontiers of "Electronics for Living"—electronics that make life happier, easier, safer.

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

NEWSTUFF

(*Continued from page* 22)

of data such as stress, vibration, pressure, temperature, speed and flow, can be recorded simultaneously at a test site. The data may be steady in nature or varying up to 30,000 cycles per second.

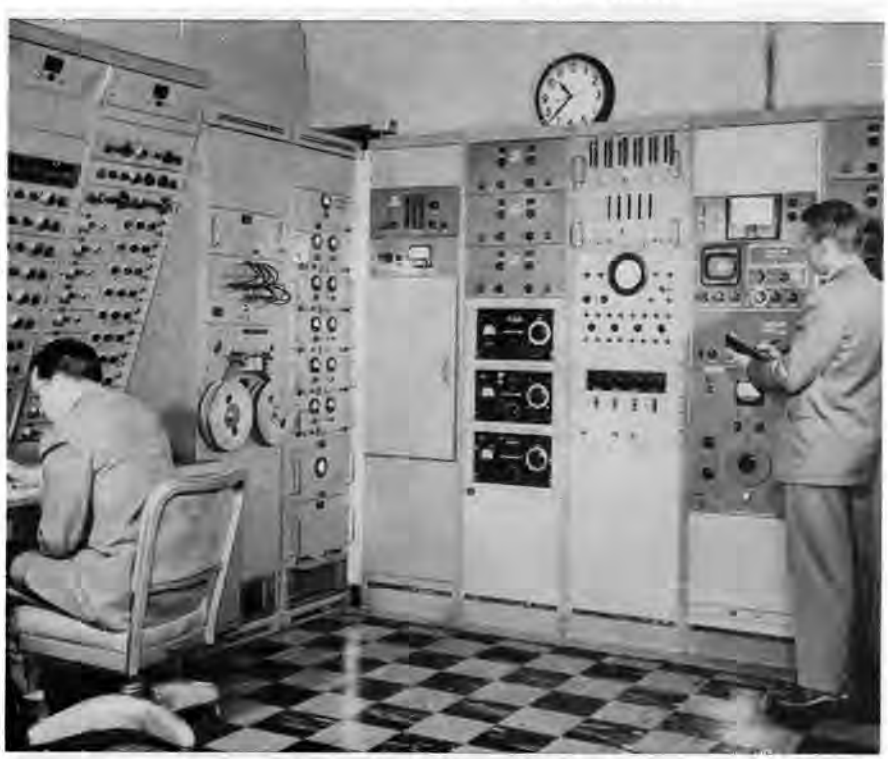
Data reduction is accomplished by this complex electronic system (shown above) designed and constructed by G-E engineers. Use of this equipment has shortened data reduction time to a fraction of what was previously required.

Reduction of the data is performed in multiple channels. Presentation of the data can be made by utilizing function plotters, direct writing oscillographs, continuous recording in terms of instantaneous amplitude and frequency, and by cathode ray oscilloscopes and oscillographs. Flexibility of the equipment provides a wide choice in ways of studying many types of data.

There is an urgent need for Chemists, Mathematicians, Metallurgists, Physicists, and Electronic Scientists in the Washington, D. C., area, the United States Civil Service Commission has announced. Vacancies are in various Federal agencies and pay salaries ranging from $4,345 to $11,610 a year.

To qualify for positions paying $4,345 a year, applicants must have had appropriate education or a combination of education and experience. For the position of Electronic Scientist, appropriate technical or scientific experience alone may be qualifying. For higher-grade positions, professional experience is also required. Graduate study may be substituted for all or part of this experience, depending on the grade of position. No written test is required.

Further information and application forms may be obtained at many post offices throughout the country, or by writing to the U. S. Civil Service Commission, Washington 25, D. C. Applicants should ask for Announcement No. 46 (B). Applications will be accepted by the Board of U. S. Civil Service Examiners, National Bureau of Standards, Washington 25, D. C., until further notice.



DATA DIGESTER—This new magnetic tape recording and data reduction system is being used by General Electric engineers at the Company's Evendale, Ohio jet engine plant to perfect designs of advanced propulsion systems. Total recall of data is done with magnetic tape, and reduction and analysis is effected electronically. Designed and built by GE, the system allows for multiple channels of data such as stress, vibration, pressure, temperature, speed, and flow to be recorded simultaneously at a test site. Reduction is also performed in multiple channels.

STARFIGHTER

(*Continued from page* 11)

trailing edges to increase lift which reduces landing speed and cuts down on take off run. The ailerons are located near the wingtips. Unlike most fighters, the landing gear is built to retract into the fuselage, rather than into the wings.

The short wings presented a problem in turns because the tail surface was almost as high as the fuselage to wingtip distance. The rudder tended to act as an aileron and cause the plane to roll instead of turn.

The roll was compensated for by putting a negative dihedral or cathedral of 10 degrees on the wings.

The "flying tail" is so called because the entire horizontal stabilizer moves. There is no elevator on the thin stabilizer, which is located almost at the top of a high, swept-back vertical fin. The location of the stabilizer, by acting as an end plate, makes the vertical tail of the F-104 about twice as effective as a normal vertical tail. Also, by being high the horizontal tail avoids many of the downwash effects of the low-aspect ratio wing.

Looking at the basic design of the airframe, the "coke bottle design" or area rule which was made such a fuss about on the F-102 is not used. Lockheed says in regard to this, "This area variation does not generally apply to straight thin wing airplanes. Also, we have such low wing volume that there is little area correction to make . . . data which has been published to date on the effect of using the area rule shows only a gain in a plane's ability to get through Mach 1. This never was a problem with the F-104."

Another design element of the 104 is symmetry about the horizontal and vertical axes. This causes drag to be 12% less for the Starfighter wing configuration than for a low-wing fighter and gives excellent air intake characteristics. The air intake advantages are very important at high speeds where the engine is acting as a ram jet and the ram effect of the air plays an important part in the plane's performance.

(*Continued on page* 28)

New On Faculty

This year, as interest in engineering intensifies, the Engineering Department was fortunate to acquire several new additions to its faculty.

Among these is Donald L. Gibson, an assistant professor of mechanical engineering. Mr. Gibson comes to us from Iowa State College where he was an instructor of mechanical engineering. He is twenty-eight years old, and seems fully prepared to undertake the rigors of teaching.

Mr. Gibson was born in St. Joseph, Missouri. He claims a St. Joseph high school and the St. Joseph Junior College as his alma maters. He continued his education at Iowa State College, where he received his B.S. and M.S. in Mechanical Engineering.

Mr. Gibson was employed for three years with the Southwestern Bell Telephone Company. He has been associated with the Missouri Highway Department and he has done experimental engineering for the John Deere Tractor Company.

He has several varied hobbies, which include hunting, fishing, boating, and photography. He enjoys teaching, and would like to continue in the field. In the future, he would like to do research on diesel injectors, residual stresses, and size changes in heat treated materials.

The Shamrock staff welcomes Mr. Gibson and hopes his stay at Missouri University will be long and enjoyable.

YOUR FUTURE IS... NOW... AT CONVAIR FORT WORTH

Now — put your years of college training to work, in the finest professional atmosphere . . . gain experience that brings added recognition and continually increasing earnings.

Before you make a decision, investigate CONVAIR-Fort Worth. Here you'll work on the nation's most challenging engineering projects. At Convair, the opportunity for rapid advancement is unlimited.

You'll like living in Fort Worth, home of the great Southwestern Exposition and Fat Stock Show, the internationally famous Colonial Invitational Golf Tournament, acres of spacious parks and conveniently accessible lakes. These and many other attractions and recreational facilities make leisure time in Fort Worth wonderfully relaxing and entertaining. Living conditions are ideal and the cost of living is low — no state income tax, no sales tax!

Whatever your major, you'll find a place at Convair. Check the list of engineering fields below, then confirm YOUR future . . . at CONVAIR-Fort Worth.

- ✓ *AERONAUTICAL ENGINEERING*
- ✓ *MECHANICAL ENGINEERING*
- ✓ *ELECTRICAL ENGINEERING*
- ✓ *CIVIL ENGINEERING*
- ✓ *CHEMICAL ENGINEERING*
- ✓ *ENGINEERING PHYSICS*
- ✓ *MECHANICS • PHYSICS*
- ✓ *METALLURGY • MATHEMATICS*

If our team missed you on their recent campus interview session, write TODAY to

MR. H. A. BODLEY

Engineering Personnel, Technical Employment

CONVAIR

FORT WORTH, TEXAS

C-V CONVAIR

CONVAIR FORT WORTH

GD GENERAL DYNAMICS

★ A DIVISION OF GENERAL DYNAMICS CORPORATION ★

STARFIGHTER

(*Continued from page* 26)

The Starfighter uses many components which have been used on other fighters but are slightly modified for the F-104. It is equipped with a landing drag parachute of the same type introduced on the F-94C Starfire jet interceptor. On the F-104 the drag parachute is installed on the lower part of the fuselage, near the end of the tailpipe. Dive flaps, or brakes, are located back of the wing and about midway up the side of the fuselage. A large engine access door, on the bottom of the fuselage, serves a dual purpose. In addition to providing ready access to the engine, the door's inner panel holds most of the plane's hydraulic equipment, to facilitate servicing.

The Starfighter uses jettisonable wingtip fuel tanks and provision has been made for underwing pylon tanks if needed for extra fuel. The range is reported to be comparable to that of present operational jet fighters, probably about 1,500 to 1,800 miles.

The Starfighter is truly a remarkable airplane, as have been most others when they were introduced. But, with the rapid progress taking place in all phases of research today, the imagination cannot conceive of the F-120's and F-130's of tomorrow.

Professor of Botany: "This twig, you will notice, is composed of bark, hardwood and pith. Of course, you know what pith is. You, Lulu—you know what pith is, do you not?"

Lulu: "Yeth, thir!"

♣

"Oh, here is the place mother told me to stay away from. I thought we'd never find it."

♣

Four Year Old: Daddy, are there any skyscrapers in heaven?"

M.E. Dad: "No, son, C.E.'s build skyscrapers."

♣

Then there was the E.E. who called his girl "Carbon" because her resistance went down as she warmed up.

♣

BEYOND THE HORIZON

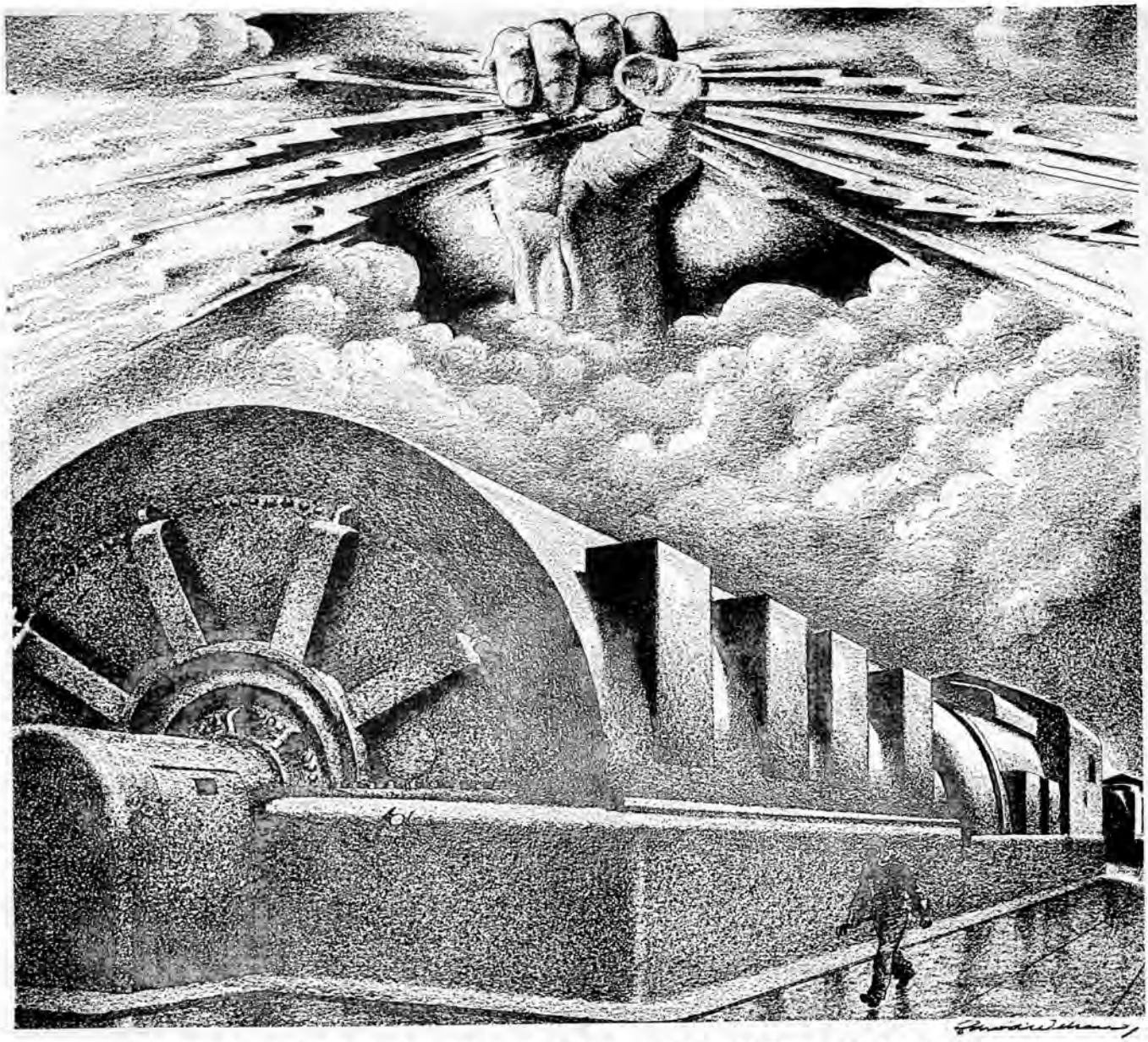
(*Continued from page* 14)

lakes and mountains. As a result, cheaper, more reliable telephone and telegraph service would be made available to the public.

These two examples only scratch the surface. Marconi wrote in 1932:

> In regard to the limited range of propagation of these VHF signals, the last word has not yet been said. It has already been shown that they can travel round a portion of the earth's curvature, to distances greater than had been expected, and I cannot help reminding you that at the very time when I first succeeded in proving that electric waves could be sent and received across the Atlantic Ocean in 1901, distinguished mathematicians were of the opinion that the distance of communications, by means of electric waves, would be limited to . . . about 165 miles.

The propagation field has now caught up with Marconi's vision. Now that the industry has cracked this last communications barrier, unlimited possibilities await—beyond the horizon.



Behind Today's Miracle Machines...
a Master's Touch in Oil

World's largest outdoor turbine plant, producing electricity for Atomic Energy Works at Paducah, Kentucky . . .

Giant eye of the Mt. Palomar telescope through which man sees farther into space than ever before . . .

World's most completely automated plant, manufacturing automobile engines . . .

First successful diamond-making machine . . .

One of every six industrial wheels turning in the free world—more than half the big turbines (5000 kilowatts and over) . . .

All have one thing in common—SOCONY MOBIL'S *master touch* in lubrication.

Good reason! Men who depend on machinery depend on SOCONY MOBIL, as a partner in its protection.

★ ★ ★

Wherever there's progress in motion—in your car, your factory, your farm or your home—*you, too, can look to the leader for lubrication.*

SOCONY MOBIL OIL COMPANY, INC.

LEADER IN LUBRICATION FOR NEARLY A CENTURY

Affiliates: General Petroleum Corporation, Magnolia Petroleum Company
Mobil Overseas Oil Company and Mobil Producing Company

BULLARNEY

bye Now

"Do you know who was the first engineer?"

"No, who?"

"Adam, he furnished spare parts for the first loud speaker."

♣

Then there's the dachshund who met his end running around a tree.

♣

C.E.: "What do you do all day?"
E.E.: "Hunt and drink."
C.E.: "What do you hunt?"
E.E.: "Drink!"

♣

For years the bum slept under bridges and in ditches. Then one day he switched to culverts and became a man of distinction.

♣

Wife: "Do you have a good memory for faces, dear?"

Husband: "Of course I have."

Wife: "That's good, I just dropped your shaving mirror."

♣

People are like steamboats — they toot loudest when they are in a fog.

♣

Adam and Eve were the first bookkeepers—they invented the first loose leaf system.

♣

She: "You remind me of the ocean."
He: "Wild, romantic and restless?"
She: "No, you make me sick!"

♣

A shipwrecked sailor was captured by cannibals. Each day the natives would cut his arm with a dagger and drink his blood.

Finally he called the king: "You can kill me and eat me if you want," he said, "but I'm sick and tired of getting stuck for the drinks."

♣

An egotist is a man who thinks that if he hadn't been born, people would have wanted to know why not.

As he felt his way around the lamp post, the overloaded senior muttered, "S' no use, I'm walled in."

♣

Anyone who thinks he is indispensable should stick his finger in a bowl of water and notice the hole it makes when he pulls it out.

♣

For book of the month club lovers only—

"He beat her in the wigwam," or "Her sufferings were intents."

♣

While out of town, a stingy husband sent his wife a check for a million kisses. The little woman, quite provoked, sent a postal card which read:

"Dear Jim, thanks for the lovely check you sent. The milkman cashed it for me this morning."

♣

Sign in window of Columbia launderette: "Ladies who care to drive by and drop their clothes will receive prompt and courteous attention."

♣

ODE TO A LAB REPORT

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

—Unanimous

For you engineers who don't know the difference between prose and poetry, here is an example.

There was a young lady from Tipps;
She went into water up to her knees.

That's prose.

If she had gone any deeper, it would have been poetry.

♣

E.E.: Want to go steady?
She: Oh, yes!
E.E.: Ever try castor oil?

♣

"Your girl is spoiled, isn't she?"

"Naw, it's just the perfume she's wearing."

♣

Wife: "Darling, tell me, how did you ever get Junior to eat olives?"

Ch. E.: "Simple, I started him with Martinis."

♣

He rounded the bend at close to 40. A sudden skid and the car overturned. They found themselves sitting together, unhurt, alongside the completely smashed car. He put his arm around her waist.

"It's all very nice," she said, "but wouldn't it have been easier to run out of gas?"

♣

A proud Texan was visiting New England and was bragging about the fact that his 75 year old father still rode horseback everyday.

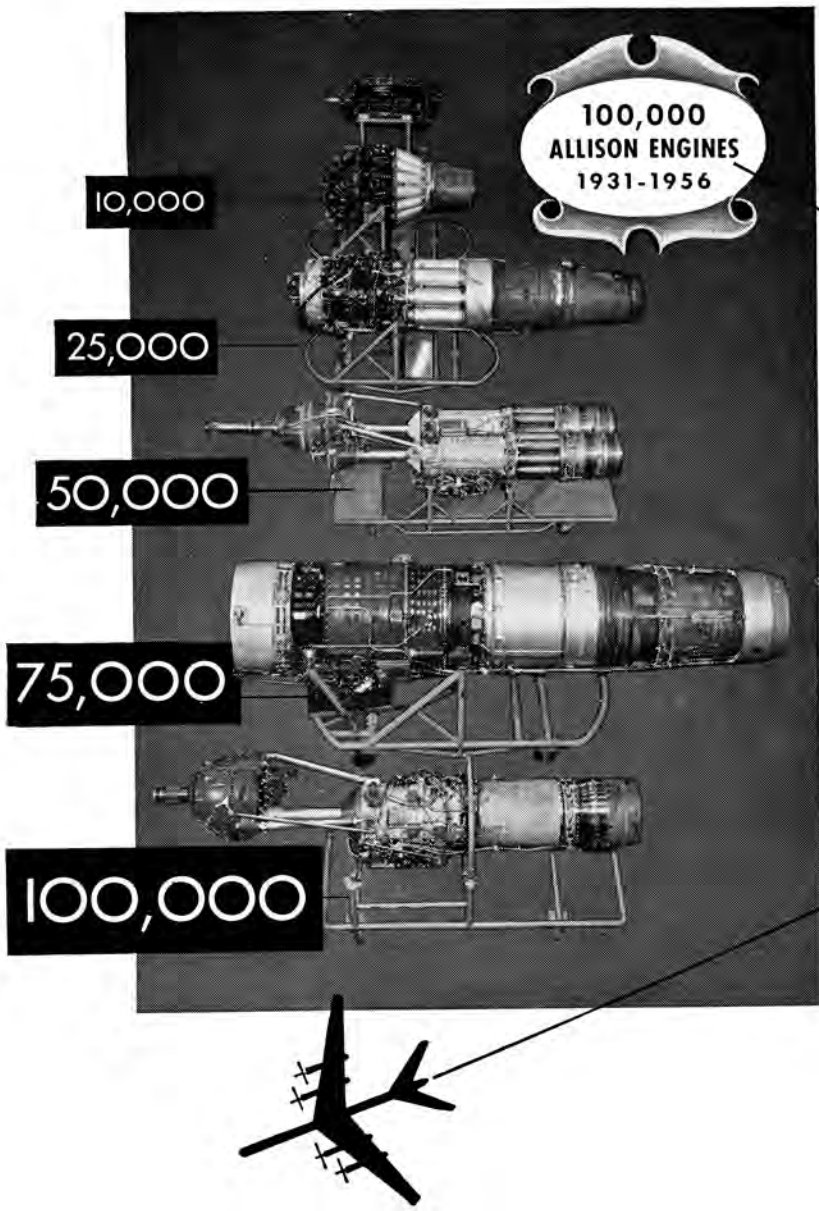
New Englander: "That's nothing, my father is 75 years old and he plowed 10 hours a day all last week except Saturday, and then he had to take off for his father's wedding."

Texan: "Wedding? How old is the old man?"

New Englander: "99."

Texan: "Well, if he's 99 why would he want to get married?"

New Englander: "Wanta; hell, he had to."



PIONEERING NEVER ENDS AT ALLISON

Today's powerful turbo-jet and turbo-prop engines are a far cry from the aircraft engines of a mere 10 years ago.

But we've hardly scratched the surface. We're still pioneering.

Sure, the sound barrier's been cracked. But, who knows, perhaps in the next 10 years we'll be flying at speeds 2 or 3 times the speed of sound. Newer, more complex, more powerful engines ARE in the offing. There'll be new fields to conquer. For instance, the thermal barrier!

Allison, a pioneer in the design, development and production of aircraft engines, now is working on advanced design turbine engines to meet future requirements . . . whatever they might be. Proven features of engines like the Allison J71 and T56 may be adapted to the engines of tomorrow. Allison engines of the future will be backed up with worlds of experience gained in the development and production of its first 100,000 aircraft engines.

Now, Allison is in the midst of a $75 million expansion program in engineering research and development facilities. Completion of the program will give Allison one of the world's most complete, best-equipped, centers for the development of new, high performance turbo-prop and turbo-jet aircraft engines. This opens new and unlimited opportunities for young graduate engineers, for the program—financed by General Motors—creates an immediate need for a 40% increase in engineers.

☆ ☆ ☆

Want to know more about YOUR career opportunities at Allison? Why not arrange now for an interview with our representative on your campus. Or, write for information about the challenging work awaiting you at Allison: Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

1956 Fashion Note: Women will wear the same thing in brassieres.

♣

Husband: "After I get up in the morning and shave, I feel 10 years younger."

Wife: "Why don't you shave before you go to bed?"

♣

He: "How about a kiss, baby?"

She: "Not on an empty stomach, sugar."

He: "Of course, not — on the mouth."

♣

At the stroke of twelve, the irascible father stomped to the head of the stairs and shouted, "Young man, haven't you got a selfstarter?

Young man: "Don't need one as long as there is a crank in the house."

♣

This EE weaved into the bar and ordered two beers. Holding them carefully he went into the men's room and disposed of them. A few minutes later he repeated the act, and then again a few more times. Finally the bartender could contain himself no longer.

"Are you nuts, pouring all of those beers into the toilet?"

The drunk shrugged: "I am just tired of being the middleman!"

Finals, finals everywhere
With drops and drops of ink
And never a prof who'll leave the room
And allow a guy to think.

♣

They dragged the student down to the jail and took him before the Sergeant.

"What am I here for?" he asked.

"For drinking," the officer sternly announced.

"Good, when do we start?"

♣

The convertible swerved to the curb, stopped near a sweet young thing walking along the shoulder of the road. "Want a ride?" the man shouted. "No thanks," came the answer. "I'm walking back from one now."

♣

"Son, after four years of college, you're nothing but a drunk, a loafer, and a damn nuisance. I can't think of one good thing it's done."

"Well—didn't it cure Ma of bragging on me."

♣

Our favorite professor: If, in going down this incline, I gain four feet per second, what will be my condition after 25 seconds.

Sophomore ChE: You'll be a centipede.

Then there was the man who slept in a hammock. He had a falling out with his girl.

♣

When you put on your cute rayon scanties
Do they crackle electrical chanties?
Don't worry, my dear,
The reason is clear,
It's just that you have amps in your panties.

♣

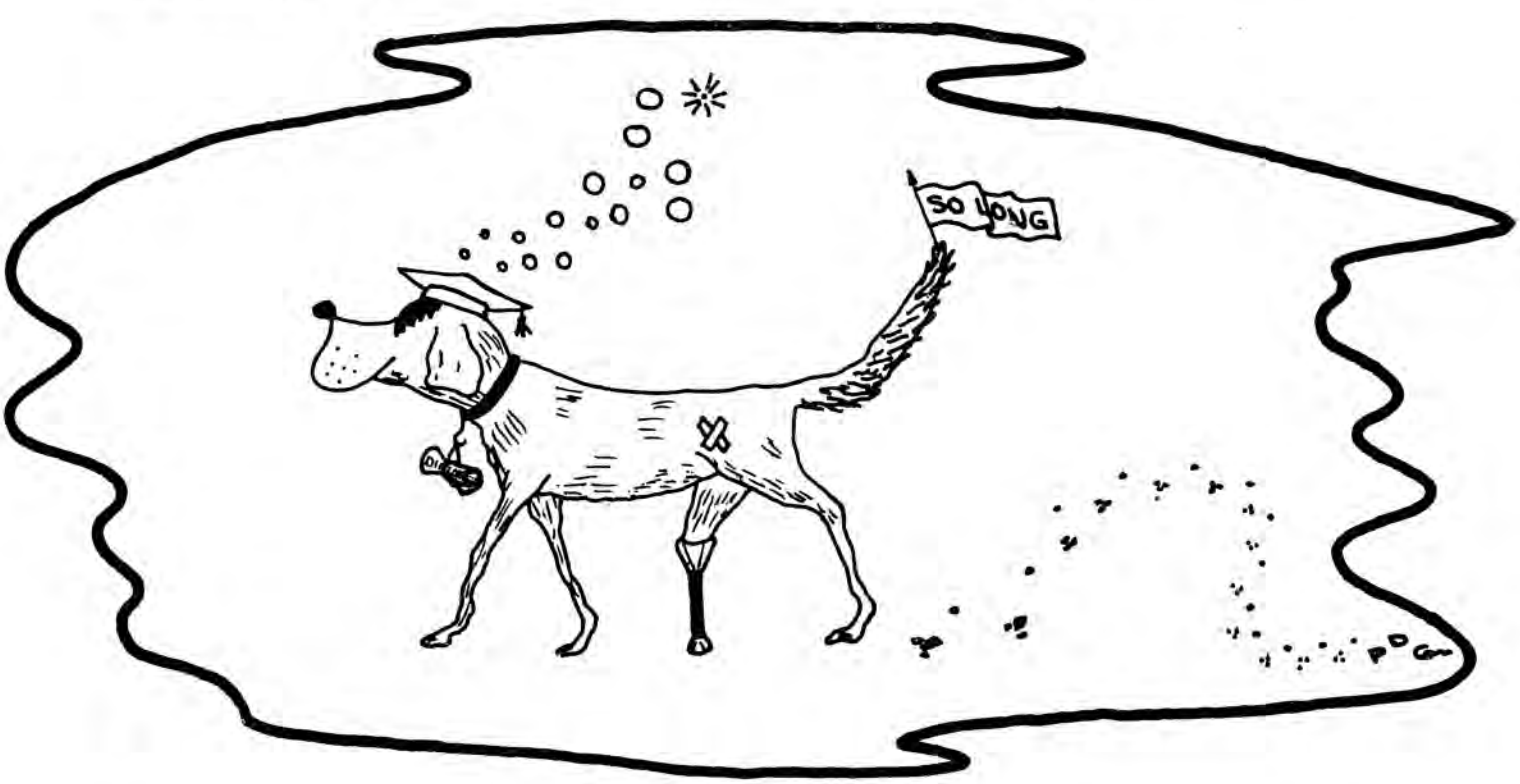
"Professor," said the engineer in search of knowledge, "will you try to explain to me the theory of limits?"

"Well, John, assume that you have called on a pretty woman. You are seated at one end of the divan and she is seated at the other. You move halfway toward her. Then you move half of the remaining distance toward her. Again you reduce the distance separating you from her by 50 per cent. Continue this for some time. Theoretically, you will never reach the girl. On the other hand, you will soon get close enough to her for practical purposes."

♣

Girl: "Am I the first girl you ever kissed?"

E.E. "Now that you mention it, you do look familiar."



To create in steel the flowing lines of today's cars, calls for metal of particular forming qualities.

Sleek styling starts with special steel:

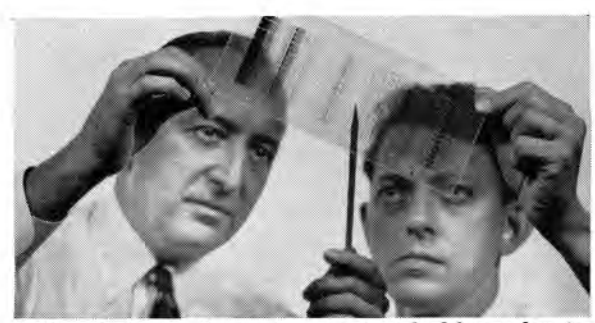
Photography turns chemist—helps produce it.

Fenders, hoods, roofs and side panels call for best quality steel—and the watchful eye of photography guards specifications and controls that quality.

Car designers' dreams come true only if steel forms well under the pressure of deep drawing operations. That takes a particularly high quality steel.

Great Lakes Steel Corporation, Detroit, Mich., unit of National Steel Corporation, makes this steel for the automobile industry. And to make sure of its high quality they use photography. For example, during production, spectrograms show chemical make-up—insure the proper minute quantities of alloying elements, and photomicrographs reveal crystalline structure.

Controlling quality is but one of the many ways photography works for modern industry. In small businesses and large it is aiding product design, simplifying production, creating sales and expediting office routine.



At Great Lakes Steel a spectrogram is readied for reading in the densitometer—one of the tests that assure quality steel.

Behind the many photographic products becoming increasingly valuable today and those being planned for tomorrow lie intriguing and challenging opportunities at Kodak in research, 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 Dept.

Eastman Kodak Company, Rochester 4, N. Y.

University Libraries
University of Missouri

Digitization Information Page

Local identifier	Shamrock1955-1956-Vol22

Source information

Format	Book
Content type	Text with images
Source ID	010-010218757
Notes	

Capture information

Date captured	Oct 2021
Scanner manufacturer	Fujitsu
Scanner model	fi-7460
Scanning system software	ScandAll Pro v. 2.1.5 Premium
Optical resolution	600 dpi
Color settings	24 bit color
File types	tiff
Notes	

Derivatives - Access copy

Compression	Tiff: LZW compression
Editing software	Adobe Photoshop CC
Resolution	600 dpi
Color	color & grayscale mix
File types	pdf created from tiffs
Notes	