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Rose Technic

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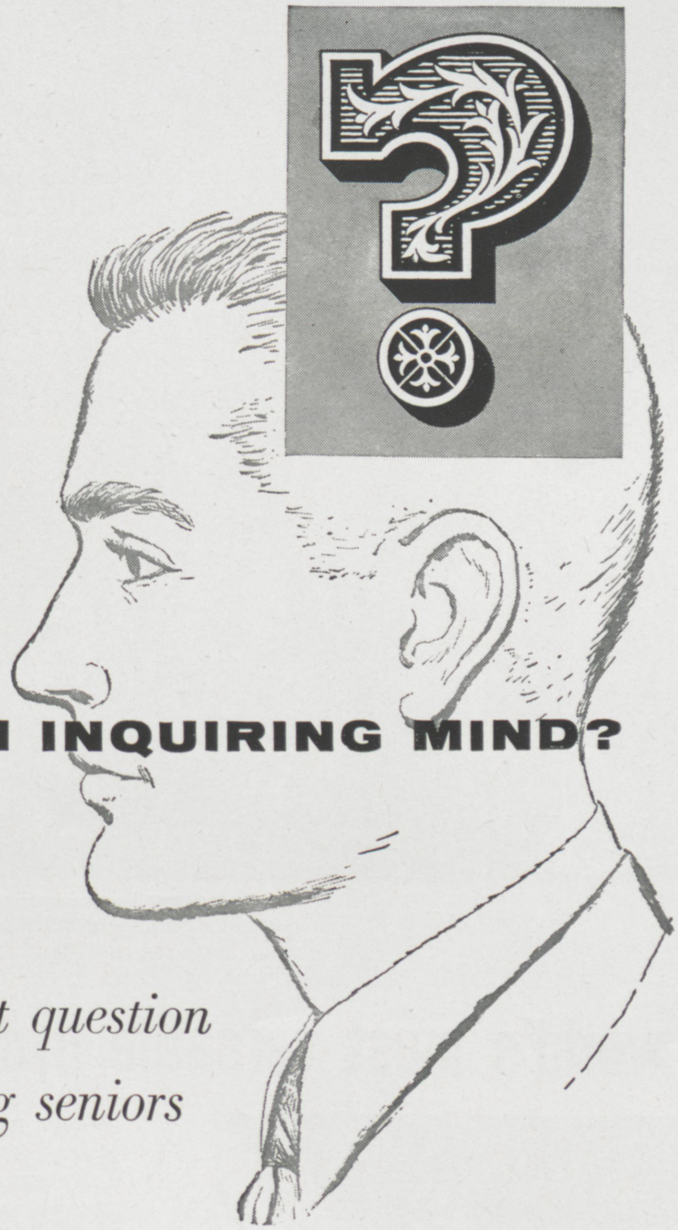

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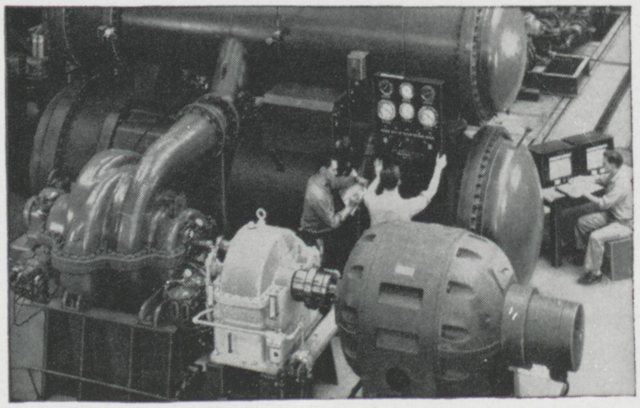

COMPREHENSIVE TESTS are run on a Worthington centrifugal refrigeration unit (lower left) now in service as one of the Arabian American Oil Company's central air conditioning units in Dhahran, Saudi Arabia.

When you make pumping equipment that has to stand up and deliver year after year anywhere in the world, you've got to be sure it will perform as specified.

That's why we built one of the world's largest hydraulic test stands at our plant in Harrison, New Jersey. Here, over a half-acre "lake," we can check the performance of anything from a fractional horsepower unit to pumps handling over 100,000 gallons a minute. When you realize there are thousands of sizes and types of centrifugal pumps alone, you get an idea of the versatility we had to build into our proving-ground.

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Rose Technic

VOLUME LXVII, NO. 7 — APRIL, 1956

Contents

Cover

Another of the great engineering accomplishments is the covering of the United States with a network of pipelines. These pipelines convey everything from natural gasses to sluggish crude oils. Pictured here is the crossing of a mountain range with a pipeline. Plates by courtesy of International Harvester Company.

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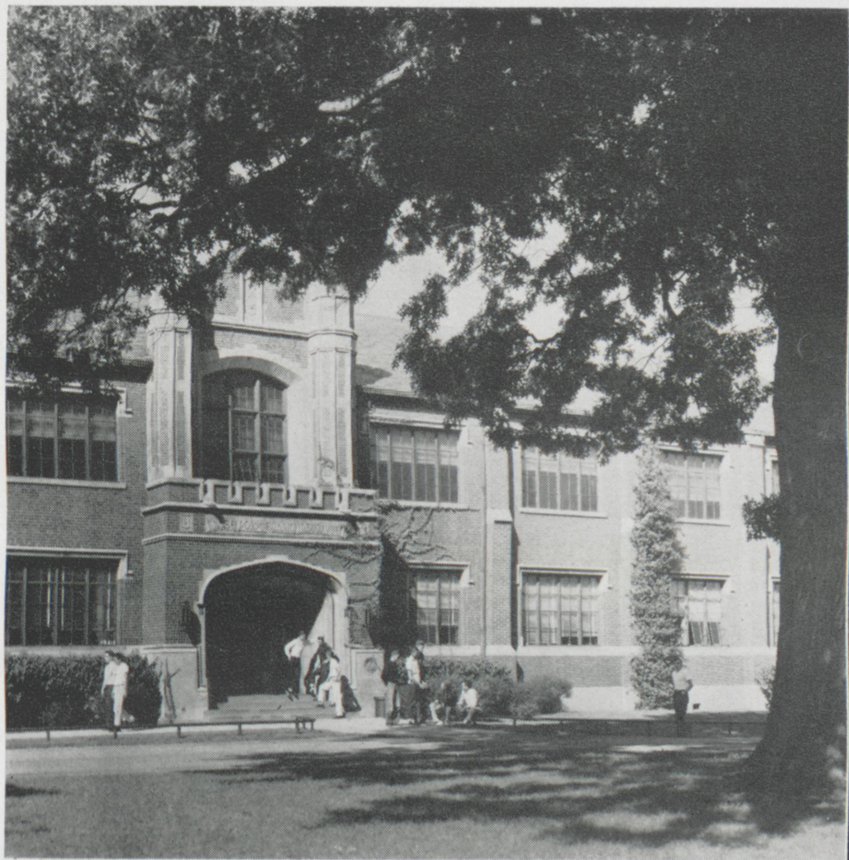

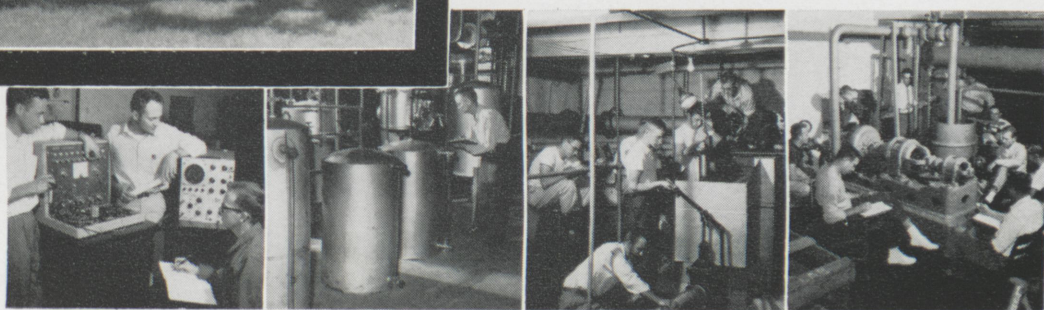

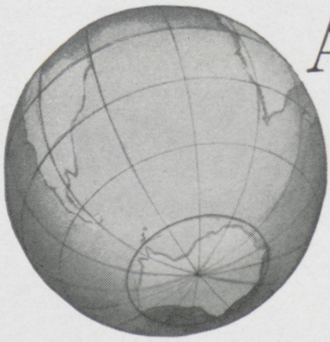

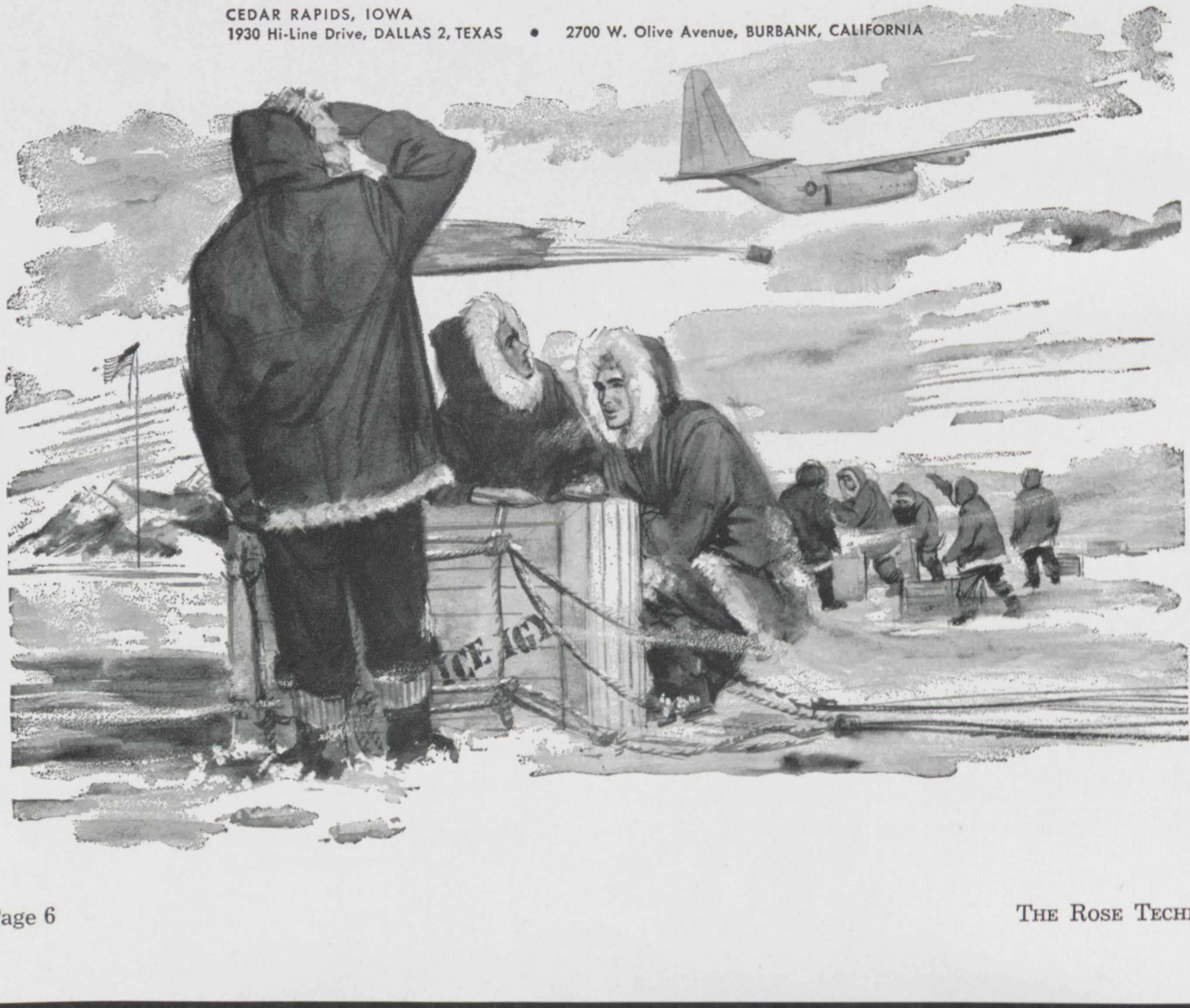

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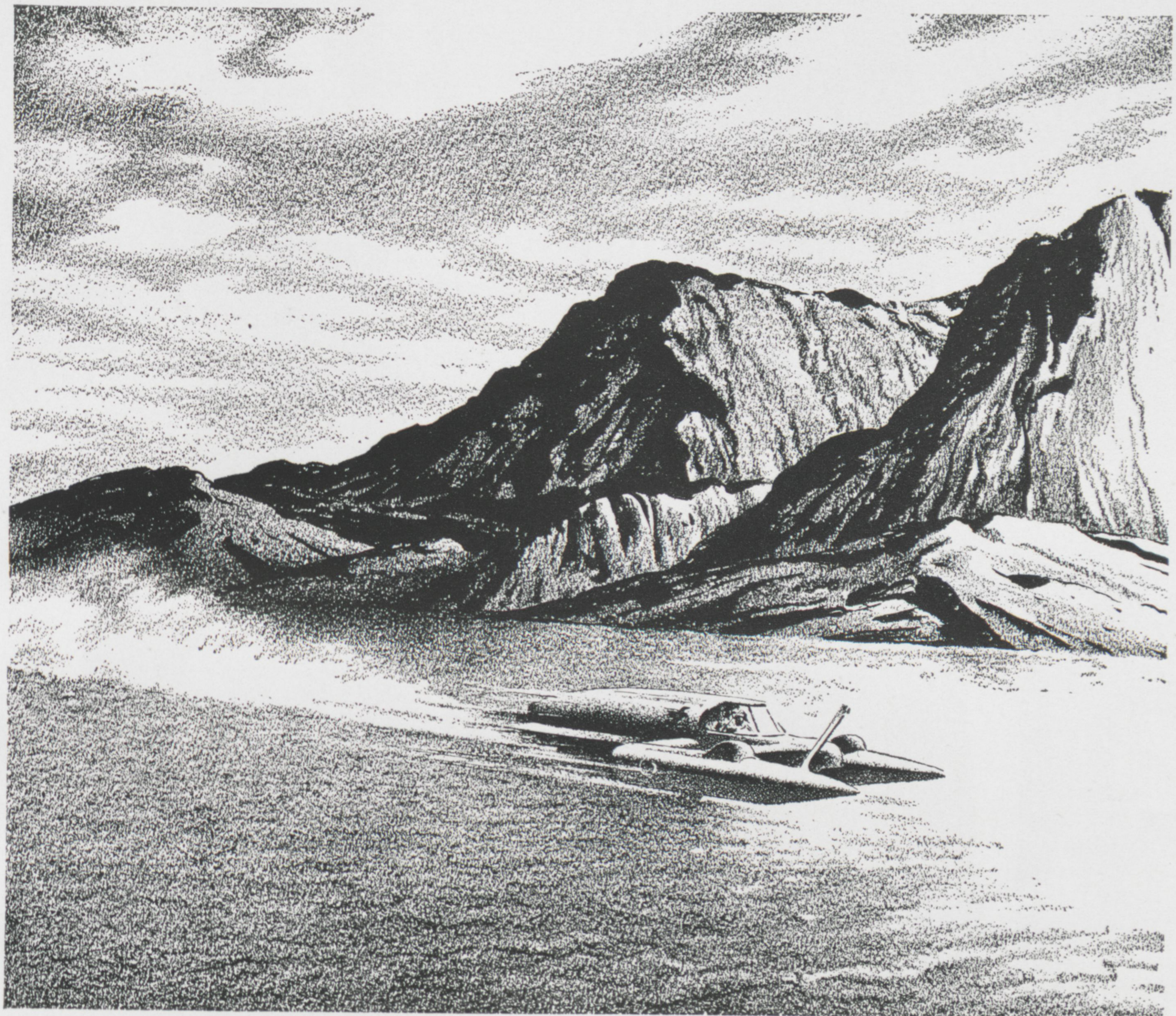
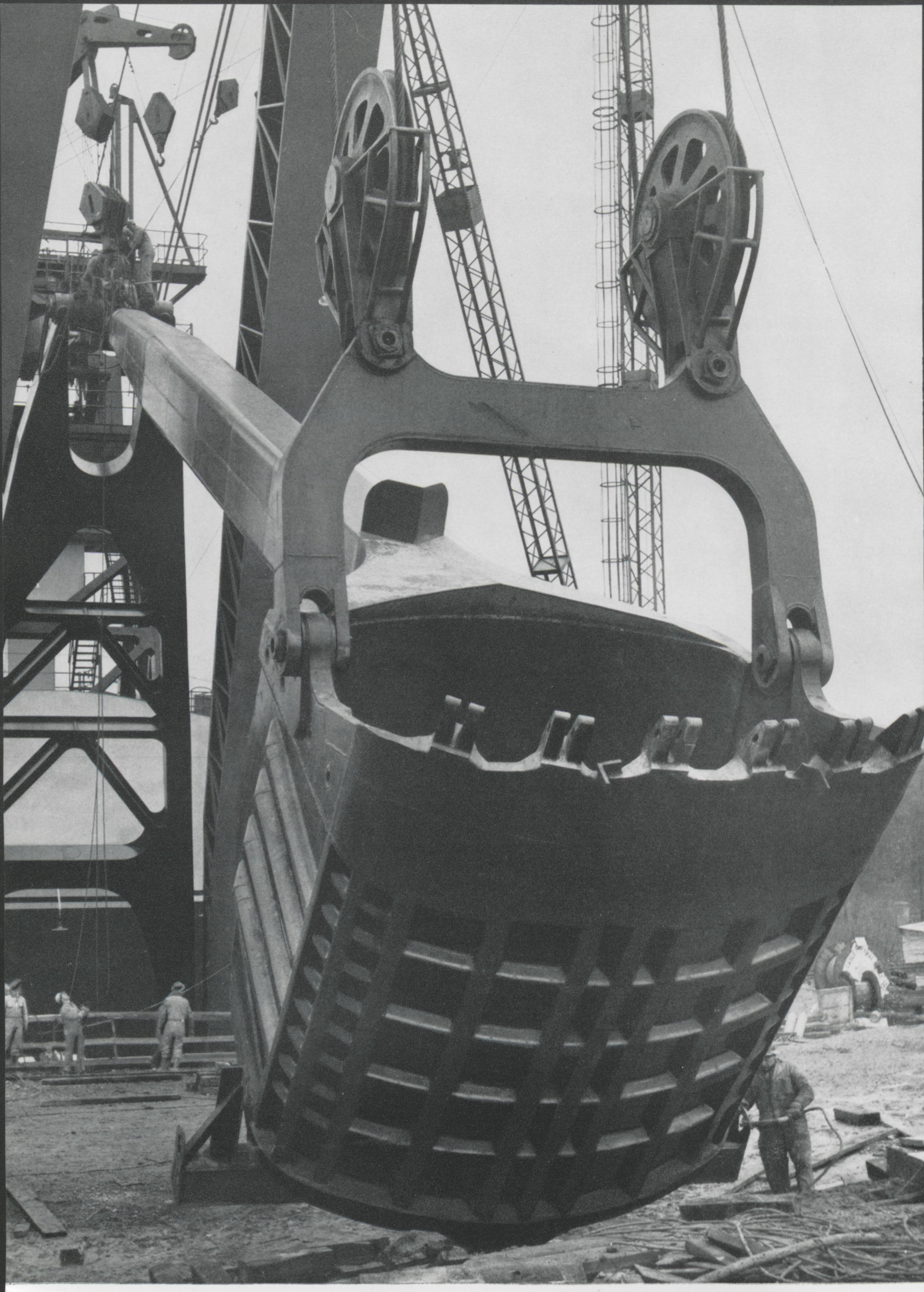




Progress Is Our Most Important Product

You quite likely recognize this title as a television advertising slogan of one of the large companies. Like most advertisements, the statement is designed to convey a pleasing thought to anyone hearing it. But, let us look at it a bit more closely. Progress is defined in the dictionary as an advance toward some objective. Thus, when we think of progress, we should think of an objective. To a manufacturing concern, this clearly defined objective may be in the form of improved products or perhaps better employee-management relations. In this highly competitive industrial world, each company must advance toward some goal or it will fail to gain or retain a profitable position in business.

This spring I was being interviewed by a company representative for summer employment, and through the course of the interview company progress was discussed. It was agreed that a manufacturing concern, of necessity, had to advance to maintain leadership in its field. I was then confronted with the question, "Why do **you** want to progress?" At the time I was somewhat at a loss for a good answer. Somehow it had never quite occurred to me that people too should have clearly defined objectives to which they are working.

The reasons for wishing to reach these objectives probably vary with each individual. They range from making more money to improving one's social position. But, it seems to me that the greatest desire to advance or progress is the great personal satisfaction enjoyed when you have done something well through your own hard work and long hours. This is the greatest reward for one's labor.

G.C.R.

←

FRONTISPIECE: The largest power shovel in the world recently began operation for the Hanna Coal Co. at Cadiz, Ohio. It carries a sixty cubic yard dipper and is capable of moving ninety tons of earth in one pass. **Cut courtesy General Electric Company.**

FIREBIRD II

By William A. Turunen and Joseph B. Bidwell,
General Motors Research Staff
Edited by Tom Hale, fr.

General Motors has built and successfully tested a new experimental gas turbine passenger car called the Firebird II. However, they have no plans for putting it into production.

The car's new *Whirlfire GT*-304 engine shows promise of being able to operate at substantially the same economy of today's automotive piston-type engines.

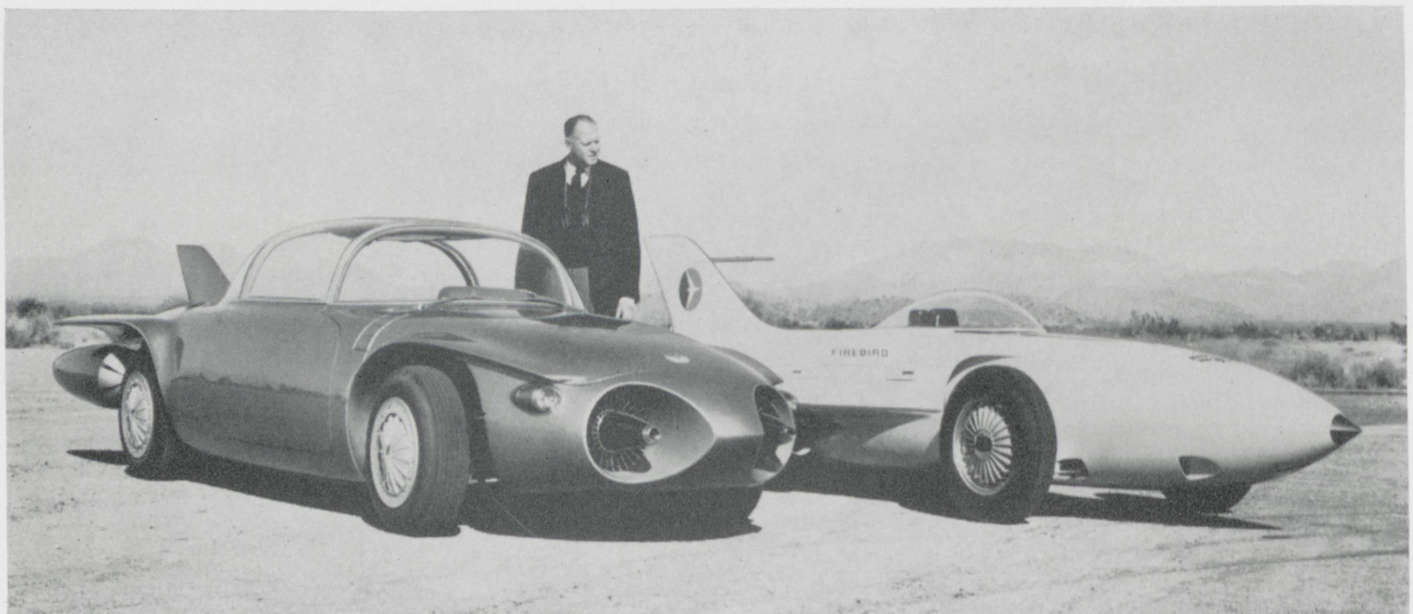
The first Whirlfire engine GT-300 (325 hp) and its successor the GT-302 (370 hp) provided GM's research engineers with the experience necessary to develop the latest model GT-304 (200 hp). All of the Whirlfire engines thus far are of the same basic design; that is, they all have independent gasifier and power sections. The gasifier section of the new engine is essentially a small four-burner jet engine. In no way connected mechanically to the drive train, the gasified section is simply a shaft with an axial flow turbine wheel on one end and a centrifugal-type air compressor on the other. At rated full power the wheel and compressor turn at 35,000 rpm. Compressor ratio is 3.5 to 1.

The stream of hot exhaust gas from the gasifier section is used to turn the axial-flow turbine wheel in the power section. The power turbine is connected through 7 to 1 reduction gears to an automatic transmission located between the rear wheels of the new turbine-powered passenger car.

One of the greatest limitations of the gas turbine for passenger car use has been low fuel economy. The new engine, however, recovers heat in the exhaust gases from the power section as a means of vastly improving this factor. This recovery heat exchanger or regenerator consists of a drum made of metal mesh which is driven approximately one-thousandth the speed of the gasifier shaft. The drum rotates first through the hot exhaust gases and then through the relatively cool compressor discharge air carrying heat from the exhaust gas to the incoming air. Over 80% of the heat in the exhaust gas is recovered by the regenerator heat which otherwise would be exhausted into the atmosphere and wasted. Since the temperature of the incoming air is raised mostly by the heat supplied from the regenerator, only enough fuel (kerosene) need be burned to raise the pre-heated inlet air up to the normal operating temperature of 1,650 degrees F at the turbine inlet. Tests using the new regenerator show that exhaust temperature can be lowered as much as 1,000 degrees F. Unlike the searing blast from a jet engine, the exhaust from the Firebird II is just pleasantly warm.

A silencer mounted on the nose of the car effectively muffles the engine noise so that the Firebird II is as quiet as most of today's stock cars.

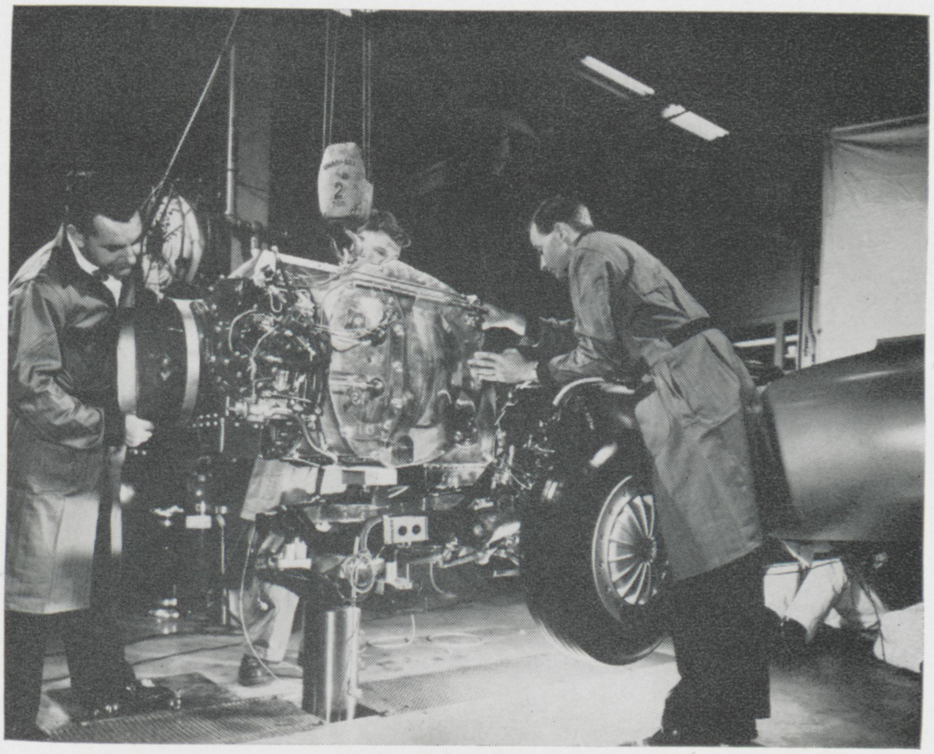
Firebird II has a 120 in. wheel



Firebird II (left) and its predecessor, the Firebird.

NEW GAS TURBINE CAR OF THE FUTURE

base, is 235 in. long, and 52 in. high to the top of the tail fin. Some of the more unusual features of the chassis are the exhaust ducts located within the side frame members, the transmission, the suspension system which keeps the car level and provides an air-cushion ride, the all metal disc brakes, the 12 volt electrical system with its a-c generator, and the central hydraulic system. Unlike the original Firebird, the GT-304 in the Firebird II is located in front of the driver much like the piston-type engines in today's stock cars. The body shell of the Firebird II is made of titanium, a light weight metal of great strength. This is the first time titanium, which presents problems so far as welding and forming are concerned, has been successfully used in an automobile body.



The new GT-304 Whirlfire Gas Turbine Engine being lowered into the chassis of the Firebird II.

Transmission

The transmission is a revolutionary, four-speed, planetary gear and fluid coupling type incorporating an idle cut-out that allows the power turbine to drive the accessories in the rear of the vehicle without actually driving the rear wheels. By mounting the transmission between the rear wheels better weight distribution is obtained, a shorter drive mechanism is possible, and the usual hump in the floor of the fornt passenger compartment was eliminated. Fastened to the frame by means of rubber mounts, the transmission with its integral planetary differential is connected through universal joints to the rear wheels. The inner joint is of the ball and roller type to permit sliding under large torques.

Suspension System

New concepts in automobile suspension are incorporated. Individual wheel suspensions, combined with the new Delco-Matic Air-Oil Suspension unit, provides smooth, level ride characteristics. Front wheel suspension is of the double-wishbone type, while the rear wheels are mounted separately on hort stub axles which are suspended from the frame by swing arms. The transmission, mounted on a frame between the rear wheels, drives each wheel separately through a double universal joint drive shaft. This arrangement has less unsprung mass than the conventional rear axle and differential combination and, thus, transmits less shock to the frame and in turn to the passengers. In addition, a new leveling system keeps the car from "bottoming" when loaded, reducing this cause of passenger discomfort at its source.

At each wheel a Delco-Matic Air-Oil Suspension unit replaces the usual shock absorber and spring combination. A cushion of air provides a soft spring action and compensates for a light or heavy loads by the hydraulic leveling action in the unit. The Delco-Matic unit, about 8½ in. long and 4½ in. in diameter, consists of a small hydraulic piston and cylinder, a rubber diaphragm separator, and the outer steel case. The outer case of the unit is fastened to the car's frame, while the rod of the piston is connected to the wheel suspension member.

The movement of the piston within the hydraulic cylinder displaces oil which forces the rubber separator to expand against the springiness of high pressure air confined between the separator and the outer steel case. This design provides a highly desirable variable spring rate,

(*Continued on Page* 42)

Human Relations In Industry

Winning Paper in Rose-Purdue A.I.E.E. Contest

By Charles Tolson, sr., e.e.

It has been a long time since the engineer confined himself in a small laboratory and only associated with a few fellow engineers. Today engineers are constantly mixing with workers in all levels of industry. It is fitting, therefore, that we prepare ourselves to be better managers so we may take our place in industry as managers when the time comes.

The present philosophy of labor-management relations seems to be that the average worker wants shorter hours with higher wages, all kinds of insurance, plant cafeterias, coffee breaks, hobby clubs, a coke machine attached to every production machine, and every other fringe benefit that can be imagined. But I believe that this is not what labor wants, and I hope to present evidence to support my belief.

To understand better the production line worker, let us first look at the present traditional method of bringing about increased productivity. First we find a job, then we find a man for the job. We train him in the few skills required to do the job, and then we tell him exactly what he is to do. (i. e., "Solder wire four to lug three.") He is told that he is responsible only to the foreman and that he is to do only what the foreman tells him to do. He is not even supposed to think without asking the foreman first. (It has not quite reached that extreme, but it could.) Surprisingly enough, this type of careful, exact training fails!

Why does the traditional system fail? It fails because industry has failed to satisfy the worker's basic social drives. Each individual has three basic social drives which must be satisfied if he is to perform his best work. They are:

(1) a sense of belongingness
(2) a sense of achievement, and
(3) a sense of recognition.

The individual trained in the traditional way finds that he must form informal social groups with others in order to protect himself as an individual. These groups protect their members from arbitrary control of their lives, from the boredom that necesarily accompanies the repetitious mass-production methods, and from the impoverishment of their social and emotional being, which is caused by a failure to satisfy the three basic needs mentioned above.

Recent experiments have shown that work output can be increased by using methods that give work groups more responsibility, allow fuller participation in decisions, and make the stable group a firm basis for support of the individual's social needs.

Let us look at the results of experiments conducted by Elton Mayo at the Hawthorne plant of Western Electric during the last war. In the Bank Wiring Room, fourteen men, trained in the traditional manner, were found to have formed a social group which was holding production down to a level below that which would normally fatigue the members. Not only did they hold down the "quota buster", but they also forced the slackers to raise their production. Conversely, in another part of the plant, six girls working on telephone relays were given a little extra attention. Their advice was sought on a number of minor things and the girls were allowed to take part in the decisions affecting their work. It was learned that their output rose steadily despite the fact that their wages were cut during the experiment.

Here we see two groups — one, autocratically led, revolting by holding production down, and the other democratically directed, producing far above the norm.

By now one can see the evolution of the group as the basic labor force, rather than the individual. It might be wise to stop for a moment to consider just what a group is. A group has been defined as.

(1) two or more people
(2) in communication with one another
(3) over a definite period of time
(4) committed to a common goal or need
(5) which no member can hope to reach alone.

Now that we have defined a group, we must, of course, define leadership. Interestingly enough, the investigation into groups and group leadership was started by Kurt Lewin at the Massachusettes Institute of Technology, which is an engineering school. Lewin said successful leadership is paradoxical. The leader who produces the most lasting changes is the very one who doesn't seem to push or lead. Laotse said 2500 years ago that the greatest leader is he who seems to follow. In other words,

MEET THE FACULTY

An Interview With Dr. Berton A. Howlett, Head of the Physics Department

By Charles Skidmore, soph, e.e.

Dr. Howlett

In an engineering curriculum the transition from the general courses of the freshman year to the distinctly specialized courses of the junior year is an important one. This "transition in thinking" is largely accomplished by the physics course of the sophomore year. For the past thirty-one years, the man who has determined the policies of the physics department and directed the endeavors of physics students here at Rose has been Dr. Berton A. Howlett.

Dr. Howlett says that when he started to school at a normal college in New York, he had not planned to be a physicist but a school teacher instead. The end of his first year at college found him in bad health, however, and he had to drop his schooling and recuperate. His ambitions to become a teacher were furthered during this time by part-time teaching positions in nearby grade schools.

When Dr. Howlett re-entered college he enrolled at Valparaiso with the intent of becoming a bio-chemist. Bio-chemistry at this time was a rapidly expanding field. His plans were to do graduate work and then go into medical research. He obtained his B.S. degree in three years and was preparing to go on into graduate school when he found he lacked the necessary money to do so. This meant that he would have to again postpone his schooling and teach for a few years to raise the needed funds. When the Dean of Valparaiso heard of his intent to take graduate work and his financial predicament, he made Dr. Howlett an offer which was to change the course of his profesional life.

While a student at Valparaiso, Dr. Howlett did some substitute teaching for a physics lecturer. He had done such a good job that Valparaiso's Dean was willing to sponsor his graduate work during the summer months if he would stay on as a physics lecturer during the school year. The only stipulation was that he had to take his graduate work in physics instead of bio-chemistry as he had planned. After careful consideration, he accepted the offer.

Dr. Howlett completed his work for his Master of Science degree in 1917 at the University of Chicago. He wrote his thesis on the highly precision measurement of the index of refraction of gases. While at the University of Chicago, he studied under such scientific greats as Millikan, who is famous for his classic oil drop experiment; Michaelson, a pioneer in optics and the inventor of the inferometer; also Professors Swan and A. H. Compton. These men have since all been awarded Nobel Prizes for their scientific work and discoveries.

Dr. Howlett, having become engrossed in his new profession, went ahead to start work on his doctorate of physics degree at the University of Chicago. Before he finished, however, he was offered a position at Indiana University as a graduate lecturer; he would also be able to finish his doctorate thesis at the same time.

As a graduate lecturer at IU, he taught courses in atomic physics. Since atomic physics was a very new subjet, Dr. Howlett was one of the few men who were qualified to teach such a course. At the same time, he was writing his doctorate thesis on "The Study of Resistance of Polarization of Fluorescent Light." He also had obtained a research assistantship and was helping IU's Dr. Foley in acoustical research.

While at Indiana University, Dr. Howlett, was awarded the honor of being invited to the J. J. Thompson Lectures at Franklin Institute in Philadelphia. These lectures were some of the first on the subject of atomic structures.

In February of 1925, the existing head of the physics d epartment here at Rose Poly was killed in an automobile accident. Dr. Howlett, who was still at I.U., was offered the position. He accepted and has been here ever since. Being an accomplished physicist, Dr. Howlett has been able to give his students numerous glimpses into the newer theoretical physics, while at the same time, grounding them in the fundamentals of the course.

While teaching here, Dr. Howlett, has done some research for industrial firms. This includes some ceramics research for Clay Products in Brazil, Ind. Also, he developed a magnetic method of testing stress-strain curves of malleable steel for the Malleable Steel Corporation.

Dr. Howlett is a member of Phi Beta Kappa and Sigma Xi honorary fraternities. He is also a member of the American Physical Society, American Optical Society, American Association for Advancement of Science, American Physics Teachers Association, and the American Association of University Professors.

Controversial Corner

By Professor Robert D. Strum

Without a doubt, the question most asked on the campus of any engineering college in these plush days of a buyer's market for engineering graduates is "Where do we get more teachers?" It seems as if very few men with an engineering degree want to do anything so routine as to teach. Some say that this is a sign that these engineering graduates have much more intelligence than we have given them credit for. The next most provocative question is, "How can we find the time to teach the ever expanding list of courses that really are of a very fundamental nature?" The first question is one that presidents and deans can spend many unsettled hours juggling without much satisfaction, but the second one might have a rather revolutionary and even heretical answer.

Many engineering graduates eventually (sometimes through surprisingly little effort of their own) become very well-paid sales engineers, department heads and plant executives. In other words, they are being paid for work that has very little resemblance to engineering in any form. After reaching these lucrative positions, these men often receive questionnaires from the alma mater inquiring about curriculum content. They are asked "Was the preparation adequate? If not, what courses should be added and which ones should be dropped?" By actual count, ninety-eight out of one hundred indicated that courses in psychology, business administration, public speaking, and dry martini mixing should be added, and that calculus, thermodynamics, and elements of electrical engineering seem to have very little use whatsoever. Almost to a man they claim that if they had been exposed to the more practical courses listed above, their path to the board of directors would have been far less rocky and much more certain.

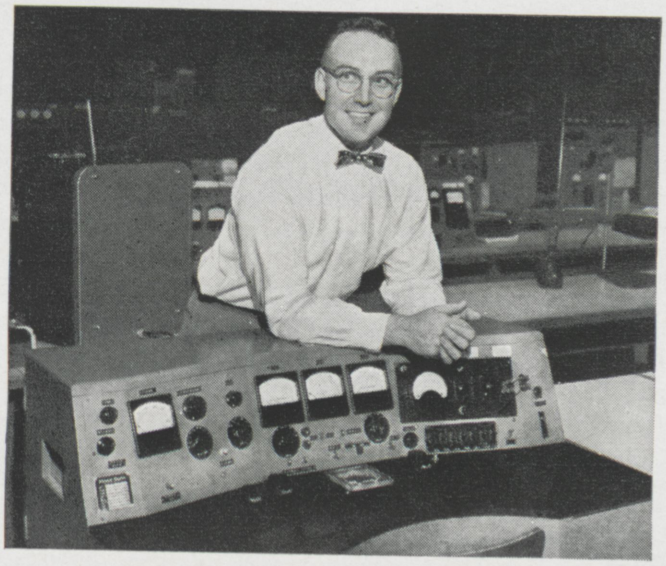
It is entirely possible that these men have forgotten exactly how their successful careers began. The first few assignments normally given a recent graduate are of a strictly technical nature. These vary tremendously in difficulty. Some are so difficult that it takes a man with Grade A training to understand just exactly what it is he is supposed to be doing. Others require very little more than a gift for remembering names and a real 32-pearl smile for the various secretaries. But, if the young engineer seems to understand the basic difference between electromotive force and entropy, he is promoted to a job that is considerably more complex. This one deals with people! You can't integrate a T-S diagram for an unhappy workman and come out with much except a real tough problem. Right away, our potentially successful executive feels as if he is in over his head. He can't find any books in his dusty library that give an indication as to how this problem might be solved. If only Gardenia Tech had offered Dealing With Unhappy Workmen I when he was a undergraduate there, life would be considerably easier right now. But this worried young man did learn one very important thing in engineering school that was to prove to be the key to his future success. He had learned *How To Solve Hard Problems.* ..Making this unhappy workman happy and productive was certainly a hard problem and the young engineer eventually solved it in a very similar nature to those difficult assignments of a strictly engineering nature he had encountered earlier in his career. He had analyzed the problem carefully, thought about it in a tough and uncompromising fashion, and most important of all, had done lots of hard work on it. Perhaps it would have been easier if he had substituted a personnel administration course for modern physics while he was in college, and perhaps it wouldn't have been easier. It seems reasonable to consider that the habits and discipplines developed in his engineering courses were the outstanding factors in his rise to the top as a sensible and capable handler of people.

If these engineering disciplines are of considerable value, why are we failing to include engineering courses about ideas of rather recent development, while maintaining a status quo on liberal studies? With the tremendous technical advances made in recent years, more and more concepts have been developed that should at least be mentioned to the engineering undergraduate. Some schools are fulfilling this obligation by adding a fifth year to the curriculum. Why shouldn't the effectiveness of certain humanities courses be investigated more carefully? Are they accomplishing what they have been set up to do? Are they making the average engineering graduate a more interested and interesting individual?

At a recent conference of engineering college officials and representatives of industry, Mr. Hjalmar Johnson, a vice-president of Inland

(*Continued on page* 35)

Young engineers making news at Western Electric

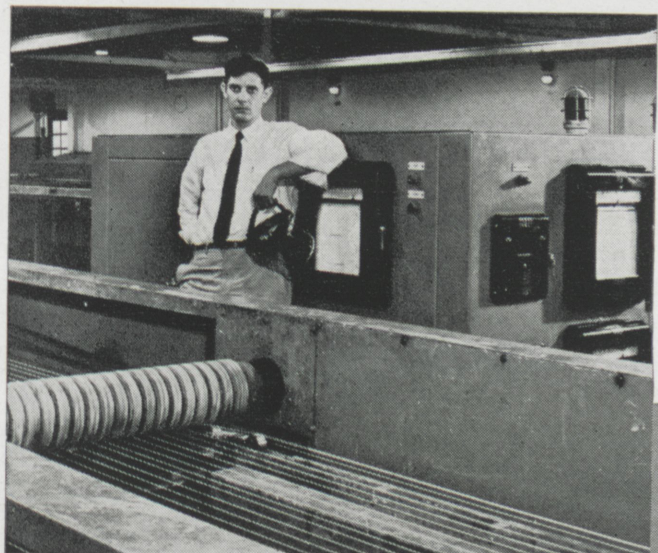


Richard C. Shafer, B.S. in mechanical engineering at Lehigh, was one of 16 engineers assigned to one of Western Electric's toughest post-war projects — developing manufacturing techniques for mass-producing *(with great precision!)* the tiny but amazing transistors which are already causing a revolution 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.

Locker Rumors

By Harold Brown, jr., ch.e.

The Engineers track squad started the track season with a loss to Indiana Central. This meet, however, did illustrate the fact that Rose has some good potential. Veteran track man Dickson again showed his talent by winning the high jump, and placing second in the pole vault. Sophomore Jim Oakes placed third in the mile run, and also ran on the record breaking mile relay team. Tom Clark, another sophomore, was also a member of the mile relay team. Two other upper classmen on the track squad, Ernie Davidson, and Ray Gompf finished second in the 880 yard run, and third in the 440 respectively. The rest were all freshmen, and they came through very well. Ned Kurtz won the broad jump, the 60 yard dash, and was on the winning mile relay team for a good display of individual performance. Larry Logue, proving that scholarship and athletics mix, copped the 440 yard run, and was anchor man on the mile relay team. Munro put the shot far enough to take third, and Larry Grimes finished third in the 880 yard run. Bob Mewhinney scored a first in the pole vault and a second in the 60 yard low hurdles. Rose's two mile representative was Crisp who finished second.

The Engineers put on a great display of track ability Engineer's Day and walloped Franklin 80½-32½. Rose won every event but the two mile run in which Miller from Franklin put on a stretch drive that wasn't to be denied. Munro heaved the shot almost 37 feet to capture first place. Kuchar placed second to Munro in the shot put. Larry Dickson again won the high jump, but he was not even pushed. We doubt that he took a shower after winning. Tom Clark tied for third place in the high jump. Sophomore Scholle took the honors in the mile run, with Oakes gaining a second place tie. Ned Kurtz again won the broad jump and the 60 yard dash. It looks like Ned will be a consistent winner in these events. Max White beat out Larry Logue for first in the 440 yard run, and Dave Staggs picked up third for a clean sweep for Rose in this event. Bob Mewhinney flew over the high and low hurdles fast enough to win first. Bob also won the pole vault and shared with Kurtz the distinction of being three event winners. Larry Dickson took second place in the high hurdles, but Rose failed to score a second or third in the low hurdles or the pole vault. The 880 yard run was all Rose too as Davidson, Gompf, and Fisher finished one, two, three. Crisp took second in the two mile run; barely losing when Miller of Franklin put on his stretch drive. The mile relay team cracked the record they had set the week before by .3 of a second, and almost lapped Franklin as the race ended. Tom Clark, Ned Kurtz, Larry Logue, and Max White were the members of this relay team.

Up to the writing of this article foul weather has prevented Rose's baseball team from presenting its wares. Coach Carr and his squad hope to make up these games, but their schedule is such that this may not be possible.

Intramural softball has started, but results up to now are not conclusive enough to tell who is going to be tough. To date rain has caused postponement of only one game.

The Interfraternity league has been set up and Lambda Chi Alpha won one over Sigma Nu in the first game. Until the latter part of this month the fraternities will play only once every two weeks. When daylight savings time rolls around, however, a game a week for each fraternity will be scheduled.

1956 Baseball Squad. Row 1, l. to r., manning, Simpson, Kennelley, Spoonamore, Merrelli, Hirst, March, Pebworth, Przybylski, Sutton. Row 2, Carr, Bock, Jackson, Paton, Herokovich, Kirts, Mook, Wetmore, Hassler. Row 3, Reece, Burtner, Blastic.

Rose's Cinder Heroes. Row 1, l. to r., Davis, Kuchar, Munro, Dixon, Sanders, Staggs. Row 2, Kurtz, Mehwinney, White, Grimes,Berman, Oakes, Foltz. Row 3, Cella, Logue, Clark, Crisp, Gomph, Sutton, Scholle, Fisher. Row 4, Coach Brown.

Library Notes

By Carson W. Bennett and Nina J. Mahaffey

In the spring a young man's fancy lightly turns to thoughts of baseball*, and if you are a baseball fan, may we recommend *General "Baseball" Doubleday,* by R. S. Holzman.

This is the story of the distinguished Civil War general who invented baseball and of the development of the game up to the present. In 1839, when a cadet at West Point, young Abner Doubleday invented the game; in the next twenty-five years the soldier and the game rose rapidly in the nation's favor.

Doubleday was second in command at Fort Sumter and aimed the first Northern shot of the Civil War. He became a general, and for a time commanded the Union troops at the Battle of Gettysburg. One of his assignments was command of the forts protecting Washington. The Civil War gave baseball its national character, for the soldiers learned the game in camp, and after the war returning troops spread the pastime over the country.

This book tells of the colorful Cincinnati Red Stockings (the first professional team to be successful), the development of baseball equipment, the starting of the leagues, the early girls' teams, and of how baseball became so popular. It tells of Doubleday Field and the Baseball Hall of Fame at Cooperstown, New York, and the final chapter gives the terse statements about baseball's immortal players recorded on bronze plaques in the Baseball Hall of Fame.

*Our apologies to Tennyson.

FROM THE NEW BOOK SHELF

Bugles and a Tiger, by John Masters.

The story of how an English schoolboy became a professional soldier in the Indian Army, and in it the reader will find an absorbing picture of India in a time and as a way of life that has gone forever. It is a book of history — from the drill parades, fights, high life, and education at the Royal Military College at Sandhurst to the outbreak of the Second World War. It is a book of action—of danger and near-death, and bivouacs in the merciless sleet of Waziristan. It is a book of color—the silver, mahogany, tradition, and comradeship of the regimental mess; the thousands of tiny lights of Dewali; the exotic color of the jungles; and the snow-capped heights of mountains. There is humor in the book, and love as well, but most of all it is a book that tells the truth about the days of a young soldier's years, and tells it eagerly and passionately, the way the days were lived. The objectivity and and honesty of the writing clarify the book's importance as a moving and permanent contribution to our understanding of some of the people and events that have made our world what it is.

The Power To Go, by Merrill Denison.

A book for everybody who likes to point a car down a road, it is the fascinating story of the automobile, from tiller to power steering. Although there were many earlier experiments, the first recognizable automobile was invented by a Frenchman in 1894. Two years later a race between Paris and Rouen was won at a blistering average speed of 13 miles per hour. At the turn of the century the one-cylinder Olds became the American star—only to be eclipsed by Henry Ford's classic Model T, which in turn was followed by his phenomenally successful Model A. Since then the industry has grown at an incredible pace until today, in the U.S. alone, nearly 6,250,000,000 horsepower on wheels is in use.

We The Judges, by William O. Douglas.

It was in 1801 that Chief Justice John Marshall took his office. Chief Justice Earl Warren started his service in 1953. This span of a century and a half, although relatively short in terms of world history, has seen a vast evolution of our concepts of governmental power and the rights of man. In *We The Judges,* Justice Douglas reviews these remarkable social and political developments.

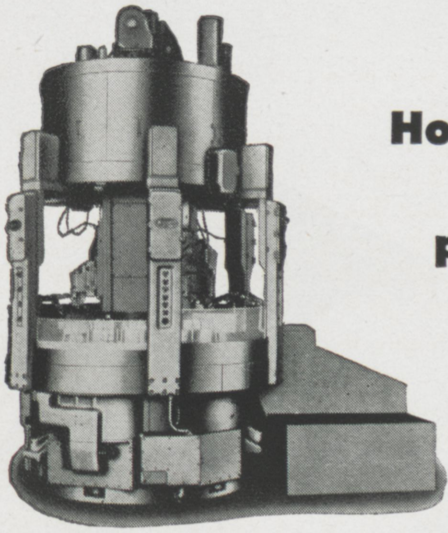
I Am a Mathematician, by Norbert Wiener.

Against the background of mathematical exploration and achievement, Norbert Wiener tells the moving and intensely personal story of his maturation as a dedicated scientist. Because of his curious childhood — he was rushed through school (and had his Ph.D. at 19) without regard for his normal development—he had constantly to struggle against great social handicaps. Sensitive to every rebuff, real or imaginary, he was outwardly assertive at one moment and self-effacing the next. How he dealt with this personal conflict and was able to provide modern science with some of its most valuable tools is told with remarkable candor and humility, making one of the most fascinating autobiographies to appear in recent years.

Pictorial History of American Presidents, by John and Alice Durant.

An informal history covering every administration and the significant and interesting events that occurred. The personality, habits, character and family of each president is presented in a personalized manner. Containing a light, sometimes humorous touch, the book will undoubtedly bring a new understanding of the lives of our presidents and the history of our country.

Another page for **YOUR BEARING NOTEBOOK**



How to locate shafts accurately on high-speed precision chucking machine

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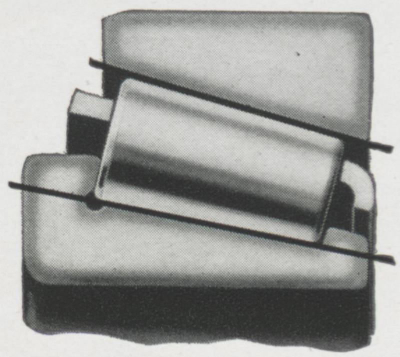

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Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent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

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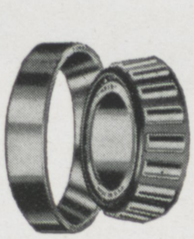

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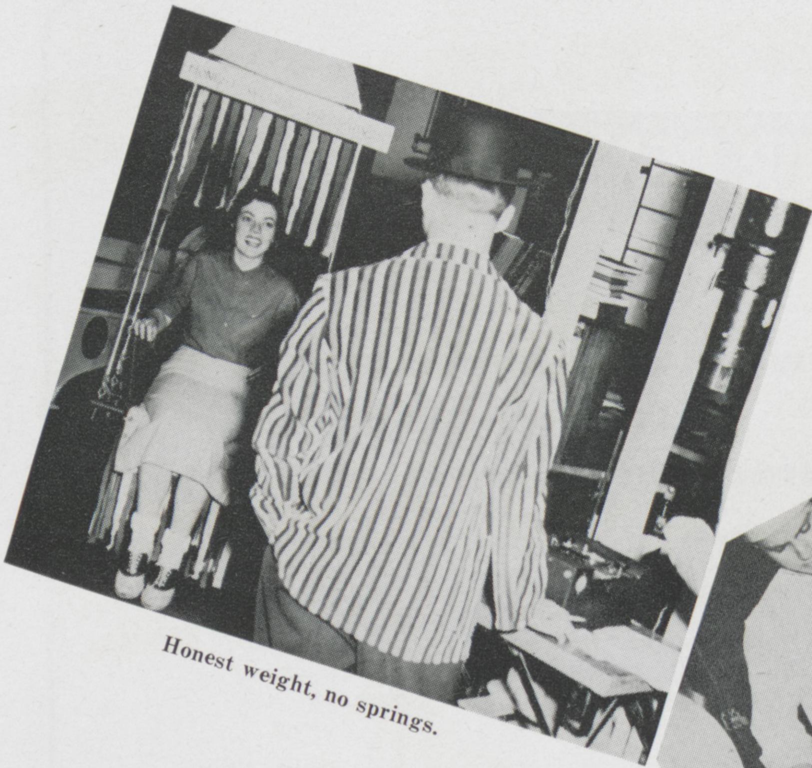
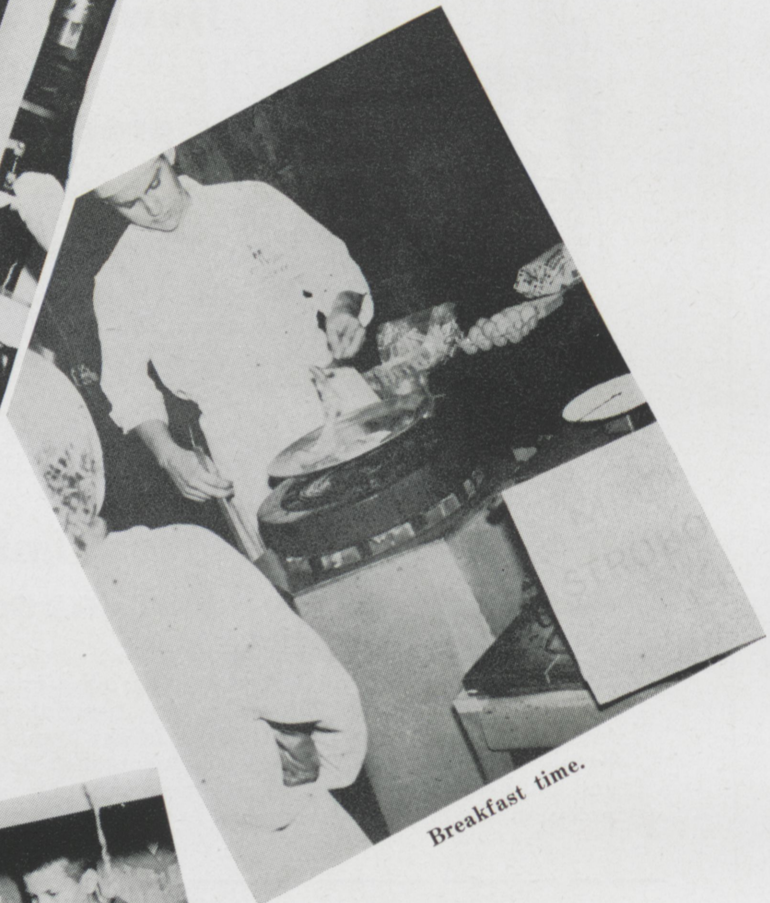
BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

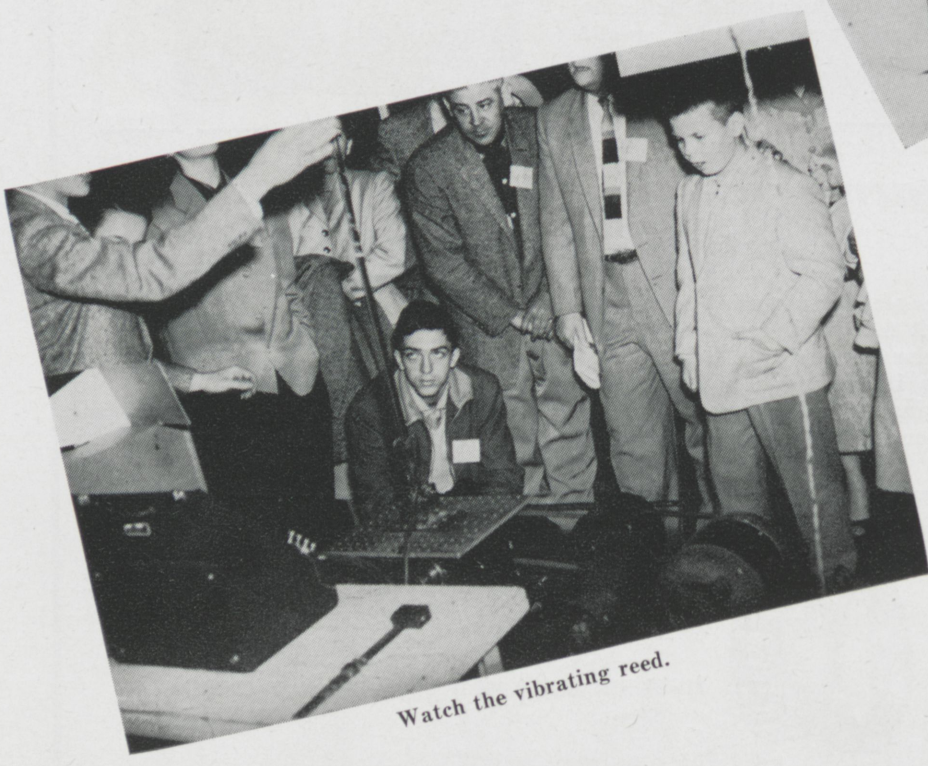
Engineer's



Honest weight, no springs.



Breakfast time.

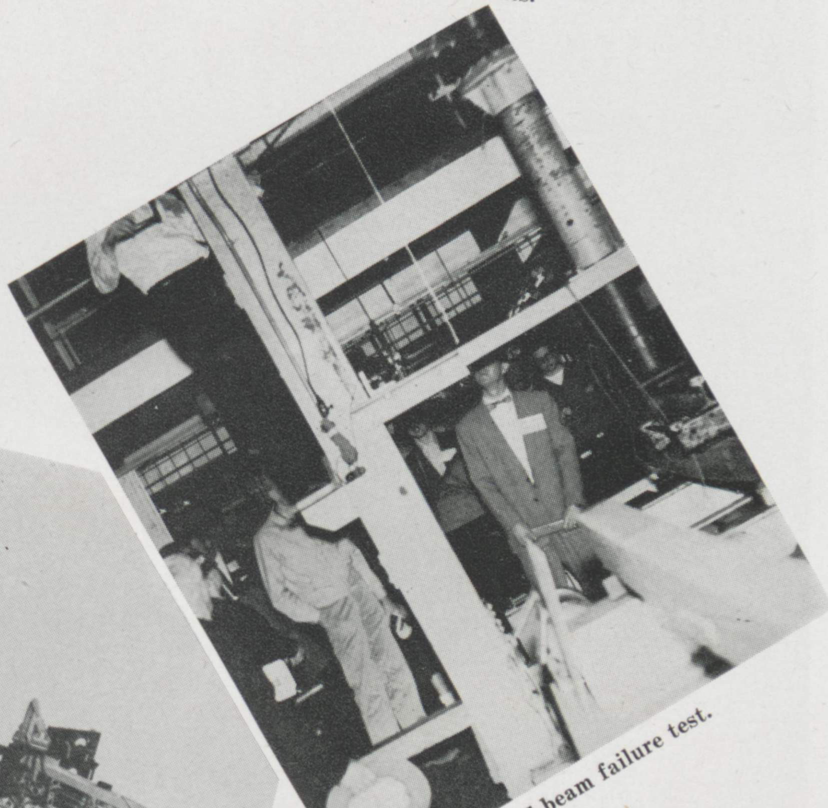


Watch the vibrating reed.

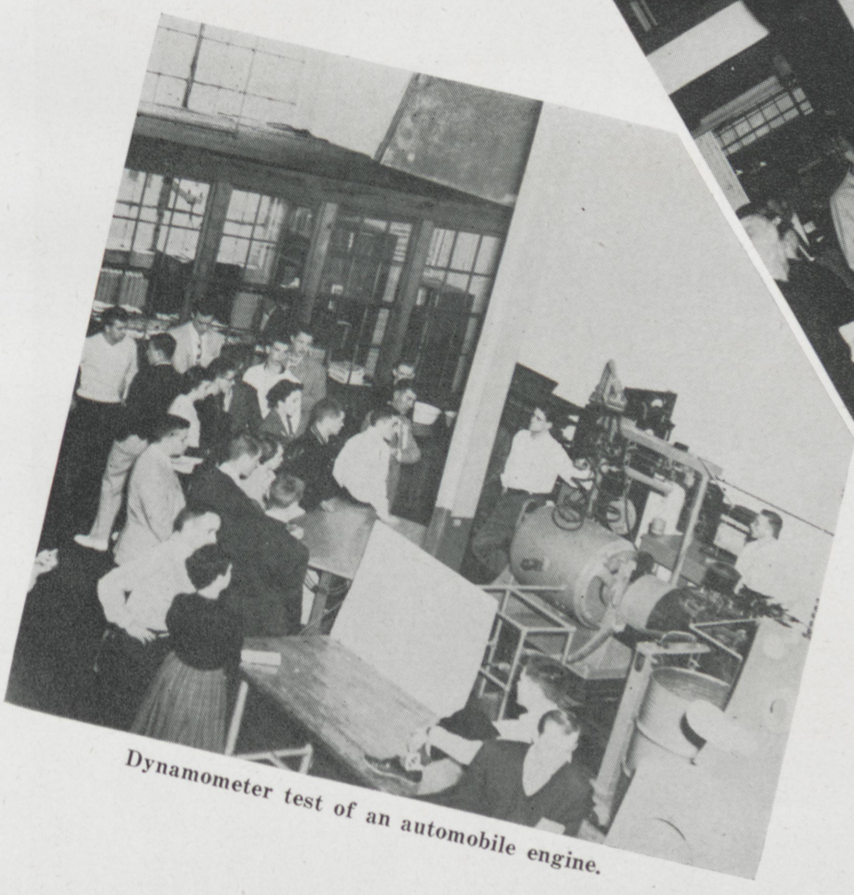
Day 1956

Low-temperature experiments.

The Technic photography staff visits a few of the many interesting exhibits on Engineer's Day held on April 7, 1956.

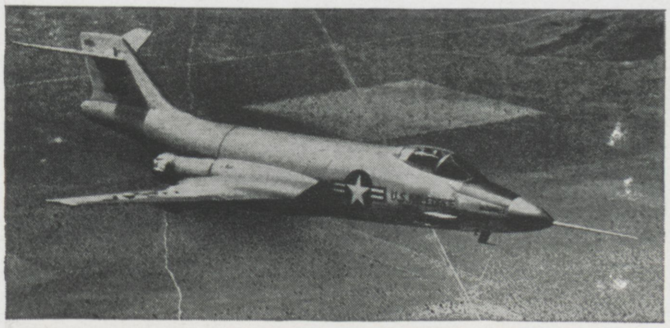


Wood beam failure test.



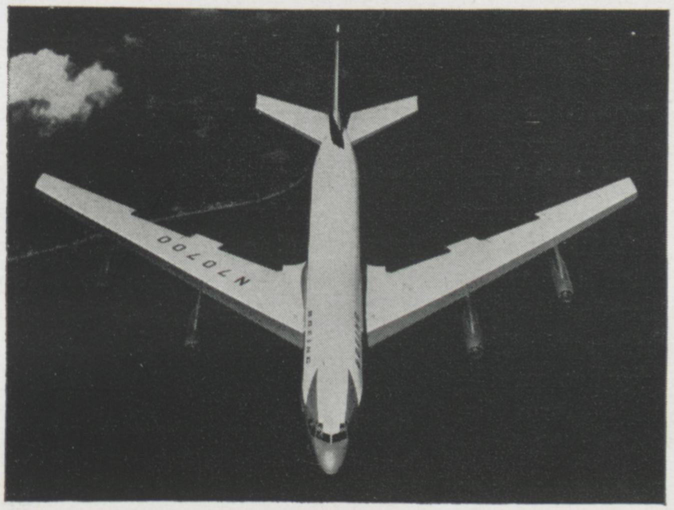
Dynamometer test of an automobile engine.


World's most powerful production aircraft engine
The J-57 axial-flow jet engine with afterburner, designed and developed by Pratt & Whitney Aircraft.

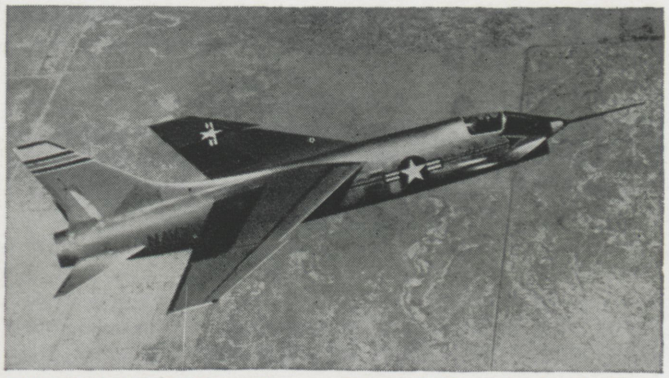


McDONNELL F-101 — The Voodoo, an Air Force supersonic fighter that has two J-57 engines with afterburners, is the most powerful jet fighter yet built.

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.

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Electrical Analogies

Subtitled Analogies Confidential

By Bill Waggonner, jr. e.e.

A spine tingling story designed to keep you on the edge of your slide rules.

For many years men have resorted to the use of analogies to explain new concepts or theories. An analogy is nothing mysterious or astounding. It is simply a method of comparing two or more systems by drawing similarities between their uses, operations, or other important features. This paper deals with the derivation and applications of analogies. The paper further subdivides the derivations into separate sections for mechanical, hydraulic, and thermodynamic systems.

In order to set up an analogy, certain similarities between the systems under consideration must be readily apparent. Two means of finding any similarity between the two are:

1. Compare the equations which govern the systems.

2. Examine the actual operation of the two. The first method of attack is the one which will be carried out in this paper.

The general concepts of the conservation of energy, equilibrium, and continuity govern both electrical and mechanical systems through some form or the other. This is therefore the logical starting point from which to compare the systems. In electrical networks Kirchoff's laws apply these concepts, while in a mechanical network Newton's laws perform the same function.

First, let us consider a mechanical system such as the dashpot shown in figure one. A dashpot consists of a piston, with small holes in its surface, which is forced through a chamber full of oil or some other viscuous material. Thus the dashpot is a device for dissipating energy. In an electrical circuit, the resistor is an energy dissipating device. By applying Newton's laws and Kirchoff's laws to the two systems, the dashpot and the resistor may be compared.

If a force is applied to the piston in the dashpot, an equal and opposite force resists any change from the equilibrium position. This force is proportional to the velocity at which the piston is moved. By the summation of the forces, the equilibrium equation is:

(1) $F - cv = 0$

where F is the applied force, c is the damping coefficient, and v is the velocity with which the force is impressed. The power, or rate at which work is done, is:

(2) $P = Fv$

For the electrical circuit, Kirchoff's voltage drop equation is:

(3) $E - iR = 0$

The power dissipated in the resistor is:

(4) $P = Ei$

Comparing equations (1) and (3), the analogy between voltage and force, current and velocity, and resistance and the damping coefficient may be seen. Equation (2) and (4) also support this analogy.

If equation (3) is rearranged in the form

(5) $i - (1/R)E = 0$

another analogy, equally as valid as the first, is apparent. This time current is analogous to force, voltage is analogous to velocity, and conductance is analogous to the damping coefficient. As far as the dashpot is concerned, either analogy describes the operation equally well.

This shows the general method of attacking the problem of setting up

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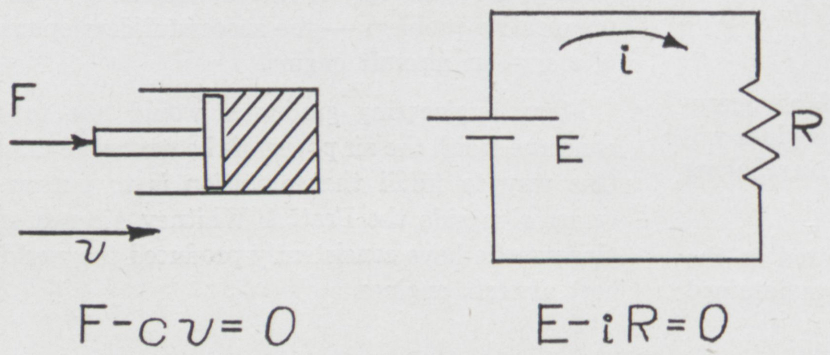

FIG. 1

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ELECTRICAL ANALOGIES

(*Continued from Page* 24)

an analogous circuit. Comparing a spring system and an inertial system (such as a force exerted on some mass) to electrical circuits containing inductance and capacitance illustrates other analogues. By extending the method used on the first example, analogies may be made which relate mass to inductance, force to voltage, and velocity to current. Again another analogy can be made between force and current, velocity and voltage, and mass to capacitance.

All of the equations and examples presented seem to contradict each other in that each example has two separate analogies. Although the analogies are different either may be correctly applied. The choice of the analogy to be used is dependent on the type of problem, the equipment available to model the analogy, and the ease with which the analogy can be set up. Certain problems are physically unsuited for one of the analogies. For this reason some authors such as J. C. Schonfeld prefer the analogy involving mass and capacitance, because it applies to all cases equally well and particularly to the case of electrical joints and mechanical joints. The mass inductance analogy is the more common analogy and the easier to visualize, but it fails to satisfy all conditions of continuity at different types of junctions. An example of a problem where this analogy fails is the case where all of the elements of the joint are not in the same plane. This means that the potential energy of the respective elements are not the same with respect to the same datum plane. Table one summarizes these two analogies. Despite the limits on the use of the mass-inductance analogy, it will not be subordinated to the mass-capacitance analogy because it is more easily visualized and logically derived. Certain problems, particularly those in electrostatics, are more readily analyzed using the mass-inductance relation.

ELECTRICAL ANALOGIES FOR OTHER SYSTEMS

Electrical analogies are also very useful for systems other than mechanical. The analogy between a hydraulic system and an electrical circuit is quite common, and many times the flow of electric current is often compared to the flow of water through a pipe. Again two analogies present themselves when the two are compared. It should be noted that in this case also, one of the analogies does not hold true for a non-topographically plane junction. This "incomplete" analogy compares hydraulic discharge and potential difference. The complete analogy is the more commony used.

Heat transfer is a thermodynamic flow which is very nicely suited to an electrical analogy. Heat transfer takes place when there is a temperature gradient between the two surfaces. The three methods of heat transfer are by conduction, convection, and radiation. The law defining the rate of heat transfer between two points for conduction is:

$$\text{(A)} \quad Q = k \frac{A}{L} dT$$

where:

Q is the rate of heat transfer.
k is the thermal conductivity of the material.

A is the cross-sectional area perpendicular to the flow of heat.

L is the length of the flow path
dT is the temperature gradient

Rewriting equation (A):

$$Q = \frac{dT}{\frac{1\ L}{k\ A}}$$

This may then be directly compared to Ohm's law,

$$I = \frac{E}{R}.$$

The temperature gradient is comparable to the potential gradient, Q is analogous to current, and $\frac{i}{k} \frac{L}{A}$ is analogous to the resistance. Since:

$$r = R \frac{L}{A}$$

k is analogous to the electrical conductivity.

Convection through a surface follows the law:

$$\text{(B)} \quad Q = hAdT$$

or

$$Q = \frac{dT}{i/hA}$$

where:

h is the coefficient of heat transfer
A is the area perpendicular to the direction of heat flow.
dT is the temperature gradient.
Q is the rate of heat transfer.

Here again, the analogous equation is Ohm's law. Radiation is not a first power function of the temperature gradient as are conduction and convection, so a direct application of Ohm's law is impossible. It is possible, however, to assume a fictitious radiation coefficient in order that radiation effects from a surface may be directly added to any convection effects. As could be expected this coefficient is defined as:

$$\text{(C)} \quad h = \frac{Q}{A\ dT}$$

which is again analogous to Ohm's law.

APPLICATION OF ANALOGIES

One use of the analogy has already been mentioned — that of a training aid. Such a use is quite common, and has been practiced for many years. In 1926, for instance, a series of articles were published in the *Engineer* magazine on analogies for use in explaining electrical engineering theories and concepts.

One important use of the analogy, other than as a teaching aid, is to set up an electrical circuit to study the characteristics of a larger, more complex system. By this means a

(*Continued on Page* 32)

Fraternity Notes

Sigma Nu

Beta Upsilon is proud to announce the pledging of two men. They are Daniel Rainville from Springfield, Massachusetts, and Don Barnett from Greenup, Illinois.

Sigma Nu has Richard Hirst, Owen March and Pledge Bob Jackson representing us on the baseball team while Tom Clark, Art Sutton and Pledges Bob Crisp and Ned Kurtz are running track this year. In his first meet, Ned Kurtz set a Field House record for the broad jump. Tom Clark and Ned Kurtz were on the mile relay team which set a record for the indoor mile relay.

Dick Light, after doing an excellent job as our basketball coach this past season, has once again been called upon to shape up a softball team for the Interfraternty Softball League. We will have just about the same team as last year and we are looking forward to a successful season.

George B. South, Jr.

Theta Xi

This month Kappa is looking forward to their annual Regional conference which is to be held in Bloomington at I. U..'s Alpha Tau chapter. It will be held on Saturday, April 14th.

In interfraternity sports we are getting ready for what we hope will be a great and successful season in softball. We started practice a couple of weeks ago and we will be in good shape for the first game with the Alpha Tau's.

We have started a new project at the house; this being the enlargement of our recreation room. I'm sure all the pledges enjoyed knocking out the wall even though it was a very dirty job.

Congratulations are in order for Bob Coma who surprised us all and got pinned to Miss Sylvia Dickis on the night of the St. Pat's Dance. Also congratulations to John Irwin who pinned Miss Marcia Malooley.

The actives and pledges of Theta Xi are proud to announce our candidate for the Military Ball's "Honorary Colonel" as being Miss Patty Ann Monninger.

Have you all seen Walter Schramm's new car? I know you just hated to part with that old five cylinder Nash with wooden wheels, Wally.

Kappa has taken two more pledges into their folds. They are Steve Powell and Bill Kunz. Welcome fellas.

Jack Wilcox

Alpha Tau Omega

It was a busy month for the Taus as everyone had his own special activity to take care of.

Bob Mewhinney, Bill Kuchar, Mike Munro and Jack Foltz are carrying Rose's colors for the track team and gathering a lot of points for the cindermen. Bob Sutton and Tom Pebworth are playing baseball and Bob Burtner and Tom Reese are managing.

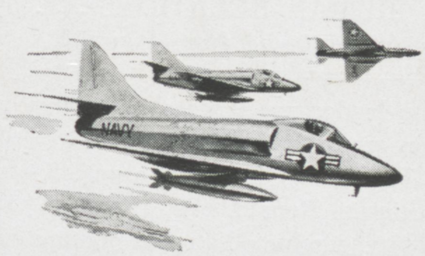
Our intramural athletes are warming up for softball and a couple of weeks ago the actives trounced

(*Continued on Page* 38)

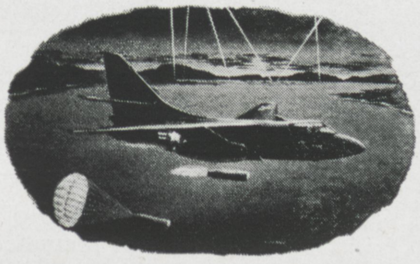
Lambda Chi's enjoy outing at McCormick's Creek.

ATO's before the St. Pat's Dance.

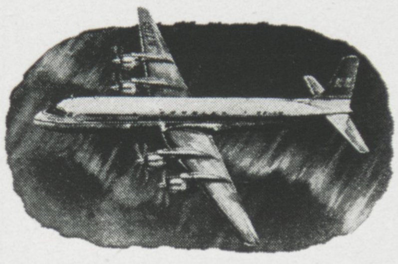

F4D, "SKYRAY"— only carrier plane to hold official world's speed record


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

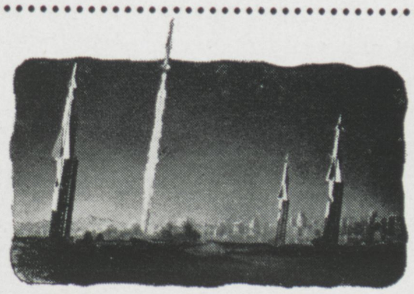

RB-66 — speedy, versatile jet bomber

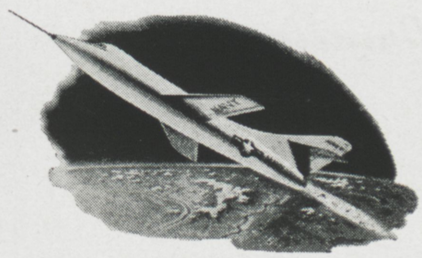

A3D, "SKYWARRIOR"— largest carrier-based bomber


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

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Mechanical test
Structural test
Flight test
Process engineering
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HUMAN RELATIONS . . .
(*Continued from Page* 12)

the leader must seem to be one of the group.

In the late '30's Lewin and his associates, Ronald Lippit and R. K. White, conducted a mask making experiment among children 10 to 12 years of age that has become classic in the field of sociology. The children were divided into three groups, each with an adult leader. One group had very autocratic leadership, with the adult leader assigning jobs to individuuals and telling them exactly what to do. This is very much like the traditional methods of industry. The second group worked on the "laissez-faire" type of organization. The adult leader was present, but the children were permitted to work the whole thing out fos themselves. The third group was a democratic one. The leader told the children how to make the masks, and then they were allowed to pick their particular task with the group's help.

The results of this test are very enlightening. In the first group, tensions resulting from the autocratic rule of the leader soon caused the members of the group to fight among themselves. In the second group the lack of organization allowed the "I-feeling" to render the group ineffective. The third group proved to be successful mash makers. The group was so organized that it was not split by internal conflict. Here again we see that a group that is given responsibility and makes its own decisions is the most successful.

Groups can accomplish more than individuals. I imagine all of you have had the experience of going away to a conference or a workshop to learn new ideas. When you returned you were full of enthusiasm and all ready to incorporate everything you had learned into making your firm a better one. But you soon discovered that your fellow workers, who had not been at this workshop, had very little enthusiasm for these new ideas. Soon you have as little enthusiasm as they do. An experiment has been made of the effect of groups on individual enthusiasm. A conference was held where part of the members were invited as individuals and the rest were invited as groups. As you might suspect, it was found that the individuals soon lost their enthusiasm but the groups kept theirs, since they had each other to keep them from becoming discouraged.

The group is an effective agent for change. During the Second World War attempts were made to educate the American housewife to buy cheaper cut of meat. One group of housewives heard a lecture urging them to buy cheaper cuts of meat. As a result, 3% of the women present changed their buying habits. Another group of women met with a trained leader to discuss buying cheaper cuts of meat. In this group, the women themselves came to the conclusion that they should buy the cheaper cuts of meat. As a result of this meeting, 32% of the women present changed their buying habits. Again the democratic group proved to have the most effect on its members.

An example of a group that exists only to meet the needs of its members is Alcoholics Anonymous. Here the members help each other overcome a personal problem because they have shared his problem.

Management has begun to wake up to the problem it faces as evidenced by one plant's decision concerning how to put a new machine into operation. The plant realized that if the workers found the new machine on the line one Monday morning, havoc might result. Therefore, the management decided on this plan to introduce the machine. First, the machine was uncrated and set on the floor with no power. After about a week, the supervisors explained to the workers what the machine was supposed to do and how it worked. The machine was then "fired up" and everyone was allowed to try his hand at running it. Finally, it was set on the line and put into production.

(*Continued on Page* 38)

ELECTRICAL ANALOGIES

(*Continued from Page 26*)

TABLE I

A Summary of Electrical-Mechanical Analogies

Mechanical	Electrical	
Force	Mass-Inductive	Mass-Capacitive
Mass	Voltage	Current
Damping	Inductance	Capacitance
Velocity	Resistance	Conductance
Compliance	Current	Voltage
Displacement	Capacitance	Inductance
	Charge	

designer can actually see how a machine might work under various conditions of operation. Of course, this does not always work, but it generally gives some indication of the machine's limits.

Rather involved analogies may be set up for problems dealing with the heat transfer. For these problems, however, the basic relationships as presented earlier are somewhat simple. Applications in this field are frequent particularly in study of the heating effects of electrical components when installed.

Very good analogies for electromganetic and electrostatic devices such as speakers can be set up. For the electromagnetic system the mass-capacitance analogy seems to be most favorable. The electrostatic system seems to favor the mass-inductance system. Servo mechanisms are very nicely illustrated by analogies.

Another important use for analogies is the analogue computer. The analogue computer is a device used to perform mathematical manipulations by making analogies between electrical or mechanical operations and mathematical operations.

A slide rule is one example of a mechanical analogue computer. Other mechanical computers have been built using levers, gears, wheels, and cams to simulate mathematical operations such as multiplication, addition, integration, and so on.

Electronic analogue computers are now more common and more accurate than the older mechanical computers. Analogue computers quite often solve nothing but differential equations. They are well adapted for this type of problem because of their ability to integrate and differentiate. The basic unit for a computer of this kind is the operational amplifier. The amplifier is a high gain, D.C. amplifier with an inverse feedback. By properly connecting resistors, capacitors, and inductors into the circuit the circuit can then integrate, differentiate, multiply, divide, add, and subtract. The use of analogies is on the rise, not only in the field of computers, but in all fields.

Alumni News

By Max Hippensteel, soph., e.e.

'00 Curtis A. Mees, c.e., of Atlanta, died March 6, 1956. Mr. Mees was a native of Columbus, Ohio and went to Atlanta in 1933 as a consulting engineer with the Georgia Public Service Commission. He later became affiliated with the Georgia Power Co., where he was instrumental in the development of a housing project. Mr. Mees retired from the Georgia Power Co. two years ago to enter private practice as a consulting engineer.

Mr. Mees was a specialist in hydroelectric development throughout the Southeast. He designed the Georgia-Alabama Power Co. dam at Albany and the White Water Power Co. dam at Montezuma.

'20 Norman A. Ruston, ch.e., has recently retired from his position as director of development and service for Emery Industries, Inc. Mr. Ruston has moved from Cincinnati, Ohio to Auberndale, Fla.

Another member of the class of '20 has also retired. He is Harold L. Kessler, e.e., of Cleveland, Ohio. Mr. Kessler was formerly division staff supervisor for American Telephone and Telegraph Co.

'29 Herman A. Moench, e.e., M.S. E., Michigan, '35, attended a meeting of the educational committee of the IRE at the New York headquarters during the time of the annual convention. Dean Moench, who served during the past year as the chairman of a sub-committee on education, participated in discussion on the operation of student branches of the IRE in colleges. A number of other Rose men attended the radio show and technical sessions. Prof. Moench reported encountering: Ted Hunter, who was associated with the Rose physics department from 1932 to '38; Carl Wishmeyer, e.e., '37, Professor of electrical engineering, Rice Institute; Larry Giacoletto, e.e. '38, John Pier, e.e., '38, Bill Anderson, e.e., '41, Orville Stone, e.e., Oct. '48, Bob Liggett, e.e., '53 and William Nelson, e.e., '53.

'32 Joseph L. Hunter, e.e., Lt. Colonel, U. S. Army, has recently returned to the States from a tour in the far east. He had been stationed in Korea and Japan but has now been transferred to Ft. Leonard Wood, Mo. where he is with the Hq. 62nd Construction Engineer Batallion.

Feb.' 43 Darrell Criss, e.e., M.S. Illinois '50, Professor of electrical engineering, Rose Poly, attended the 18th annual meeting of the American Power Conference held at Chicago. Prof. Criss represented the e.e. department of Rose and was accompanied by three students, Dale Rushline, sr. e.e., James Griffith, jr. e.e., and Ronald Frieberger, jr. m.e. The students were sponsored by various public utilities companies and there were over 130 sponsored students. The conference is a national forum for the discussion of problems and for the exchange of inormation about matters of interest to the power industry and its associates.

Aug. '50 Jack Marshal, e.e., senior electronics design engineer, Cook Research Labs, Skokie, Ill., has recently completed a trip around the world. For the past 2 years Mr. Marshal has been working on classified projects and has visited a number of industrial areas scattered over the globe. On his most recent trip, Mr. Marshal visited several countries in both Europe and Asia in search for a suitable "sight."

'52 Robert L. Metz, e.e., Mifford, Conn., has accepted a position as Design Engineer with the Norden-Ketay. Mr. Metz is returning from the Army where he was sttaioned at Ft. Monmouth, N. J.

CONTROVERSIAL CORNER

(*Continued from Page 14*)

Steel Corporation, said that he was against the inclusion of any more humanities courses if it meant weakening the teaching of engineering fundamentals. At first, it might seem unusual or such an unorthodox remark to be made by an official of a corporation that depends a great deal on competent engineers for its continued profitable existence. On closer examination, however, it seems to "track" as they used to say in the Navy. Is it possible to become "cultured" by attending Engliomic I at 8:00 A.M. on Monday, Wednesday, and Friday and spend the rest of the week with consistently dull and technically overbalanced engineering instructors? We engineering instructors should be able to provide the stimulus to inspire our students to have a broad outlook, and to recognize the need for culture in their lives as responsible and mentally awake citizens. Selfishly, it would make our own lives much more interesting to be something other than a textbook wired for sound, and besides that, think of all those hours that would be free for solid-state physics, nuclear energy applications, etc.

At the same meeting, Mr. L. J. Fletcher, a vice-president of the Caterpillar Tractor Company, made the same point in a slightly different way. He said that "humanities are caught not taught." In order to make this more probable, Mr. Fletcher also suggests that the *engineering faculty* should take the humanities courses instead of the undergraduate engineering students. If more engineering teachers would stimulate the interest of their students in the world about them by the way that they themselves lead their lives, it is certain that engineers would boast about reading a respectable book now and then instead of boasting about not reading anything stronger than the latest issue of *Mad Comics.*

Research and Development

By Phil Kennedy, soph., e.e. and John Kassebaum, soph., e.e.

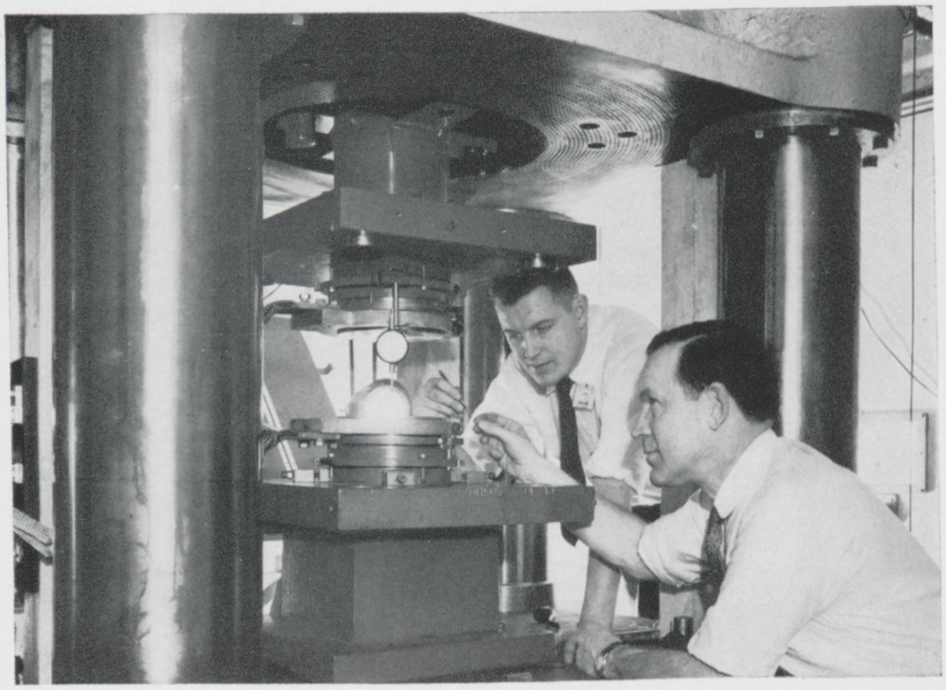
DIAMONDS IN THE MAKING

One of the most widely reported non-atomic scientific stories of recent years was the announcement in February, 1955, that a team of G-E scientists had made diamonds in the laboratory. Although the man-made diamonds are not large —the biggest measures approximately one sixteenth of an inch long and weighs less than one hundredth of a carat—they are suitable for a wide variety of industrial applications. Commercial responsibility for their manufacture and sale already has been assigned to a G-E department.

To create the diamonds, scientists subjected carbonaceous compounds to temperatures and pressures never before attained. Before announcing the achievement, the scientists conducted exhausting tests to prove that man-made diamonds were identical to natural diamonds in hardness and chemical composition. The most conclusive test, involving x-ray diffraction, found the "fingerprints" of the diamonds to be the same as those of natural diamonds. To further confirm the results, two independent groups of scientists from other departments repeated the work with success.

In subsequent experimentation, combined pressures and temperatures of 5000 F and 2,700,000 psi have been achieved and maintained for long periods of time. As a result, great new experimental areas were opened for super-pressure research.

One of the year's interesting scientific sidelights was the demonstration of how nature makes garnet. Natural hornblende was transformed into garnet by simultaneously dehydrating it, heating it to about 2200 F, and subjecting it to pressures of more than 375,000 psi.



General Electric's 1,000 Ton Diamond Making Press.
Cut courtesy of General Electric Company.

WORLD'S LARGEST POWER SHOVEL
(see frontpiece)

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 in one pass. The new machine over-shadows all previous large shovels in reach and power much more than it does capacity.

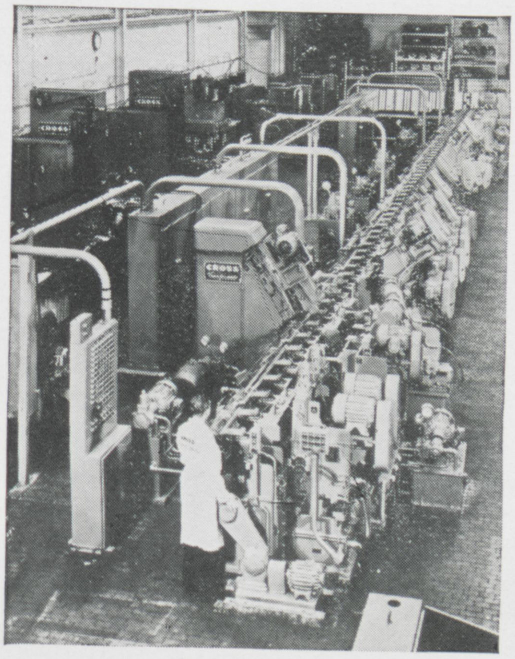
The 150 foot boom and the 100 foot dipper stick are about 40 per cent larger than those on the largest shovels heretofore used. The resulting long reach and high lift will handle correspondingly deeper overburden economically. This will make available for single cut, open pit mining, many thousands of 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 ft. bank.

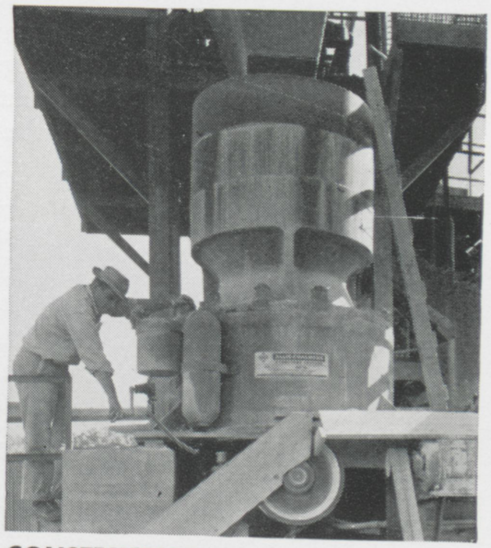
Power is transmitted to the shovel through a 250 mcm, type sh-d, rubber armored, 3 inch diameter, trailing cable a 6.9 kv from a 5000 kva, 69000-6900 volt, portable substation. This marks a new development in power distribution to large shovels. The voltage almost universally used in large open pit mining 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.

(Continued on page 40)

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.

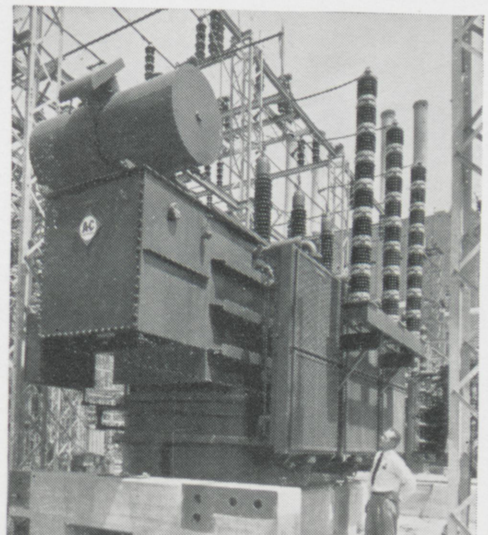
THERE IS much talk today about growth companies. Allis-Chalmers is one of them, supplying machinery for three basic industries—manufacturing, construction and power.

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.



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

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.

A-4684 **ALLIS-CHALMERS** A-C ALLIS-CHALMERS

Plants and Sales Offices all over the World

HUMAN RELATIONS . . .

(Continued from Page 30)

This method was definitely an improvement over the first way of just setting the machine on the line Monday morning, but it still left something to be desired in satisfying the basic social needs of the group. A much better method would have been to allow the group to decide through investigation and discussion that such a machine would help them do their job better. In other words, make it something the group itself will do, not something the group has done for it.

Most of us believe in free labor, but we hesitate to extend that freedom beyond cutting the chains that bind men to their machines. We fail to allow the production line worker to fulfill his three basic social needs in our present system.

We, as engineers and future engineers, can pave the way to better and more human production methods by working to see these policies adopted towards the production worker. We must recognize the work group as the basic element to deal with. We must allow these groups to decide to make their own changes. We must seek their advice and design machines for them to use with the worker in mind. We must help these groups realize that what they do is important. And we must always recognize every worker as a human being with problems just like you and I.

Dorwin Cartwright, Director of Research Center for Group Dynamics at the University of Michigan, has said,

> "I am convinced that future research will also demonstrate that people working under such conditions become more mature and creative individuals in their homes, in community life, and as citizens."

And I would like to add that I believe that the engineering profession can lead the way toward bringing these conditions about.

FRATERNITY NOTES

(Continued from Page 28)

the pledges 10-4. "Sore arm" Bloxsome was responsible for the win.

Art Masters recently became engaged to Janet Rhodes. Good choice Art!

Parties before the St. Pat's dance and the Military Ball made those nights a lot more fun. The Mil-Ball was made a lot more fun when Lou Ann Tangeman, the ATO candidate, was elected Honorary Colonel and Frank Eppert and Mike Munro got first and second in the O'Grady Drill.

The new pledge class has been shaping up but they seem to have developed an unusual interest in the Active's alarm clocks and other necessities of life. How about that fellows?

The Gamma Phi Betas from State have some very good looking girls and Friday the 13th turned out to be a very lucky day for an open house down at the Tau house.

Tom Pebworth

Lambda Chi Alpha

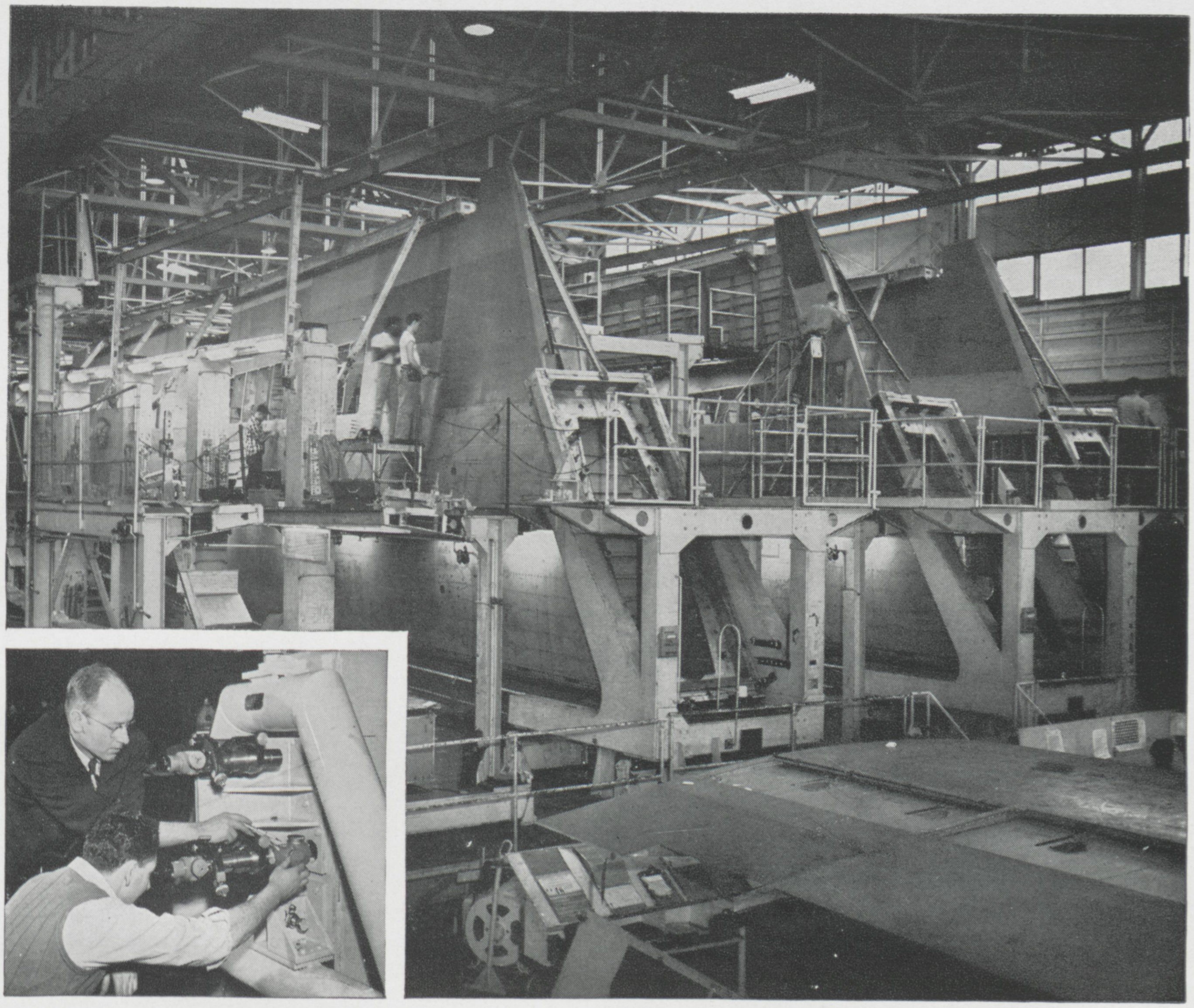
Everybody enjoyed the picnic that was held after the St. Pat's Dance (Sunday morning that is) at McCormick's Creek State Park. Even with burned weiners held with frozen hands, the picnic received much praise and plans were made to have another picnic, with the Delta Gamma sorority, in April.

The Lambda Chi softballers got off to a running start on April 4 by defeating Sigma Nu 16-3 behind the control pitching and power hitting of Bob Bright and excellent fielding of Coach Harold "The Arm" Brown.

Because the pledges "voluntarily" returned our silverware we were able to eat once again at the house. Would somebody please chase away the birddogs so our pledges could keep a few of their dates.

No pinnings or engagements this month but congratulations to a hopeful — B. B. We are getting low on cigars.

John Bizal



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 longstanding 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

RESEARCH AND DEVELOPMENT

(*Continued from Page 36*)

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, 35000 kva, .8 power factor, 1200 rpm, synchronous motor. This motor drives four 400 kw, 500 volt d-c 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 generator for suppling 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 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 motors There are four vertical swing motors totaling 750 hp and two crowd motors each of 187½ hp. All of the main driving motors are of the heavy duty, armored, mill type construction with forded 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, power peaks and plugging. Extreme flexibility in adjustments are accomplished easily and readily, due to the simplicty of the adjustment circuits.

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.

In the large diameter, hollow center pin of the machine there is an automatic, apartment house type 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 gentry, 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.

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.

It is called a magnetic tape recording and data reduction system and 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 affected electronically.

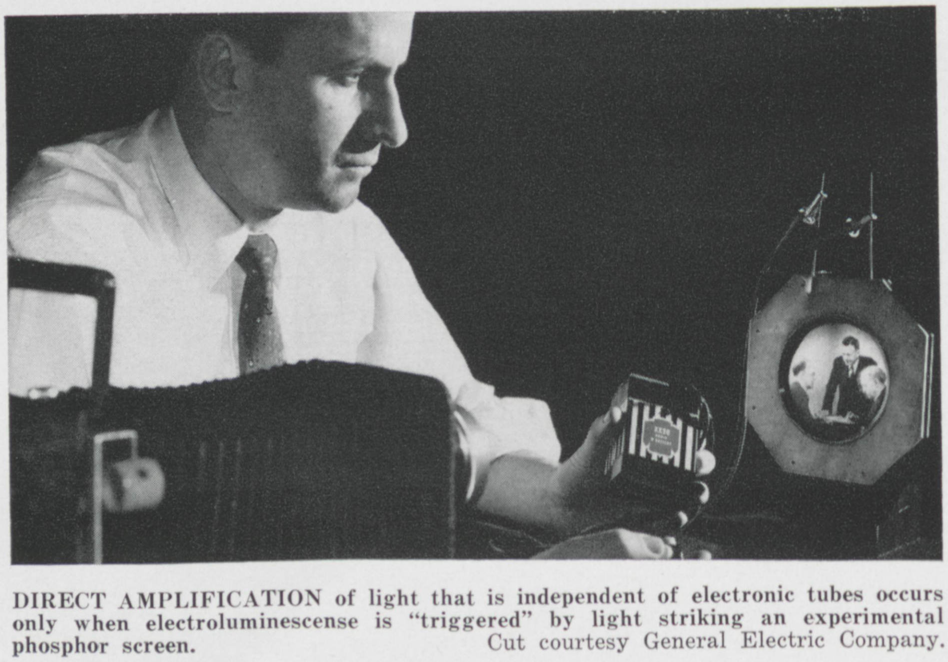
With this system, multiple channels of data such as stress, vibration, pressure, temperature, speed and flow, can be recorded simultaneously at the test site. The data may be of a steady nature or vary up to 30,000 cycles per second.

The data reduction is accomplished by this complex electronics system designed and constructed by constructed by G-E engineers. Use of this equipment has shortened data reduction time to a fraction of what was previously required.

The 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.

LIGHT AMPLIFIER

Demonstration by scientists of direct amplification of light independent of electronic tubes, created new interest in the study of solid-state amplification devices. Experimental phosphor screens with an electric field applied to them give off many times as much light as that projected on them. Because the amplification is nearly proportional, the device can be demonstrated by projecting a picture on the screen with an ordinary lantern-slide projector. The projected image is brightened not by altering the projector's lamp or lens but by "turning on the screen." Applying an electric field does not of itself cause the thin phosphor film to give off light. Ultraviolet energy falling on the screen occurs only when the electroluminescence is "triggered" by light striking the screen.



DIRECT AMPLIFICATION of light that is independent of electronic tubes occurs only when electroluminescense is "triggered" by light striking an experimental phosphor screen. Cut courtesy General Electric Company.

ADVERTISING INDEX

FIREBIRD II

(*Continued from page* 11)

smoothing out severe bumps as well as small road irregularities. It likewise gives a variable spring constant, acting as a strong spring when the car is heavily loaded and a weak spring when the car is lightly loaded. The result is an essentially constant spring frequency that makes the car ride just as smoothly with the driver alone as it does when fully loaded. Leveling is accomplished by varying the quantity of oil in each suspension unit.

Central Hydraulic System

Incorporated is a novel central hydraulic system. The uniqueness of this system lies in its single, compact, high pressure hydraulic supply. From this single source is drawn the hydraulic power for the Firebird's Air-Oil suspension units, power steering, new linear power brake booster, and hydraulic windshield wiper.

The heart of this system is in the high pressure hydraulic pump. This pump, in conjunction with accumulators and filter, makes up the hydraulic power supply.

Hydraulic energy is drawn from the accumulators, devices which store the hydraulic energy from the pump just as a battery stores electrical energy from the generator. When system pressure drops to 850 pounds per square inch, an unloading valve on the pump automatically operates, and the high pressure pump recharges the accumulators to 1,000 pounds per sq. in.

The use of accumulators insures a reserve of hydraulic energy instantly available. The accumulators also provide a hydraulic supply with the ignition on but the engine not running. With the ignition off, electric check valves are closed to insure that accumulator pressure is maintained.

Of particular interest is the Saginaw Steering Gear's new linear brake booster. This device multiplies the braking force, permitting a smooth, quick stop with a very light pedal pressure.

Turbo-X Brake

A new all metal brake, the Turbo-X, provides smooth, positive, straight ahead stopping ability. It operates by squeezing a rotating cast iron disc between pads of metal lining material. The name Turbo-X is derived from the new turbo-cooling feature built into the disc. The cast iron disc rotates with the wheel. When the hydraulic pressure is applied to the brake, this disc is squeezed between the movable pads of metal lining material on the inboard side of the disc and fixed pads on the outboard side. Stopping power is directly proportional to applied hydraulic pressure.

To increase the brake's stopping ability, engineers developed a unique turbo-cooling system built into the cast iron disc. The disc has an air space between its braking surfaces with blades that pump air centrifugally through the disc while it is spinning. Heat generated by the braking action is carried away by the air stream and dissipated.

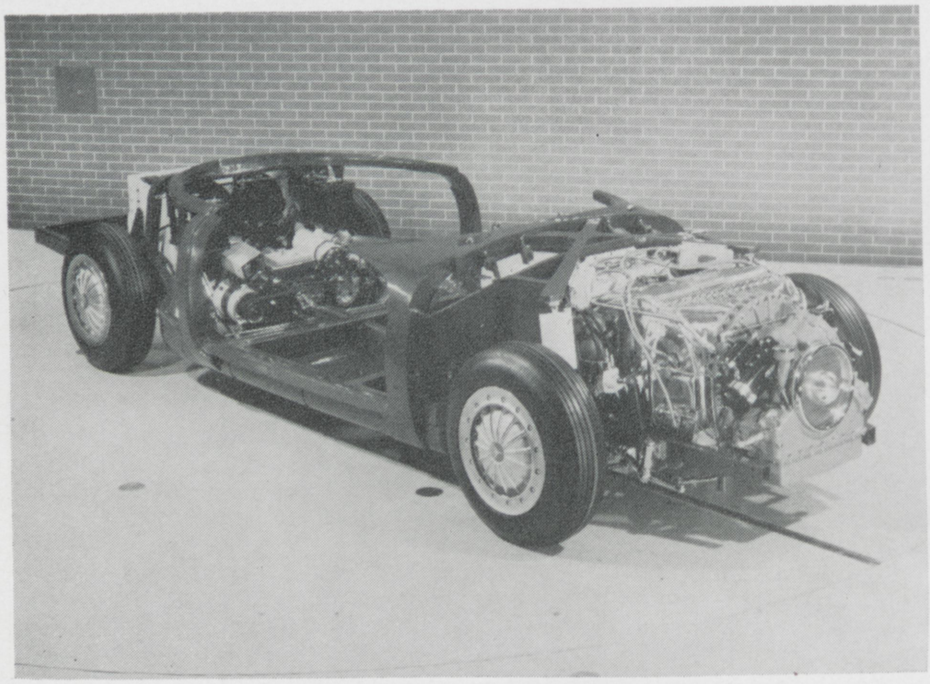
Electrical System

A 12 volt electrical system is used. The electric starter motor turns over the gasifier section of the turbine. At 4,000 rpm fuel enters the burners automatically and is fired by means of conventional igniter spark plugs. Once the fuel is ignited, the starter motor continues to assist the turbine until it reaches idle speed (15,000 rpm). At idle speed the starting motor and plugs are de-energized automatically, and the car is ready to be driven away.

The charging circuit uses an alternating current generator. The reasons for this choice were first, a-c generators have better voltage-speed characteristics and, thus, can deliver nearly rated output at idle speed; second, much higher output can be obtained from a smaller unit; third, the a-c generator output is not handled by a commutator, thus permitting the use of very high currents with a minimum of maintenance. Since the a-c generator's output is 3-phase alternating current, a rectifier is used to convert the alternating current to direct current for the car's 12 volt electrical system. Current and voltage regulation is accomplished by a new transistor-type regulator.

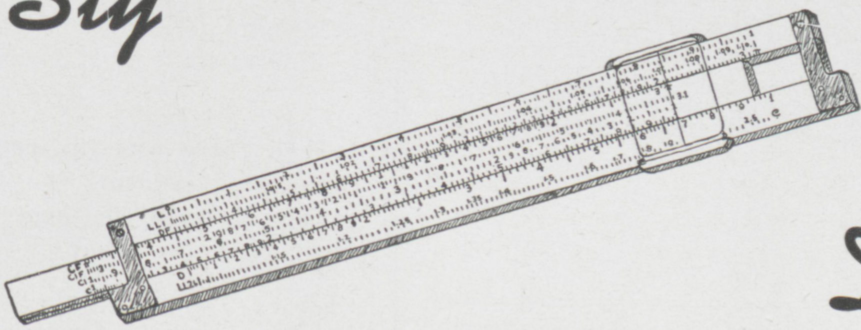
Summary

The Firebird II is an experimental car, showing the progress that has been made in gas turbine automobiles during the past two years, and serving as a show case and proving ground for other advanced engineering features. The result is a number of new automotive engineering concepts—all on trial for the first time in the Firebird II.



Chassis view of the new Firebird II.

Sly



Droolings

Stolen by Don Grantham, soph., e.e. and Tom Reese, soph., c.e.

She was a "Honey Chile" in Dallas
The sweetheart of the bunch,
But on the old expense account,
She was gas, cigars, and lunch.

* * *

The Southern farmer was introducing his family of boys to a visiting governor.

"Seventeen boys," exclaimed the father. "All of 'em are Democrats but John, the little rascal. He got to readin'."

* * *

Professor: "Young man, do you know who I am?"

Freshman: "No sir, but if you remember your address, I'll take you home."

* * *

R.O.T.C. Sergeant: "Does your uniform fit satisfactorily?"

Frosh: "Well, the jacket is OK, sir, but the pants are a bit snug under the armpits."

* * *

College — A fountain of knowledge where all come to drink.

* * *

Joe: "How did you get that flat tire?"

Paul: "I ran over a milk bottle."

Joe: "Didn't you see it?"

Paul: "No, it was in the kid's coat pocket."

* * *

The man in the employment office was talking to a grad fresh out of Business College.

Here's a job open at the Eagle Laundry, think you can handle it."

"Don't know, I ain't never washed no eagles."

* * *

Vacation telegram to a girl:

"Having a wonderful wish: time you were here."

"Where is the car?" demanded Mrs. Bloxsome.

"Dear me!" said Professor Bloxsome. "Did I take the car out?"

"You certainly did. You drove it to town."

"How odd! I remember now that after I got out I turned around to thank the gentleman who gave me a lift and wondered where he had gone."

* * *

She reached below her dimpled knee
Into her rolled down stocking
And there she found a roll of bills;
Ah, to me was so shocking,
"Why don't you keep them in a bank?"
Inquired a nosy pryer.
"The principle's about the same
But the interest here is higher."

* * *

A countess sued a man for defamation of character because he called her a pig. The man was fined, and afterwards, he asked the judge, "You mean I can never call the Countess a pig again?"

"That's right," was the reply.

"Well," said the defendant, "Is it all right if I call a pig, countess?"

"That you can do," replied the judge.

The defendant then turned toward the witness box, looked her right in the eye, and said, "Good afternoon, Countess."

* * *

A learned man claims: "The grade of a student's examination paper will approach zero as the number of dates a week he has approaches seven."

Sign at AF base: Notice. Absolutely no flying permitted over nudist camp exactly 8.35 mile from this base on a true course of 190 degrees.

* * *

A bored cat and an interested cat were watching a game of tennis.

"You seem very interested in tennis," said the bored cat.

"It's not that," said the interested cat, "but my old man's in that racket."

* * *

The average husband is proof enough that a woman can take a joke.

* * *

Actress: They laughed when I came on in shorts, but when I sat down they split.

* * *

An Engineer is said to be a man who knows a great deal about very little and who goes along knowing more and more about less and less until finally he knows practically everything about nothing; whereas,

A Salesman, on the other hand, is a man who knows very little about a great deal and keeps knowing less and less about more and more until he knows practically nothing about everything.

A Purchasing Agent starts out knowing practically everything about everything, but ends up knowing nothing about anything due to his association with engineers and salesmen.

* * *

She's the kind of a girl who whispers sweet nothin' doin's in your ear.

A bee has a stinger .03125 inch long. The other 24 inches is your imagination.

* * *

Mother is always having trouble with either Father or the furnace. Everytime she's watching one the other goes out.

* * *

She: "And what would you be if it weren't for my money?"

He: "A bachelor!"

* * *

A professor, whose theories were always open to doubt, but who nonetheless found many and devious ways of proving them, was lecturing on insects at a university.

"On my right hand," he said to his subjects, "I have a flea. I now order him to jump over to my left hand. As you see, the flea obeys me. Now," he continued, "I remove the legs of the flea and order it to jump. You note that it does not jump. Therefore, we have scientific proof that a flea whose legs are removed becomes deaf."

Students are like blotters, they absorb what the instructors say, but they get it backwards.

* * *

If a doctor is doctoring a doctor, does the doctor doing the doctoring have to doctor the doctor the way the doctor doctored wants to be doctored, or does the doctor doctoring the doctor, doctor the doctor the way he usually doctors?

* * *

"What is an Engineer!"

An engineer is a person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude infinite strings of incomprehensible formulae calculated with micromatic precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of doubtful reliability and questionable mentality for the avowed purpose of annoying and confounding a hopeless, chimerical group of fanatics referred to, all too frequently as Engineers.

"What is your favorite sport, doc?"

"Sleighing."

"I mean apart from business."

* * *

Then there was the petroleum engineering student who flunked geology because he kept taking every thing for granite.

* * *

A serious thought for today
Is one that may cause us dismay;
Just what are the forces
That bring little horses,
If all of the horses say, "nay."

* * *

Deft-nitions—

Chinese Wolf — A guy who takes his girl for a rickshaw ride, then stops and tells her he ran out of coolies.

Tomorrow — Today's greatest labor saving device.

* * *

When she said that he made a fool of her, she didn't realize what a lasting impression he had made.

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.

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