Spartan Engineer

★ How to Be an Employee

★ Peacetime Use of the Atom

★ The Mackinac Bridge

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James Chisholm, class of '41,
speaks from experience when he says,

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James Chisholm is typical of the young men who rapidly rise to an important position at U.S. Steel. Jim came to U.S. Steel as a trainee in 1941 after graduating as an M.E. Shortly thereafter he entered military service for four years. Upon his return to U.S. Steel in 1946, he advanced steadily until, in 1951, he was appointed to his present position as Assistant Superintendent of Blast Furnaces at the new Fairless Works at Morrisville, Pa.

Jim is now in charge of quality control for open hearth furnaces at Fairless, the unloading of all ore ships and the operation of the plant's two big blast furnaces—each with a rated output of 1500 tons per day.

Jim feels that the opportunities for graduate engineers are exceptional at U.S. Steel. He remarked that in his own department alone, six college trainees have been put into management positions within the last couple of years. He says that chances for advancement are even better now with the current expansion of facilities and the development of new products and markets.

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Conquering the Impossible

The Mackinac Bridge:

DAVID B. STEINMAN, Consulting Engineer
Reprinted from Columbia Engineering Quarterly
November, 1955 Issue

THE THOUGHT of connecting the two sections of the State of Michigan by a physical link across the Straits of Mackinac has challenged the imagination of engineers and the public for the past three-quarters of a century. The difficulties, both physical and financial, appeared insurmountable. Various plans and designs were proposed from time to time during the past forty years. Some of the schemes would have been impossibly fantastic in cost. One official design for the proposed bridge would have collapsed before completion. People (who were not engineers) said that the project was impossible; that the cost would be prohibitive; that it could not be financed; that the bridge could not be built; that the foundation problems could not be solved; that the wide glacial gorge under deep water in the middle of the Strait could not be spanned; that the bridge, if built, would not stand up; that it would be destroyed by the elements; that no foundation piers could withstand the pressure of ice from the Great Lakes in winter; that no span could withstand the storms and wind forces at the site.

Despite all obstacles and difficulties, both natural and man-made, the project has now been successfully financed; all of the engineering problems have been successfully, economically, and safely solved; the difficult foundations have been successfully conquered; and the construction of the bridge, commenced in July 1954, is well under way to meet the scheduled completion date of November 1957.

The Mackinac Bridge is five miles long. In the deepest water, spanning the wide submerged glacial canyon, a record-breaking suspension bridge is being built; the length, 8,614 feet from anchorage to anchorage, makes it the longest one in the world. The central span, from tower to tower, is 3,800 feet; this is 300 feet longer than the span of the George Washington Bridge, and is exceeded only by the 4,200-foot span of the Golden Gate Bridge. The difficult foundations under the two main towers, one at each rim of the submerged gorge, were carried down to rock, reaching the remarkable foundation depths of 205 feet and 210 feet, respectively, below the water surface. The cables are carried on steel towers 552 feet high, each containing 6,250 tons of structural steel; and the suspended trusses, carrying the roadway, have a normal clear height of 155 feet above the water.

The total cost of the bridge, including the bond-interest during construction, is $99,800,000. This cost figure establishes a new record for the magnitude and difficulty of a bridge project, and will certainly be a long-time record for a bridge carrying only four lanes of highway traffic and no railway loading.

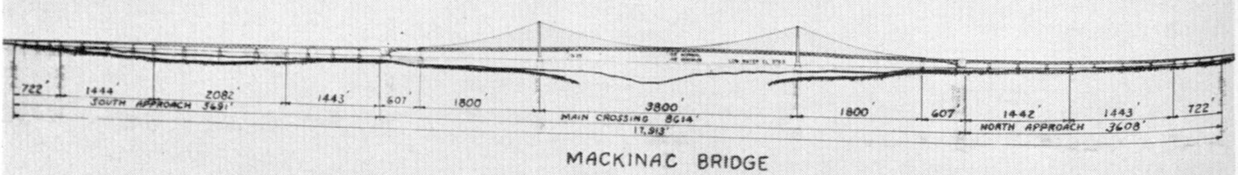
Without careful economic design, the cost would have been many millions of dollars greater and the financial feasibility of the project would have been defeated. Scientific design made the bridge possible, while at the same time assuring a high margin of strength and safety.

By spending a few million dollars more, the span could easily have been made the longest in the world. (In fact, the foundation problems would have been easier.) But the writer feels very strongly that an engineer is violating his obligation if he seeks personal glory at the expense of his clients, in this case the traveling public.

The Need for the Bridge

The Straits of Mackinac, four miles wide, joins Lake Michigan and Lake Huron. These waters divide the State of Michigan into the 41,700 square mile Lower Peninsula and the 16,500 square mile Upper Peninsula.

The far greater part of the population of the State is concentrated in the highly industrialized Lower



MACKINAC BRIDGE

Peninsula and its large cities such as Detroit; but the Upper Peninsula is possessed of immense natural resources which, when further developed, will attract additional population and industrial activity.

The Upper Peninsula is 400 miles long and is nearly equal to the combined area of four New England states. The principal industries at present are forestry, mining, agriculture, and recreation. Part of this area is world-famous as "The Copper Country." The area is also known as a "Vacation Paradise," drawing tourists and sportsmen from many states for hunting, fishing, camping, sailing, and winter sports.

The Mackinac Bridge will replace the existing State-operated highway ferry system in order to provide an all-year, all-weather, direct, time-saving connection between these two great Peninsulas of Michigan.

It is recognized that the project, which will contribute most to the further development of the Upper Peninsula, is the Mackinac Bridge. But, in a larger measure, it will contribute to the advantages of Michigan as a whole and of the entire Great Lakes area as well as of the Province of Ontario in Canada. In the words of Governor G. Mennen Williams, the builders of the Mackinac Bridge "are participating in Empire-building."

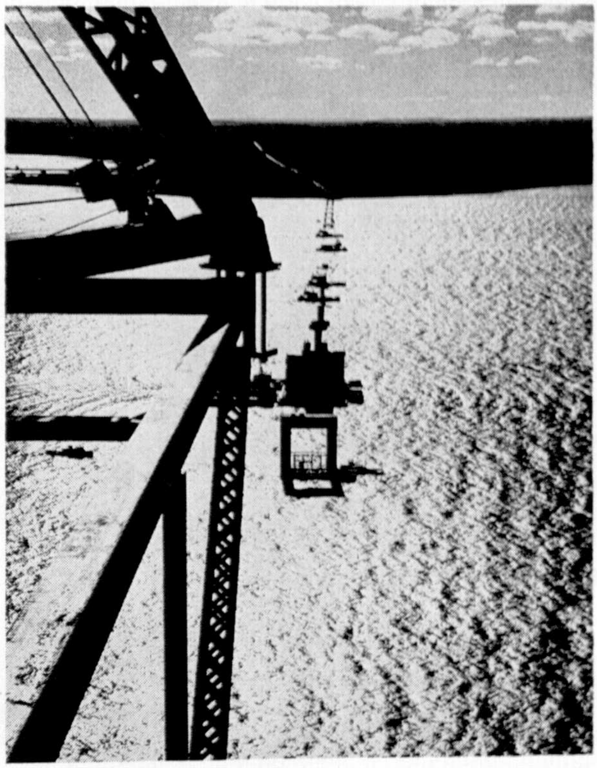
People doubted the possibility of financing the Mackinac Bridge because it does not directly connect two large cities or population centers. But modern highway uses have enlarged our vision and our perspective. Within a radius of 500 miles from the Straits of Mackinac there resides a population of 30,000,000 people in the United States and Canada who will benefit from the construction of the Mackinac Bridge and who, in turn, insure the economic practicability of the project.

The major highways of Michigan converge at Mackinaw City on the south and St. Ignace on the north of the Straits of Mackinac. Thus, the Mackinac Bridge will funnel traffic from the Lower Peninsula into the Upper Peninsula and then into Canada by way of Sault Ste. Marie, 50 miles north of Mackinac Straits. Furthermore, the Mackinac crossing will provide a shorter east-west route for bonded truck traffic between the western provinces of Canada and populous southeastern Ontario.

Truck traffic on the Mackinac Straits ferries has been increasing rapidly, and already amounts to 12 percent of the total vehicular traffic.

The Mackinac ferry rates were increased 45 percent in 1953 and, in spite of this increase in rates, traffic for the ensuing months increased 12 percent above the same period of 1952.

The five-mile ferry crossing takes over one hour; the bridge will reduce the crossing time to ten minutes. But, more important, the bridge will save the time now lost in waiting in line for the ferries. During the summer months, this lost time amounts to 3 to 4½ hours; and on holidays and during the deer-hunting season, to as long as 14 to 17 hours! The lines of waiting cars have extended along the highway as far back as 20 miles from the ferry. Parking fields are provided for



View of Michigan's lower peninsula from top of south tower.

the waiting cars, and the occupants find overnight accommodations to resume their place in line in the morning.

Photographs, stereo-views, and movies of these traffic conditions at the Mackinac ferries were used to convince bankers and investors before the bridge bonds were sold.

The proposed toll rates on the bridge will average 10 percent higher than the present rates on the ferries; the time-saving will be the governing advantage to the motorists. At an average toll rate of $3.08 per vehicle ($2.10 for a passenger auto, more for trucks), the estimated traffic of 2,000,000 cars and trucks in 1958 will yield a revenue of over $6,000,000 in the first year of operation, with progressive increase thereafter. According to the traffic experts, the bridge will pay for itself in 18 years (retiring all bonds), and can then be made toll-free.

From Dream to Reality

In 1920 the Michigan highway commissioner suggested a submerged floating tunnel for the Mackinac Straits crossing.

In 1928 the State Highway Department recommended a bridge, but the subsequent depression put a stop to the project.

In 1934 a Bridge Authority was created by the State Legislature. The Authority retained three successive consultants, who presented respective diverse plans

(Continued on page 7)

Early construction of south tower during summer months.

MACKINAC BRIDGE

(Continued from page 5)

in 1934, 1935, and 1940. World War II stopped all planning.

In 1950 the present Mackinac Bridge Authority was created by the Michigan State Legislature. The Authority promptly appointed a Board of Consulting Engineers: O. H. Ammann, G. B. Woodruff, and the writer. In 1951 the three-man Board of Consultants reported that construction of the bridge was feasible. The traffic-engineering firm of Coverdale and Colpitts was retained to make the survey of traffic and prospective revenue.

In January 1953, the Authority selected the writer to design and supervise the construction of the bridge, and the writer engaged Glenn B. Woodruff as his Associate Consultant. Within two months, in March 1953, preliminary contract plans and estimates of quantities were ready and the substructure and superstructure contracts were negotiated and awarded for prompt commencement of construction as scon as the bonds could be sold. All plans were rushed to get construction started in the spring of 1953.

Two attempts to sell the bonds were made in April and June, 1953, but the bond market was unfavorable. A new syndicate of investment bankers was formed and in December 1953, this group of bankers purchased the $99.8 million of bonds to finance the project.

Through the spring of 1954 the contractors proceeded to order materials and to mobilize equipment. During the next few months, $5 million of floating construction equipment was assembled and in place along the line of the bridge for the substructure contract, said to be the largest and finest floating equipment ever assembled for a construction contract.

On July 10, actual excavation was commenced for the subaqueous foundations. Over 750 men were engaged on the work at the site, working 20 to 24 hours a day. It was a race against time and a battle against the elements. The winter ice conditions at the Straits limit the normal working season to eight months. Word went down the line to every man in the organization to spare no effort or expense to meet the engineer's schedule and to get all the suspension bridge piers and anchorages down to rock before the freezing of the Straits occurred. To make up for time lost by impossible weather conditions, the men continued working in the rough water of the Straits through the winter cold, snow, and storms until finally forced to stop on January 14, 1955; but the two main-span piers were safely down into the bed rock under the Straits, and the side-span piers and anchorages were already completed as scheduled.

An Ultra-Safe Bridge

Because of the unusual formation, people said that the rock underlying the Straits could not support the weight of the bridge. To resolve any doubts, outstanding geologists and soil-mechanics authorities were retained. Exhaustive geological studies, laboratory compression tests, and "in-place" load tests on the rock under water at the site established, without a doubt, that the rock under the Straits can safely support more than 60 tons per square foot. This is four or more times as great as the greatest possible load that will be imposed on the rock by the structure, including the combination of dead load, live load, wind load and ice pressure. The foundations were proportioned to keep the maximum possible resultant pressure below 15 tons per square foot on the underlying rock.

Because the public had been alarmed by unscientific claims that no structure could withstand the ice pressure at the Straits, we added a further generous margin of ultra-safety. According to the most recent engineering literature on the subject, the maximum ice pressure ever obtained in the field is 21,000 pounds per lineal foot of pier width, and the greatest ice pressure pro-

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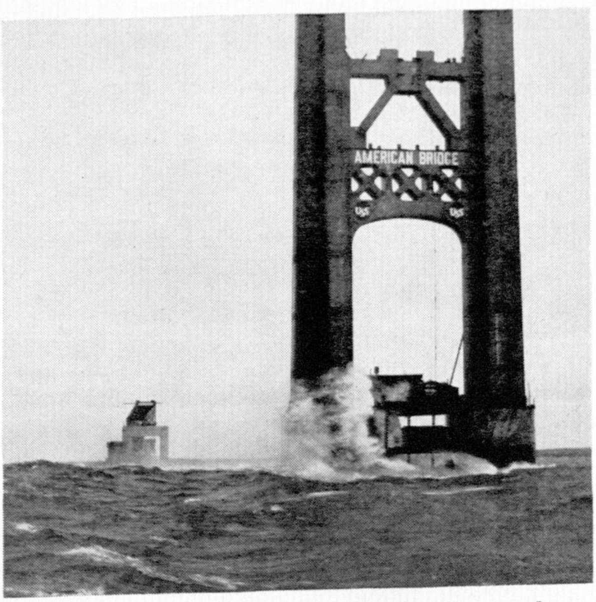

Construction progressed to this point before early winter storms forced a halt in work.

PEACETIME USE OF THE ATOM

by DON POLLAKOWSKI

Power production in the United States in 1955 amounted to the "staggering figure" of one trillion, forty billion kilowatt hours, a 250 per cent increase over the 1954 rate of power used in this country, according to the latest marketing experts' estimates.

If low cost energy is to determine our economic health, in the next 25 years conventional fuels must carry a bigger load than reports indicate they are capable of handling. Mr. O. B. Falls, Jr., marketing manager for the Atomic Power Equipment Department of the G-E Atomic Products Division, has said that 65 per cent of new power generating plants added in 1980 will be atomic.

In order to provide in the next century increased production and a better standard of living for a population that is expected to be two and one-half times that at present, there seems to be no choice but to depend on atomic energy.

Although the cost of electric power production by atomic means is prohibitive at the present time, forecasts of costs of future atomic power plants show that much of the country's energy needs will be met successfully. At the present time, and probably until 1960, the cost of building an atomic power-generating plant of the boiling reactor type is estimated at somewhere between \$200 and \$270 per kilowatt, while the cost of building a conventionally fueled steam plant of the same size would be about \$175 per kilowatt. Increasing the size of reactors by five to 50 times, reducing unit development costs, quantity production, and simplified test procedures will cut future costs rapidly. By 1980 the cost of a nuclear power plant is expected to decrease to somewhere in the neighborhood of \$145 to \$165 per kilowatt.

If at present progress does not look particularly encouraging, we must remember that industry has been in this position before. Seventy-five years ago we stood in the same relationship to the electrical age and the bold and imaginative plans made then changed the course of history.

Signifying the optimism shown by private business toward our atomic future General Electric Company has announced establishment of a new major atomic organization for the design, development, manufacture, and marketing of atomic power equipment. With this, one of the nation's first co-ordinated industrial sales programs for nuclear research reactors was launched. The new department will help customers to obtain and operate reactors. General Electric, according to last reliable figures, has a total force of some 12,000 people working directly in atomic energy activities.

On July 21, 1955, at West Milton, N. Y., where excess power from a prototype submarine reactor was channeled through a 12,500 kilowatt turbine-generator, Chairman Lewis L. Strauss of the Atomic Energy Commission threw the switch which sent automatically-produced electric current into power lines of the upstate New York area. This marked the first time the energy of the atom was transmitted commercially to private consumers.

On March 31, 1955, the Commonwealth Edison Company, on behalf of Nuclear Power Group, filed a proposal with the Atomic Energy Commission announcing their contract with G. E. to build a \$45 million, 180,000-kilowatt power plant. The plant will be built on the Illinois waterway, 47 miles southwest of Chicago. Its onput will feed into the Commonwealth Edison system serving Chicago and northern Illinois.

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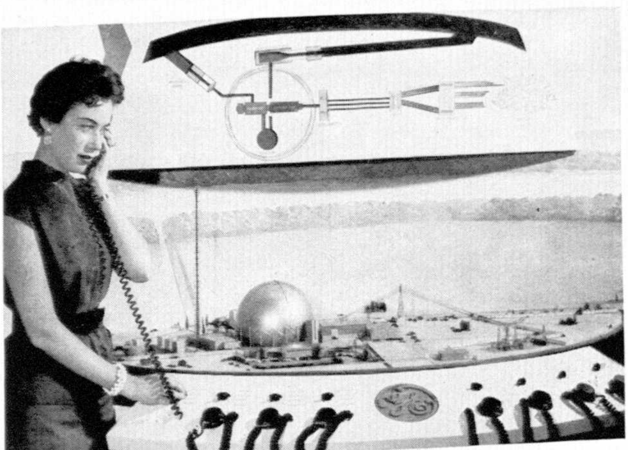
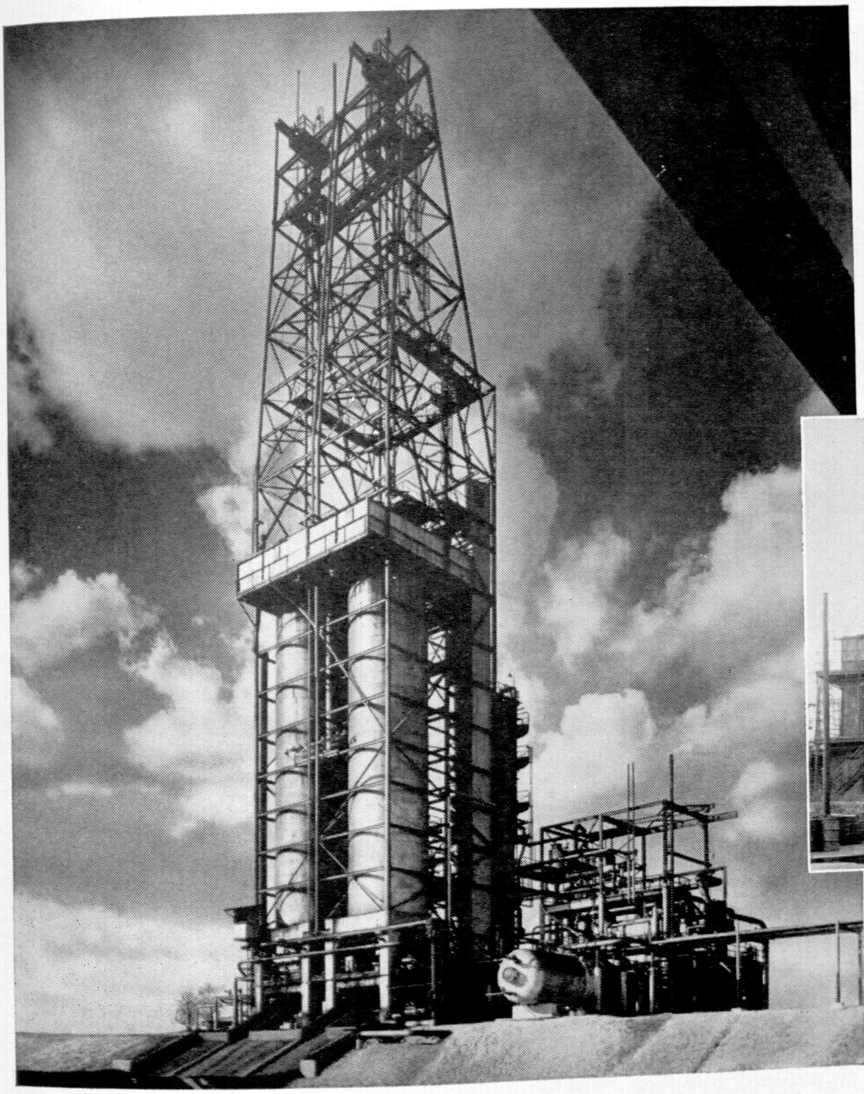
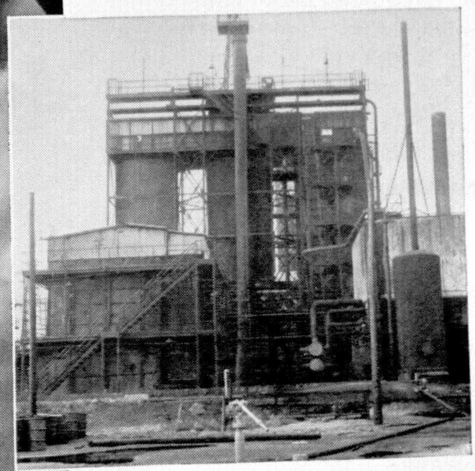


Model of 180,000 kilowatt power station to be constructed near Chicago, is given last-minute check before shipment to the United Nations conference at Geneva. A 200-foot sphere will house the atomic reactor and turbine-generator.



This towering modern unit at the El Dorado, Ark., refinery of Pan-Am Southern Corporation, a Standard Oil subsidiary, produces 700 tons of coke daily.



Standard's original delayed coking unit at Whiting recently celebrated its 25th birthday "on stream" and going strong.

How to make an exception prove a rule

TECHNOLOGICAL PROGRESS is rapid in the petroleum industry. Few processes have a chance to "grow old" on the job. Most are killed off through the combined efforts of thousands of scientists working constantly to improve everything we do, make or use in our business.

Every now and then, though, we experience a happy exception to this rule. That occurs when a new development not only meets the immediate need but also provides the right answer to situations yet unforeseen.

Twenty-five years ago last August a process known as "delayed coking" was invented. The new process made a quicker, cleaner job of converting heavy residual oil into gasoline, gas oil, and coke. It paid off spectacularly when catalytic cracking was invented and these giant new units began calling for feed. It paid off again when the diesel locomotive came along to put the heavy oil burning steam locomotive out of business.

Dr. Robert E. Wilson, chairman of the board of Standard Oil today, was the inventor of delayed coking. Almost all of the young scientists who worked with him in its development are still with Standard too, in responsible positions requiring their special skills.

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Something about Mexico

by FELIPE JAUREGUI

The history of our country during the last 34 years, that is, since the revolution settled down to constructive tasks, has been, principally, a continuous struggle to develop its agricultural economy upon sound and efficient standards.

There is no doubt that we are the possessors of an extensive variety of natural resources distributed throughout the 676,590 square miles of a territory, whose peculiar shape, tradition has identified with the horn of plenty, but the actual fact is that the mountainous and desertic character of a considerable portion of this territory to the northwest where rainfall is extremely scarce for the cultivation of crops; the swampy lowlands to the southeast where, on the contrary, rainfall is abundant and with river floods often disastrous; together with a steady demographic increase now close to the 30 million inhabitants are factors that account for shortages of foodstuffs which our much praised cornucopia was unable to supply from 1948 to 1952.

However, in less than three years the present government has succeeded in straightening out this precarious condition through its Department of Hydraulic Resources, and for the first time after the aforementioned period the deficit of indispensable commodities such as corn, wheat, and beans, has actually disappeared.

According to a report issued by Engineer Eduardo Chavez, who is at the head of the Department of Hydraulic Resources, 148,260 new acres, which amount to half the irrigated area of Mexico from 1926 to 1948, will be incorporated to cultivation by the end of 1955. Two large projects, started by his department in 1952, the Macuzari on the Mayo river in Sonora, and the Miguel Hidalgo on the Fuerte river in Sinaloa, will be finished this year to irrigate a total of about 650,000 acres, in addition to 526 small dams already giving service to the 28 States of the Republic. Furthermore, there are 87 storage and diversion dams, plus 313 wells to supply ground water in process of construction and drilling, respectively, to irrigate 65,000 acres more.

When all the creative forces represented by the mighty streams of the southeast which drain into the Gulf of Mexico and the Pacific ocean below the State of Guerrero begin to spend their blessings upon near villages, distant towns and cities; that fertile region will become an amazing center of agricultural prosperity; the very bread basket of Mexico capable of providing food for all its people, and what is of the utmost importance, of absorbing a great deal of the central plateau population now migrating to earn a living beyond our northern frontier. This pathetic exodus has lately snowballed to alarming proportions, and our own crops, principally cotton, early vegetables, and fruits that find a ready market in the United States, paradoxically suffer for lack of farm hands.

The most immediate relief to this anarchic condition shall be in part of the southeast, especially in the States of Veracruz and Oaxaca, the completion of the Papaloapan irrigation project, a really ambitious undertaking that besides permitting the utilization of extensive tracts of excellent tropical soils will supply electrical energy to textile plants and other industries in States as close to the Federal District as Puebla and Tlaxcala now urgently needing additional electric power.

Turning back to the northwest which in some parts is nothing but barren wilderness subject to the onslaught of summer's hot breath that has gradually desiccated it during years of prolonged drought, there are great expanses of good tillable land, sufficient hydraulic resources, and a favorable climate that will make possible the cultivation of a large assortment of crops; its topographic conditions are adapted to the development of hydroelectric installations on the high part of the watersheds. But the main problem is the absence of transversal communications coupled to the deficience of the longitudinal ones in existence as well as those along the seaboard where ports are now being improved.

Another drawback that is hanging heavy upon Mexico's eager desire of a general advancement, social, cultural, and economic, is the uneven distribution of its people over the country that has subsisted since the time of the Aztecas. The central plateau is densely populated, and the major part of the farm lands available have been subdivided from days of old into small lots which, together with adverse climatological conditions and scarcity of hydraulic resources, to say nothing of the one-crop system of cultivation, make yields very low, insufficient oftentimes but for a poor human existence.

There are, of course, many other problems that have to be taken care of, but irrigation is the material instrument that can insure a flourishing agriculture to make Mexico a self-supplied country notwithstanding the relatively small area (12 per cent of the whole terri-

(Continued on page 55)

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Pointers on . . . .

HOW TO BE AN EMPLOYEE

By PETER F. DRUCKER

Most of you graduating today will be employees all your working life, working for somebody else and for a pay check.

A hundred years or so ago only one out of every five Americans at work was employed, i.e., worked for somebody else. Today only one out of five is not employed but working for himself. And where fifty years ago "being employed" meant working as a factory laborer or as a farmhand, the employee of today is increasingly a middle-class person with a substantial formal education, holding a professional or management job requiring intellectual and technical skills. Indeed, two things have characterized American society during these last fifty years: the middle and upper classes have become employees; and middle-class and upper-class employees have been the fastest-growing groups in our working population—growing so fast that the industrial worker, that oldest child of the Industrial Revolution, has been losing in numerical importance despite the expansion of industrial production.

This is one of the most profound social changes any country has ever undergone. It is, however, a perhaps even greater change for the individual young man about to start. Whatever he does, in all likelihood he will do it as an employee; wherever he aims, he will have to try to reach it through being an employee.

Yet you will find little if anything written on what it is to be an employee. Increasingly, especially in the large business or in government, employeeship is more important to success than the special professional knowledge of skill. Certainly more people fail because they do not know the requirements of being an employee than because they do not adequately possess the skills of their trade.

The basic skill

The first question we might ask is: what can you learn in college that will help you in being an employee? *This one basic skill is the ability to organize and express ideas in writing and in speaking.*

As an employee you work with and through other people. This means that your success as an employee —and I am talking of much more here than getting promoted—will depend on your ability to communicate with people and to present your own thoughts and ideas to them so they will both understand what you are driving at and be persuaded. The letter, the report or memorandum, the ten-minute spoken "presentation" to a committee are basic tools of the employee.

As soon as you move one step up from the bottom, your effectiveness depends on your ability to reach others through the spoken or the written word. In the very large organization, whether it is the government, the large business corporation, or the Army, this ability to express oneself is perhaps the most important of all the skills a man can possess. Of course, skill in expression is not enough by itself. You must have something to say in the first place.

Expressing one's thoughts is one skill that the school can really teach, especially to people born without natural writing or speaking talent. Many other skills can be learned later. But the foundations for skill in expression have to be laid early: an interest in and an ear for language; experience in organizing ideas and data, in brushing aside the irrelevant, in wedding outward form and inner content into one structure; and above all, the habit of verbal expression. *If you do not lay these foundations during your school years, you may never have an opportunity again.*

If you were to ask me what strictly vocational courses there are in the typical college curriculum, my answer—now that the good old habit of the "theme a day" has virtually disappeared—would be: the writing of poetry and the writing of short stories. Not that I expect many of you to become poets or short-story writers—far from it. But these two courses offer the easiest way to obtain some skill in expression. They force one to be economical with langage. They force one to organize thought. They demand of one that he give meaning to every word. Above all they force one to write.

I know very well that the typical employer does not understand this as yet, and that he may look with suspicion on a young college graduate who has majored, let us say, in short-story writing. But the same employer will complain—and with good reason—that the young men whom he hires when they get out of college *do not know how to write a simple report, do not know how to tell a simple story, and are in fact virtually illiterate.* And he will conclude—rightly—that the young men are not really effective, and certainly not employees who are likely to go very far.

The next question to ask is: what kind of employee should you be? Pay no attention to what other people tell you. This is one question only you can answer. It involves a choice in four areas—a choice you alone can make, and one you cannot easily duck. But to make the choice you must first have tested yourself in the world of jobs for some time.

Here are four decisions—first in brief outline, then in more detail:

1) Do you belong in a job calling primarily for faithfulness in the performance of routine work and promising security? Or do you belong in a job that offers a challenge to imagination and ingenuity—with the attendant penalty for failure?

2) Do you belong in a large organization or in a small organization? Do you work better through channels or through direct contact? Do you enjoy more being a small cog in a big machine or a big wheel in a small machine?

3) Should you start at the bottom and try to work your way up, or should you try to start near the top? On the lowest rung of the promotional ladder, with its solid and safe footing but also with a very long climb ahead? Or on the aerial trapeze of "a management trainee," or some other staff position close to management?

4) Finally, are you going to be more effective and happy as a specialist or as a "generalist," that is, in an administrative job?

Let me spell out what each of these four decisions involves:

1: Is "security" for you?

The decision between secure routine work and insecure work challenging the imagination and ingenuity is the one decision most people find easiest to make.

The difference is one of basic personality. It is not too much affected by a man's experiences; he is likely to be born with the one or the other. The need for economic security is often as not an outgrowth of a need for psychological security rather than a phenomenon of its own. But precisely because the difference is one of basic temperament, the analysis of what kind of temperament you possess is so vital. A man might be happy in work for which he has little *aptitude;* he might be quite successful in it. But he can be neither happy nor successful in a job for which he is *temperamentally* unfitted.

Jobs in which there is greater emphasis on conscientious performance or well-organized duties rather than on imagination—especially for the beginner—are to be found, for instance, in the inside jobs in banking or insurance, which normally offer great job security but not rapid promotion or large pay. The same is true of most government work, of the railroad industry, particularly in the clerical and engineering branches, and of most public utilities.

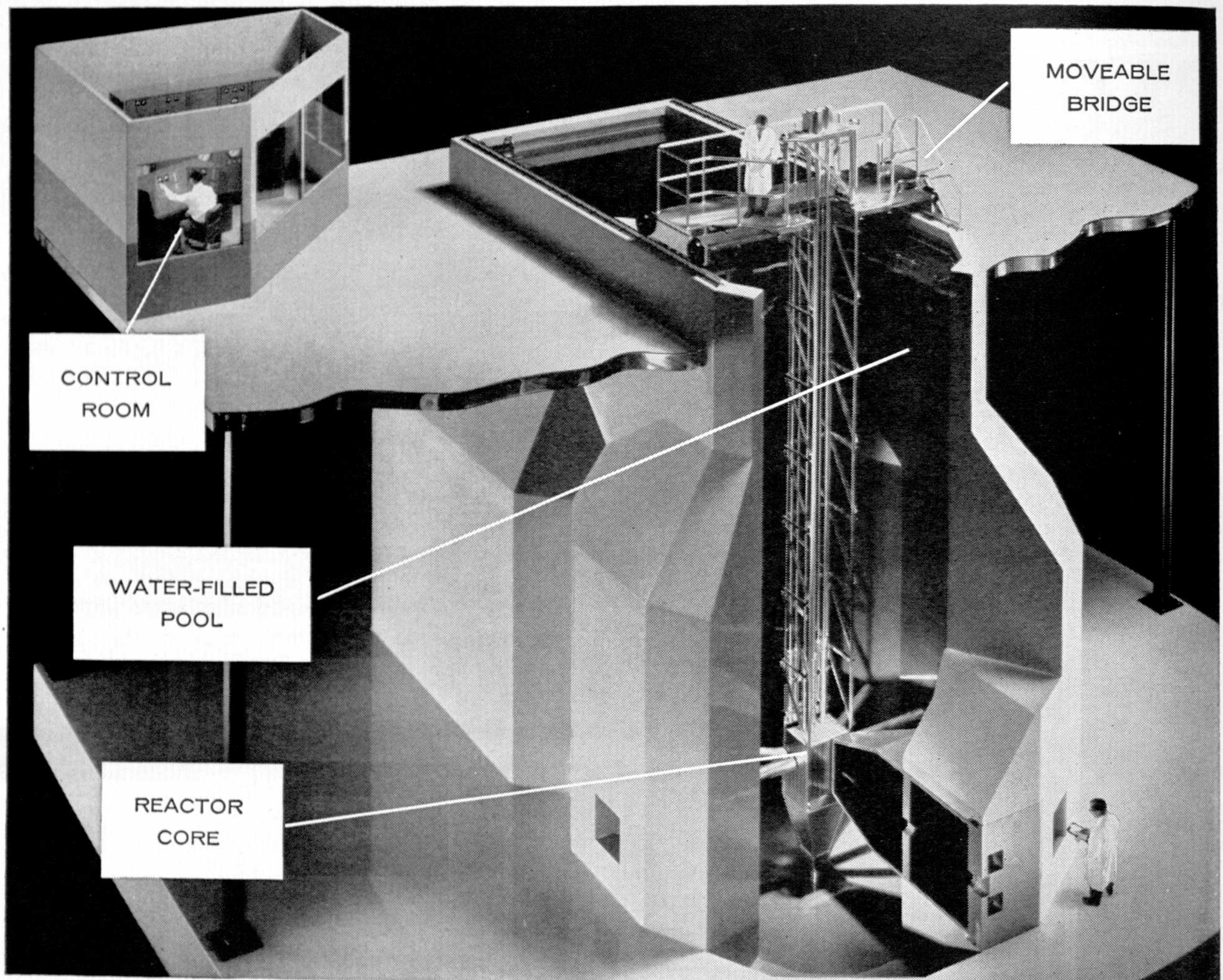
At the other extreme are such areas as buying, selling, and advertising, in which the emphasis is on adaptability, imagination, and a desire to do new and different things. In those areas, by and large, there is little security, either personal or economic. Rewards, however, are high and come more rapidly. Major premium on imagination—though of a different kind and coupled with persistence with details—prevails in most research and engineering work. Jobs in production, as supervisor or executive, also demand adaptability and imagination.

Contrary to popular belief, very small business requires, above all, close attention to daily routine. But in very small business there is also room for quite a few people of the other personality type—the innovator or imaginer. If successful, a man of this type soon ceases to be in a very small business. For the real innovator there is, still, no more promising opportunity in this country than that of building a large out of a very small business.

2: Big Company or small?

Almost as important is the decision between working for a large and for a small organization. The difference is perhaps not so great as that between the secure, routine job and the insecure, imaginative job; but the wrong decision can be equally serious.

There are two basic differences between the large and the small enterprise. In the small enterprise you operate primarily through personal contacts. In the large enterprise you have established *"policies,"* "channels" of organization, and fairly rigid procedures.



Cutaway of Bendix nuclear research type reactor model displayed at Atoms For Peace Conference, Geneva, Switzerland.

One of Today's Great Engineering Firms Builds for Tomorrow!

The atom has been split and the bomb has been built, but where we go from here depends largely on the strange structure in the photo and others like it. It is a nuclear *research type* reactor. Right now scientists have literally thousands of ideas for putting the atom to work in medicine, biology, chemistry, metallurgy. But they need this reactor to hatch the eggs—are handcuffed without it.

If this nation is to keep pace with the progress of other countries throughout the world, reactors must be built in ever-increasing numbers by those companies whose achievements qualify them for this vital work.

Bendix experience on nuclear projects qualifies it as a top source for research reactors. For eight years our Kansas City Division has been operated exclusively for the Atomic Energy Commission; for five years our Research Laboratories Division in Detroit has worked on design of research reactors, reactor power plants, control components, reactor simulation equipment and nuclear power plants.

For this work Bendix needs men, lots of them . . . talented young engineers with ambition and curiosity. These are the kind of men who, for so many years, have kept Bendix in the forefront as a supplier of a thousand different products to almost every type of industry in existence. For Bendix is in many businesses besides nucleonics. Whatever your field, whatever your geographic preference, it's likely that Bendix has the job you're seeking in one of its twenty-six divisions from coast to coast. See your placement director or send for the brochure "Bendix and Your Future" for a detailed look at Bendix activities.

EMPLOYEE

(Continued from page 19)

In the small enterprise you have, moreover, immediate effectiveness in a very small area. You can see the effect of your work and of your decisions right away, once you are a little bit above the ground floor. In the large enterprise even the man at the top is only a cog in a big machine. In a small and even in a middle-sized business you are normally exposed to all kinds of experience, and expected to do *a great many things without too much help or guidance.* In the large organization you are normally *taught* one thing thoroughly. In the small one the danger is of becoming a jack-of-all trades and master of none. In the large one it is of becoming the man who knows more and more about less and less.

There is one other important thing to consider: do you derive a deep sense of satisfaction from being a member of a well-known organization—or is it more important to you to be a well-known and important figure within your own small pond? There is a basic difference between the satisfaction that comes from being a member of a large, powerful, and generally known organization, and the one that comes from being a member of a family.

3: Start at the bottom, or . . . ?

You may well think it absurd to say that anyone has a choice between beginning at the bottom and beginning near the top. And indeed I do not mean that you have any choice between beginner's jobs and, let us say, a vice presidency of General Electric. But you do have a choice between a position at the bottom of the hierarchy and a staff position that is outside the hierarchy but in view of the top. It is an important choice.

In every organization, even the smallest, there are positions that, while subordinate, modestly paid, and usually filled with young and beginning employees, nonetheless are not at the bottom. There are positions as assistant to one of the bosses; there are liaison positions for various departments; and there are positions in staff capacities, in industrial engineering, in cost accounting, in personnel, etc. Every one of these gives a view of the whole rather than of only one small area. Every one of them normally brings the holder into the deliberations and discussions of the people at the top, if only as a silent audience.

On the other hand the great majority of beginner's jobs are at the bottom, where you begin in a department or in a line of work in the lowest-paid and simplest function, and where you are expected to work your way up as you acquire more skill and more judgment.

Different people belong in these two kinds of jobs.

In the first place, the job *"near the top" is insecure.* You are exposed to public view. Your position is ambiguous; by yourself you are a nobody—but you reflect the boss's status; in a relatively short time you may even speak for the boss. In today's business and government organization the hand that writes the memo rules the committee; and the young staff man usually writes the memos, or at least the first draft. But for that very reason everybody is jealous of you. You are a youngster who has been admitted to the company of his betters, and is therefore expected to *show unusual ability and above all unusual discretion and judgment.* Good performance in such a position is often the key to rapid advancement. But to fall down may mean the end of all hopes of ever getting anywhere within the organization.

At the bottom, on the other hand, there are very few opportunities for making serious mistakes. You are amply protected by the whole apparatus of authority. The job itself is normally simple, requiring little judgment, discretion, or initiative. Even excellent performance in such a job is unlikely to speed promotion. But one also has to fall down in a rather spectacular fashion for it to be noticed by anyone but one's immediate superior.

4: Specialist or "generalist"?

There are a great many careers in which the increasing emphasis is on specialization. You find these careers in engineering, in production, in statistical work, and in teaching. *But there is an increasing demand for people who are able to take in a great area at a glance,* people who perhaps do not know much about any one field—*though one should always have one area of real competence.* These "generalists" are particularly needed for administrative postions, where it is their job to see that other people do the work, where they have to plan for other people, organize their work, initiate it and appraise it.

He is an "educated" man; and the humanities are his strongest foundation. Very rarely is a specialist capable of being an administrator. And very rarely is a good generalist also a good specialist in a particular field. Any organization needs both kinds of people, though different organizations need them in different ratios. It is your job to find out, during your apprenticeship, into which of those two job categories you fit, and to plan your career accordingly.

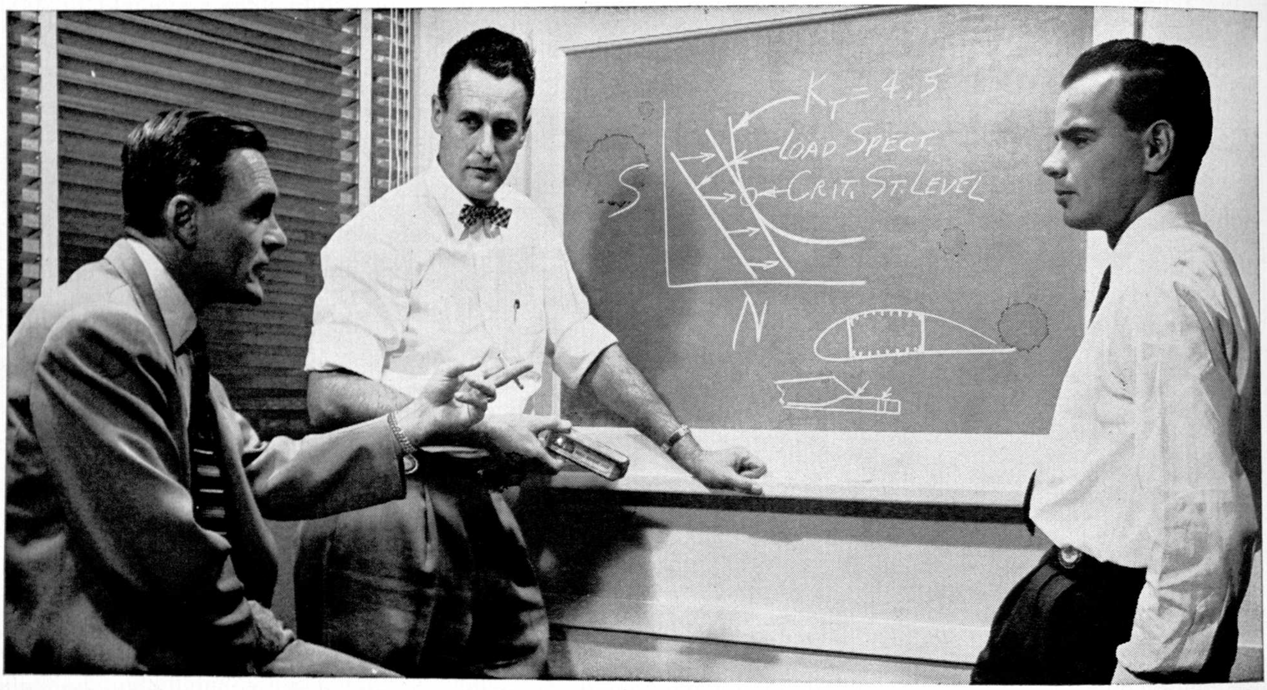
The importance of being fired

Nobody has ever lived, I daresay, *who has not gone through a period when everything seemed to have collapsed and when years of work and life seemed to have gone up in smoke.* No one can be spared this experience; but one can be prepared for it. The man who has been through earlier setbacks has learned that the world has not come to an end because he lost his job—not even in a depression. He has learned, above all, that the way to behave in such a setback is not to collapse himself.

Obviously you cannot contrive to get yourself fired. But you can always quit. And it is perhaps even more important to have quit once than to have been fired once. The man who walks out on his own volition acquires an inner independence that he will never quite lose.

To know when to quit is therefore one of the most important things—particularly for the beginner. For

(Continued on page 59)



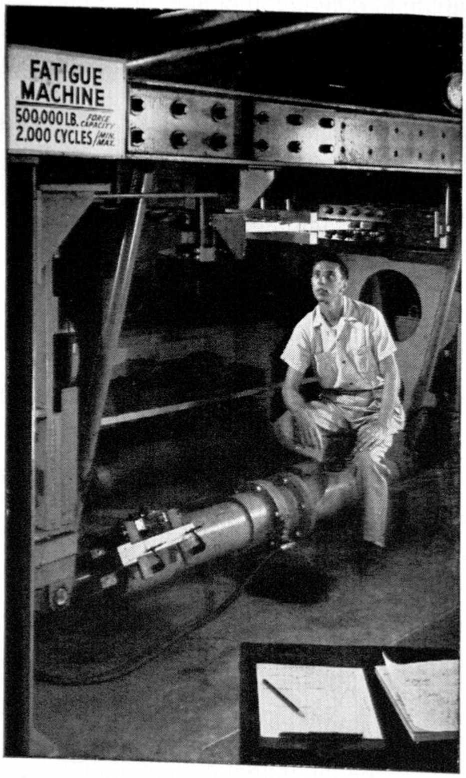
J. F. McBrearty, chief structures engineer (left) discusses fatigue test program of integrally-stiffened wing lower surface structure of a new transport with E. H. Spaulding, structures division engineer and J. G. Leewolt, stress engineer. Lockheed's 500,000 lb. Force Fatigue Machine was used in test program.

Advanced structures facilities speed careers of Lockheed Engineers

Engineers in Lockheed's Structures Division are supported by unmatched research and testing facilities in their constant effort to increase strength while decreasing weight.

Among those facilities are the Lockheed-designed 500,000 Lb. Force Fatigue Machine, first of its size; Shimmy Tower, only one in private industry; and Drop Test Tower, largest in the nation.

Facilities such as these give engineers a major advantage in making technical advances – and thus advancing their careers. Moreover, the large number of projects always in motion at Lockheed mean continuing opportunity for promotion as well as job security.



Ralph Oliva, research engineer, examines Super Constellation skin for signs of fatigue failure.

Why Lockheed needs Engineers with Structures training:

1. "Fail-Safe" Structures – Lockheed has begun an extensive pioneering effort in the new concept of "fail-safe" structures. Studies are being applied to virtually all phases of Lockheed's diversified development program – already the largest in the company's history.

2. New studies in: Effect of high temperatures on structures; optimization of thin-wing designs and other aero-elastic problems; new materials such as ultra-high heat treat steel; panel instability at extremely high speeds.

You are invited to contact your Placement Officer for a brochure describing life and work at Lockheed in the San Fernando Valley.

Lockheed

AIRCRAFT CORPORATION

BURBANK, **California**

Strange Genius

Reprinted from POWER May 1955

Ask any group of power men to name those who laid the foundation for today's electrical generation and distribution. You'll wind up with an impressive list—Edison, Brush, Thompson, Westinghouse, many others. But there is almost sure to be a significant omission.

Yet this forgotten man conceived the polyphase ac motor—still basic—and devised a suitable system of generation and distribution for applying it. To grasp the magnitude of this contribution, we must turn back to the 1880's when the electrical era was being born, and the "battle of the systems" held sway.

Arc lights and motors were being operated on constant current series systems. Edison's Pearl Street generating station had opened in 1882, supplying incandescent lamps and later, dc motors on a constant-potential system. Under the leadership of Westinghouse and Stanley, the advantages of ac distribution were demonstrated. But there was no successful ac motor.

In May, 1888, a young Yugo-Slav engineer, but four years in the United States, read a paper before the American Institute of Electrical Engineers. In it he described a new ac system. Its heart was the induction motor with its basic and beautiful concept of the rotating magnetic field. The man was Nikola Tesla, the system he described was destined to sweep the field.

With characteristic vision, George Westinghouse realized the fundamental importance of the polyphase ac system and acquired the basic patents. Its first impact on the general public was at the Chicago World's Fair of 1893. There a 2-phase generator supplied motors and lamps, and, through rotary converters and motor-generators, a variety of dc equipment.

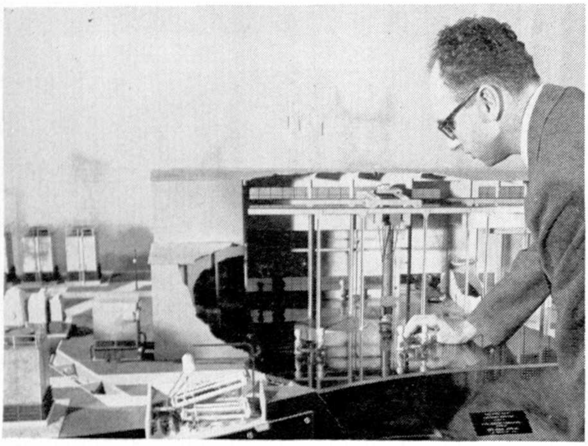
But it remained for the Niagara Falls power project to demonstrate in the most dramatic way possible that polyphase ac was the system of the future. Since 1886 when a charter to develop its power had been granted, the eyes of the world had been on Niagara. An international commission, headed by Lord Kelvin, had reviewed 17 proposals, found none acceptable. Later, just five years after Tesla's AIEE paper, it was officially decided to use the polyphase system.

In August, 1895, Niagara power was delivered to the first industrial customer and in 1896 ac transmission to Buffalo, 22 miles away, was begun. By that time, the steam turbine had been introduced in America and the modern age of electric power had truly opened.

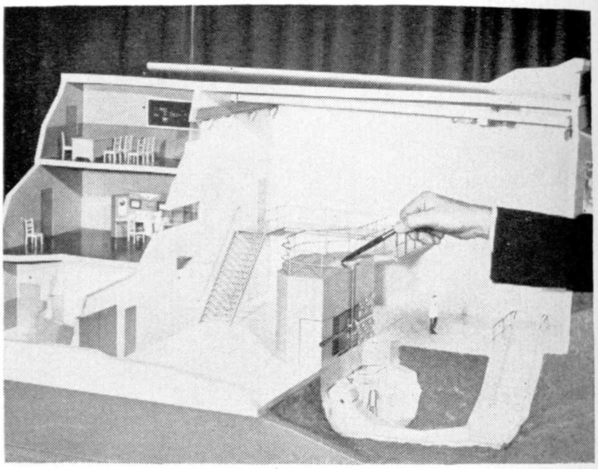
For Nikola Tesla, these far-reaching inventions were but a beginning. Still to come was brilliant work in high frequencies, thinking basic to much of today's radio art. Yet by the time of his death in 1943, both he and his work had begun to slip into obscurity. Why?

A man of flashing insights and enormous brilliance, Tesla was largely indifferent to the development of his ideas. This he left to others while he followed the lure of new challenges. In later years, his projects became more grandoise, his ways more mysterious, his pronouncements more Olympian. And working alone, as he did, he formed none of the institutional ties that help to perpetuate a record of accomplishment.

Next year—July 10, 1956—will be the 100th anniversary of Nikola Tesla's birth. It would be fitting for our engineering societies to commemorate this occasion, to acknowledge our debt to this strange and lonely genius who changed our world for the better.



Model of sodium graphite power reactor illustrating how electricity can be produced from atomic energy. The power reactor model represents an installation designed to produce 75,000 kilowatts of electricity, and is being considered by the Consumers Public Power District of Nebraska in their proposal under review by the Atomic Energy Commission.



Model of the first nuclear reactor for private industrial research which is being built. The 50,000 watt reactor, illustrated by the scale model, will be used for nuclear research in the fields of chemistry, textiles, petroleum, and food and drug sterilization.

USE OF THE ATOM

(Continued from page 11)

We can now see that the peaceful use of atomic energy has already come a long way since that fateful day in 1945 when a flash in the western sky changed the face of the globe.

Another major product of the atomic energy industry is the production of radioactive isotopes. Radioactive isotopes are made by placing chemical elements such as cobalt, iron, or calcium inside atomic reactors where rapidly moving neutrons convert them to radioactive forms of the same or another element.

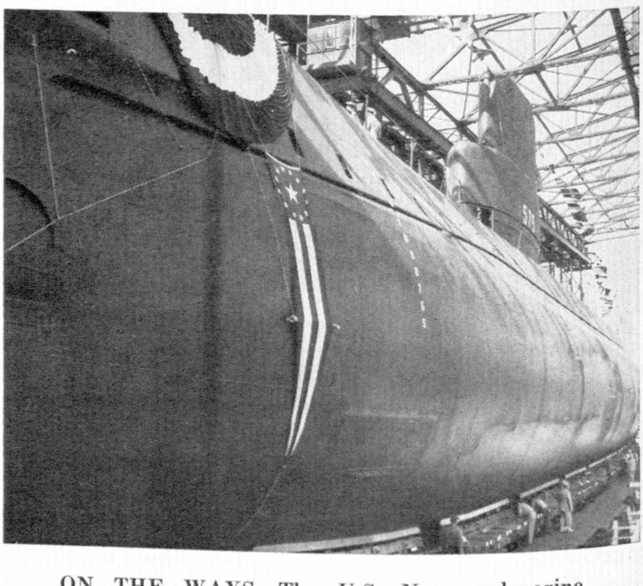
Oak Ridge National Laboratory is the sole supplier of processed radioisotopes and is the point of sale or authority for sale for all of the AEC's radioactive isotopes. O. R. N. C. purifies packages and stores isotopes produced at its own site and at all other reactor sites in the U. S. From Oak Ridge they are shipped to customers in all parts of the United States and are available to 53 foreign countries for use in industry, medicine, and research.

The various isotopes produced in the country are used by industry for control, labeling and inspection.

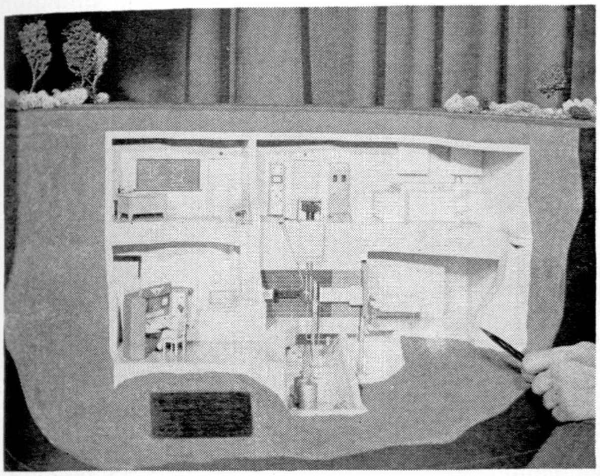
One "control" use is for thickness gauges in manufacturing processes where materials such as steel, paper, or plastic are produced in continuous sheet form. A capsule of radioactive material and a detection instrument are placed on opposite sides of the moving sheet. The thicker the sheets, the less radiation comes through, so if the intensity of radiation changes, the thickness is changing. The detection instrument can be connected with electrical equipment so that if the intensity changes, the setting of rollers or other equipment will be automatically changed to correct the thickness of the sheet.

A typical "labeling" use for radioactive isotopes is in marketing fluids in a pipeline. Standard Oil Company's petroleum pipeline between Salt Lake City, Utah, and Pasco, Washington, was among the first to employ this idea. The pipeline carries a number of different petroleum products one after another. At the Utah end of the line, workers add a small amount of a compound containing a radioactive isotope when they change the type of petroleum product flowing into the line. The radioactive material moves along at the interface of the two liquids. A radiation detection instrument at the Pasco terminal signals the arrival of the isotope and the operators can quickly switch the flow from one storage tank to another.

In the field of inspection, radioactive isotopes are replacing X-ray machines for some types of jobs. A radioactive element like cobalt-60 can be placed on one side of a metal casting, for example, and a sheet of photographic film on the other. The gamma rays (which are high-energy X-rays) from the cobalt penetrate the metal and make an X-ray-type picture, revealing any flaws that might exist.



ON THE WAYS—The U.S. Navy submarine "Seawolf" here is about to slide down the ways. Its power plant is a liquid sodium cooled reactor.



Nuclear reactor model describing machine being built for the University of California at Los Angeles Medical Center for cancer studies and other medical research. Part of the Atomics International display at the National Rural Electric Cooperative Association meeting and exhibit in St. Louis, January 23 to 26.

Radioactive isotopes are valuable in research because the radiation their atoms give off can be detected with instruments. The radioactive isotopes of an element behaves the same chemically as an ordinary, non-radioactive isotope of the same element, and it can be subjected to heat or pressure of any other physical or chemical condition without the slightest change in its degree or type of radioactivity.

The ease with which radioisotopes can be detected, and therefore traced through a series of chemical reactions, is highly important to researchers in petroleum, chemical processing, metallurgy, medicine, and biology. Previously, scientists knew what went into a reaction and what came out. From radioactive isotopes, they now have a tool to follow these processes step-by-step. Biological reactions like blood formation, digestion, and photosynthesis, and complex processes such as the production of gasoline from coal can now be understood more precisely.

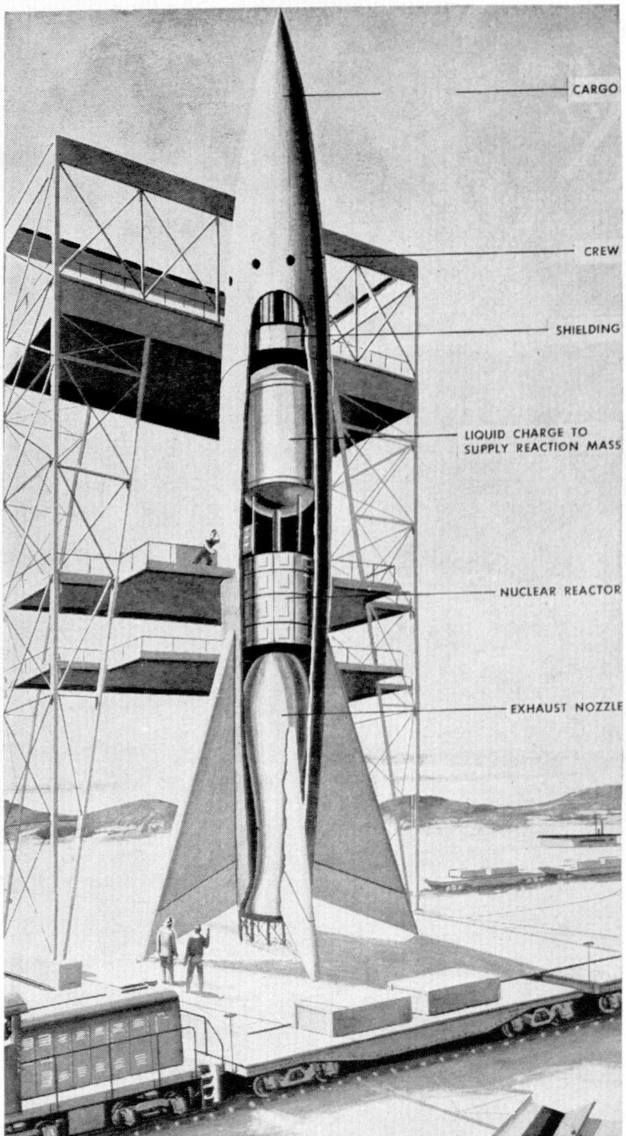
One highly important medical use of radioactive isotopes is for the treatment of some types of cancer. An element that emits gamma rays (cobalt-60 is the most-used one now) is placed in an easily-manipulated "head." By rotating the "head" around the patient, keeping the beam of radiation aimed constantly at the tumorous tissue inside the body, the radiation dose can be concentrated on a deep-seated cancer, without destruction of surrounding healthy tissues.

Radioactive materials also may be inserted in tissues to provide localized irradiation. Another method of administering them is the "atomic cocktail." The patient drinks a solution containing radio-iodine which concentrates in the thyroid gland. The condition of the gland may be diagnosed through the use of instruments which detect the radiation emitted by the radio-iodine in the thyroid tissue by the radiation.

The use of radioactive isotopes is still in its infancy, yet hundreds of industrial firms, hospitals, and research centers are using them already on a routine basis. A number of research organizations, some of them under AEC contracts, are finding new uses for the versatile tools manufactured as a by-product of the atomic energy business.

Although still in its infancy, the peaceful use of atomic energy has already shown its effect on the lives of engineers in every field. As the engineer devises more and more uses for the energy of the atom, his problems, such as the disposal of atomic wastes multiply at an increasing rate.

The progress we make will be directly related to the ability with which we, as engineers, meet these problems.



Here is how components of an atomic-powered passenger-carrying interplanetary rocket might be arranged if such a rocket were constructed, according to a nuclear physicist.

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NEW DEVELOPMENTS

Edited by John Boyd

Billionth-of-a-Second 'Stop Watch'

"Split-second" timing has been given a new degree of meaning by scientists. They have developed the world's fastest "stop watch"—an electronic tube which can time atomic "events" down to less than one billionth of a second.

Actually, the exact top speed of the new "stop watch" must await the development of better laboratory techniques to measure it experimentally. But the tube has been timed down to the billionth of a second figure, and calculations show it is probably 10 times faster than this.

Light, the fastest thing in the universe, travels at a rate which can carry it more than seven times around the earth in a single second. But during the shortest interval scientists expect to measure by their electronic "stop watch," light can travel no more than a few inches.

A photomultiplier tube strengthens weak pulses of radiation and detects the time intervals between them. An important application of the new tube will be for fundamental research in nuclear physics, where it will be used to time with great exactness the flight of speeding atomic particles. Now it will be possible to measure, with a new order of precision, the speed, and therefore, the energy of atomic particles as they "smash" into atoms and produce nuclear reactions, or as they are ejected from the atom during such reactions. This precision should provide a new insight into the causes and effects of nuclear reactions, and perhaps, into the structure of the atomic nucleus itself.

Electronic Light Amplifier

Successful electronic amplification of light in an image of television quality has been achieved with a developmental light amplifier.

In tests the developmental light amplifier has multiplied by twenty times the brightness of an extremely dim image projected against it, producing a bright and clearly defined monochrome picture. This increase in brightness is sufficient for practical use in brightening dim images in such applications as X-ray fluoroscopy and radar, and further development is expected to achieve a substantially greater amplification, as well as the ultimate ability to produce images in more than one color.

The light amplifier operates, in effect, by receiving light from the projected image on the photoconductive layer and recreating the image in far brighter form as light emitted by the electroluminescent layer.

This process is made possible by the fact that the photoconductive material will permit current to flow when it is subjected to light, while the electroluminescent material emits its own light when an electric current flows through it.

Impact Guillotine for Testing Shock Resistance

To a metallurgist, the Charpy Notch Impact test is as familiar as the chemical symbols Fe, C, and O. Although long used as a method for determining the transition point between ductile and brittle zones of metals, the method has some major disadvantages. For example, sample preparation takes considerable time and a V-shaped notch must be accurately machined 79 mils deep into one side of the small sample. A pendulum-type apparatus breaks the sample by swinging a weight against it. Final data is in the form of a graph with impact energy for rupture plotted against the temperature of the sample. Even after elaborate preparations and careful technique, the exact temperature of the transition is not clearly defined.

A new method now being used by materials engineers uses an impact guillotine and a much larger sample, 14 inches long by 3½ inches wide, by 1 inch thick. Instead of the notch, a weld bead is put on the bottom side of the sample and an artificial crack put into this weld by means of an abrasive cutting wheel. A standard weight is dropped on samples at various temperatures and the transition temperature readily bracketed within a narrow range. For example, if trials at minus 20 degrees F. show breakage each time, and trials at plus 20 degrees F. produce no breakage, the transition point is clearly defined within useful limits.

Results are reproducible by the guillotine method and sample preparation has been cut to one-third that of the Charpy method. Another laboratory step that's making the metallurgist's job a little easier.

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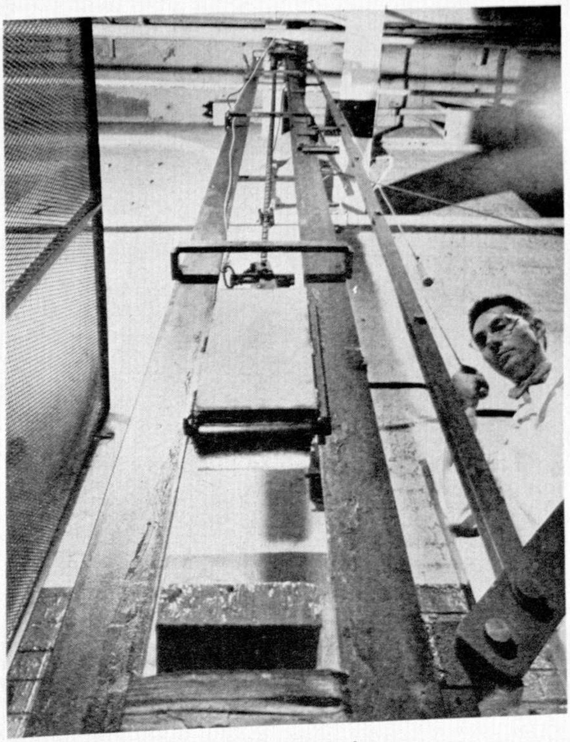
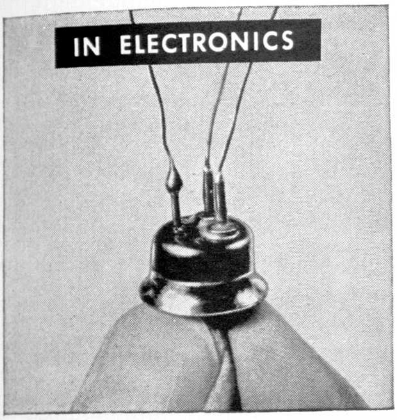


Impact Guillotine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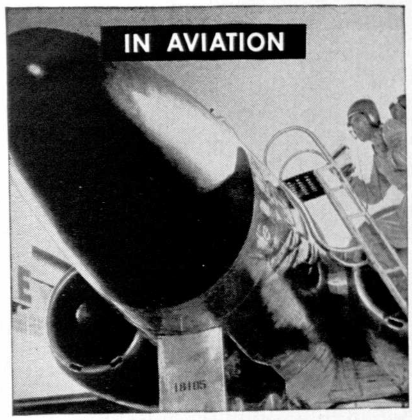
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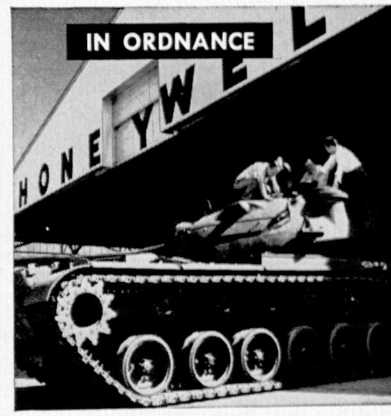
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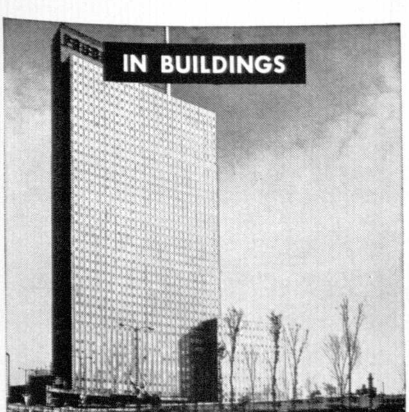
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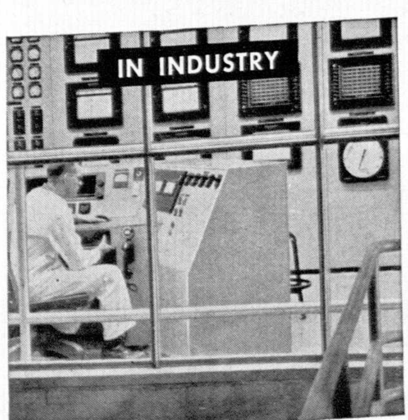
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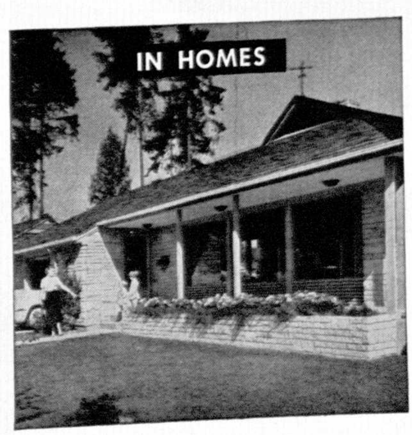
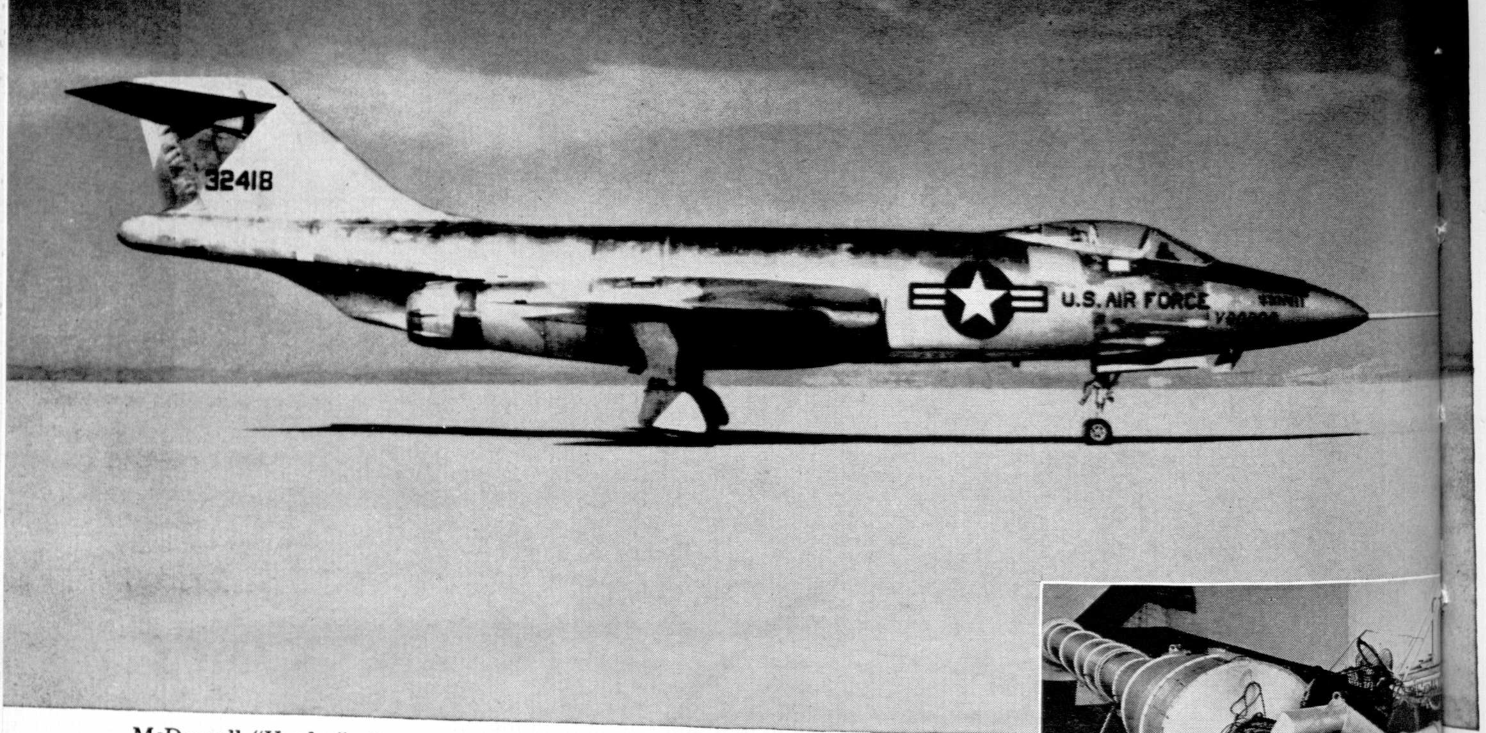

IN HOMES

it takes many engineering skills to create the top aircraft engines



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

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

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

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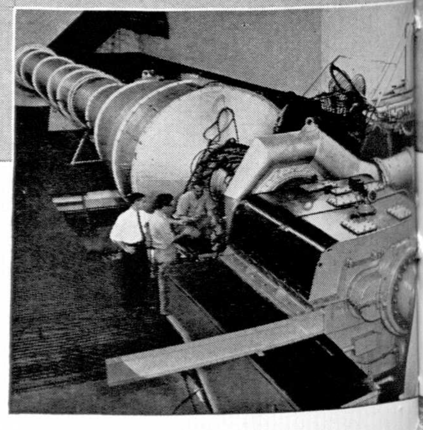
F-102	B-52
F4D	KC-135

COMMERCIAL

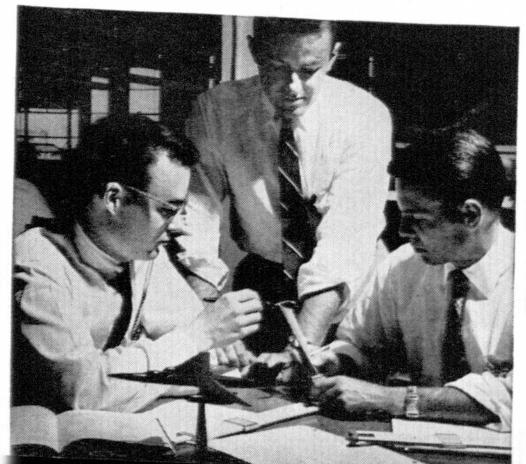
Boeing 707

Douglas DC-8

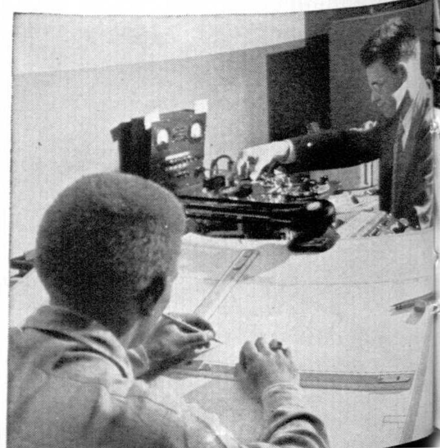


MECHANICAL ENGINEERS are concerned with many phases including experimental testing and development, mechanical design, stress and vibration analysis, combustion research, heat transfer and nuclear reactor development.

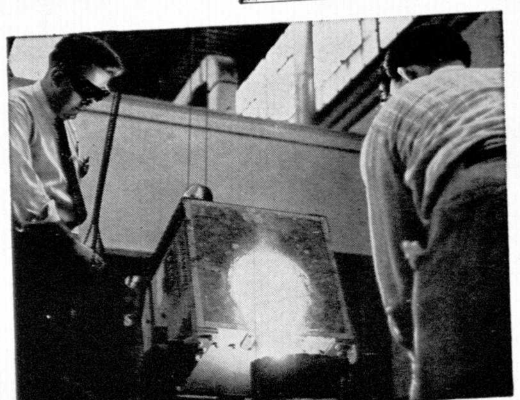
AERONAUTICAL ENGINEERS work on innumerable internal and external airflow problems concerned with design, development and testing of aircraft powerplants. Some who specialize in analytical engineering forecast engine-airplane combinations a decade in advance of design.



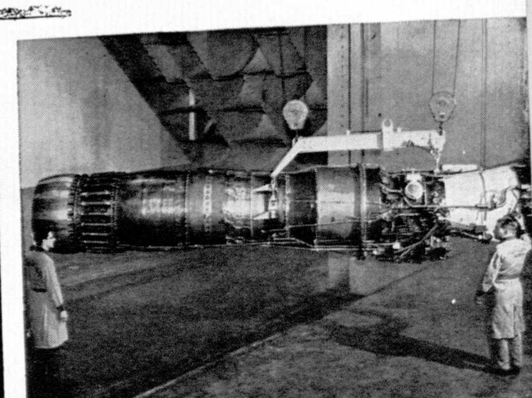
ELECTRICAL ENGINEERS directly contribute their specialized skills to the analysis and development of controls, systems and special instrumentation. An example is the "Plottomat" which automatically integrates and plots pressures, temperatures and air angles in performance testing.



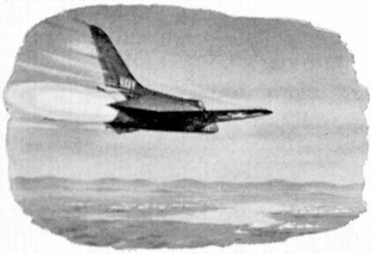
CHEMICAL ENGINEERS, too, play an important role. They investigate the chemical aspects of heat-producing and heat-transferring materials. This includes the determination of phase and equilibrium diagrams and extensive analytical studies.



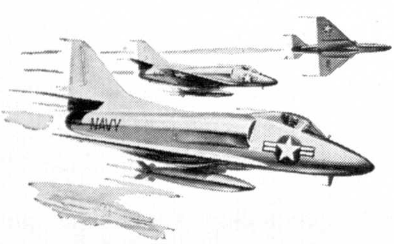
METALLURGISTS investigate and develop high temperature materials to provide greater strength at elevated temperatures and higher strength-weight ratios. Development of superior materials with greater corrosion resistance is of major importance, especially in nuclear reactors.



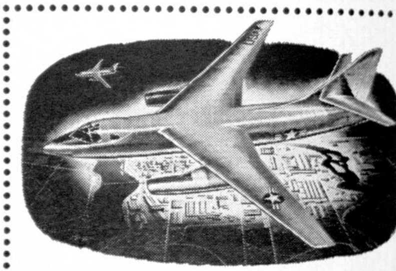
WORLD'S MOST POWERFUL production aircraft engine. This J-57 turbojet is in the 10,000-pound thrust class with considerably more power with afterburner.



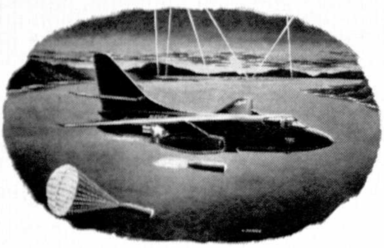
F4D, "SKYRAY"— only carrier plane to hold official world's speed record



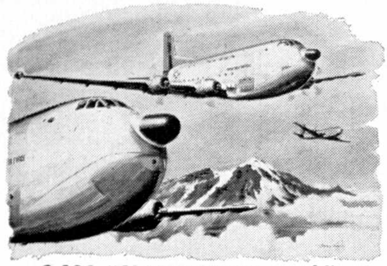
A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier



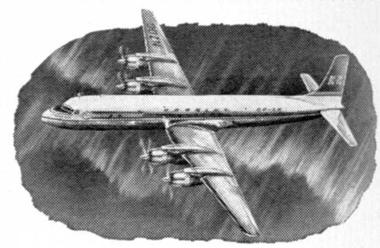
RB-66 — speedy, versatile jet bomber



A3D, "SKYWARRIOR"— largest carrier-based bomber

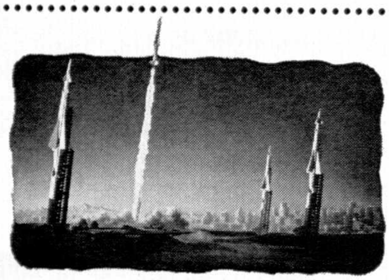


C-124, "GLOBEMASTER"— world's largest production transport

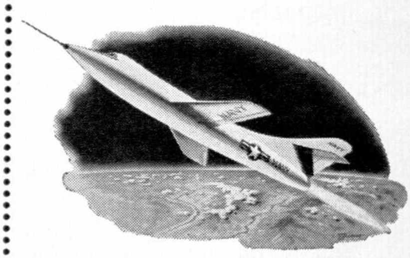


DC-7 "SEVEN SEAS"— America's finest, fastest airliner

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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"I'm a metallurgical engineer, Class of '51. I wanted to get into development work, so I started with Electro Metallurgical Company in their Metals Research Laboratories in Niagara Falls. Three years' research work in steels and titanium gave me the technical background I needed. Now I'm working on applications of titanium as a development engineer."

"I'm a mechanical engineer, Class of '49. I started in the Tonawanda, N. Y., laboratories of Linde Air Products Company. In a few months I was doing research in low-temperature rectification and heat transfer equipment. Now I'm a Section Engineer, responsible for a group of research and development engineers—a member of LINDE's management team."

"I'm a chemical engineer, Class of '50. I started with Bakelite Company, in their training program for production. Now I'm Assistant Department Head at the main plant in Bound Brook, N. J. The group I direct handles resin quality control and technical service. BAKELITE gave me the chance to rise to a significant position in management."

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OUR ENGINEERING ALUMNI

by AGNES McCANN

"Once in a hundred years" is a phrase often used, but seldom applied in reality. However, during the Centennial of MSU this past year, and for once in a hundred years, several of our Engineering alumni were honored at banquets and at the Engineering Symposium. The men thus honored were:

PORTER, DRURY L., '04

Retired Vice-President and Treasurer of Motor Wheel Corp. One of the three original incorporators of the Motor Wheel Corp. of Lansing in 1920 and an officer of the Corporation from that time until his retirement in July, 1952. Mr. Porter is active in civic affairs of Lansing.

WILBERT W. GASSER, '07

Chairman of the Board of Gary National Bank. Mr. Gasser has been very active in business and community affairs. He is Director of Chicago, South Shore and South Bend Railroad; Lake County Title Company; Gary Methodist Hospital; Gary Taxpayers Association; Gary-Hobart Water Corp.; Gary Chamber of Commerce; Gary Industrial Foundation. He is past president, Indiana Bankers Association and Chairman of Indiana U. S. Savings Bond Committee.

CURTISS, CHARLES D., '11

Mr. Curtiss began his career as an instructor at Michigan State College in Civil Engineering. He then became Superintendent of Continental Public Works Company in New York. His following positions included Bridge Inspector, Michigan State Highway Dept., Asst. Engineer with the Iowa Highway Commission, Asst. to Chief and Chief, Division of Control, Deputy Commission with the Bureau of Public Roads and was also with the U. S. Department of Commerce.

Mr. Curtiss is known not only for his great achievements in the field of Engineering, but also as the author of numerous contributions and recognized national authority on highway finance, administration, recruitment and training. The following awards have been given to him by various associations: Gold Medal Exceptional Service Award by U. S. Department of Commerce; American Society of Civil Engineers award for distinguished service as Secretary of the Highway Division; also in 1953, Mr. Curtiss was awarded the Alumni Award for Distinguished Service by Michigan State College.

Mr. Curtiss is a member of American Society of Civil Engineers; American Association of State Highway Officials; Highway Research Board; National Academy of Sciences; Cosmos Club, Washington; Michigan State University Alumni Award Committee for three years. U. S. Army.

VERNE LEE KETCHUM, '12

He is not only a Civil and Research Engineer but is also an author and lecturer. He served as Surveyor and Draftsman in U. S. Forest Service, was Draftsman, Inspector for Commission of Public Docks, Portland, Oregon. Engineer and Chief Draftsman for Blood and Williams, Consulting Structural Engineers. Appraisal Engineer, Pacific Power and Light Company. Designing Engineer, War Department. Consulting Engineer in private practice. Chief Engineer, Timber Structures, Inc., Portland, Oregon. Contributed extensively to professional magazines and books with articles on design and construction. An outstanding leader and authority, both technically and economically, in developing proper engineering uses of timber. Member, American Society of Civil Engineers; Engineering Institute of Canada; American Railway Engineering Association; Forest Products research Society; National Society of Professional Engineers; American Society for Testing Materials; Research Institute of America; American Institute of Timber Construction.

JAMES H. FOOTE, '14

President and Chief Engineer-in-Charge of Commonwealth Associates, Inc., Jackson, Michigan. He is a native of that city. A 1914 graduate in Civil Engineering at Michigan State College, he worked on surveying and hydro-electric projects upon leaving school. Appraisals of electricity supply systems and design and construction supervision of electric distribution and transmission lines and systems followed. Subsequent assignments included 17 years as Electrical Engineer-in-Charge of the Engineering department of Commonwealth Power Corporation and successor companies and then 12 years in charge of the Engineering of the northern division of the Commonwealth and Southern Corporation. Since 1949 he has been President of Commonwealth Associates.

For over 30 years he has been active in engineering, technical and educational society work, having served as a director and officer of numerous societies and committees thereof. These include: Edison Electric Institute, Association of Edison Illuminating Companies, American Society for Testing Materials, American Institute of Electrical Engineers, American Association for the Advancement of Science, American Standards Association, American Society for Engineering Education, Michigan Engineering Society, Michigan Society of Professional Engineers, and others. He recently completed a seven-year term as member and chairman of the State Board of Registration for Architects, Professional Engineers and Land Surveyors.

A son, James Harold, Jr., graduated from Mechanical Engineering at Michigan State in 1941, and is now Executive Vice-President of The Electric Manufacturing Company in Battle Creek.

P. EDUARD GELDHOF, '14

Inventor and Vice-President of Whirlpool Corp. Since 1937 Mr. Geldhof has been at the head of all development, and, with a very competent staff, has produced highly acceptable products, particularly the automatic washing machine which has met with phenomenal success. All of the fundamental patents taken out by this corporation have been issued in his name and these products are still being manufactured under these patents. He has practiced engineering constantly from the time of graduation from M.S.U. and has devoted all of his efforts toward creating and designing domestic and commercial laundry equipment. Mr. Geldhof was given membership in Tau Beta Pi in October, 1955, in recognition of his accomplishments.

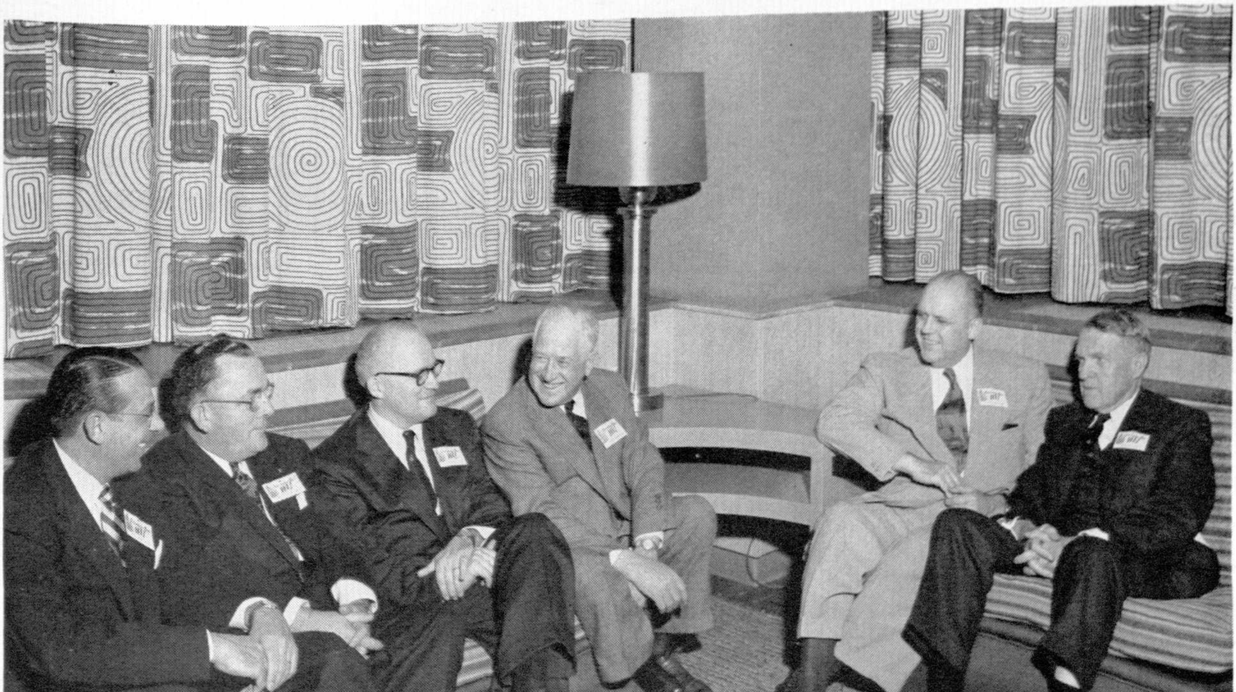
GEFFELS, RAYMOND F., '15

The firm of Geffels and Vallet are nationally known for their outstanding work in the field of Architecture. We, in Engineering, are very proud that they are the Architects for our new Mechanical Engineering Building which will also house Applied Mechanics and the Administration Offices and for which we hope to have Legislative approval soon. Mr. Geffels is Secretary-Treasurer of the firm.

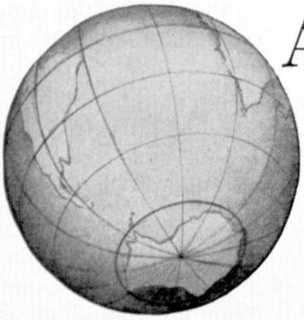
HARTT, SAMUEL J., '15

Jay Samuel Hartt received his B.S. degree in Electrical Engineering in 1915. After graduation, Mr. Hartt began his career by becoming Resident Engineer and Asst. Superintendent of LaCrosse, Wisconsin, gas plant, American Public Utilities Company until 1917 when he served in World War I in charge of inspection of construction materials, QM Corps, U. S. Army. After serving in the U. S. Army, Mr. Hartt worked with Byron T. Gifford (later partner) as an Engineer until 1924. In 1920, Mr. Hartt was put in charge of the Madison, Wis., office. Since 1924, Mr. Hartt has been rendering service to utilities and municipal organizations as a construction engineer. The classes of service include: corporate and voluntary reorganizations; reinstatement of capital; public utility, common carrier and industrial valuations; natural gas studies; public utility financing; certifs. to indenture trustees; reports for purchase or sale; market analysis; public utility rate cases; utility operating surveys; depreciation studies; water power studies; diesel engine reports; public utility construction.

Mr. Hartt is Chairman of Executive Comm., Middle West Service Co., Chicago South Shore and South Bend R.R. He is Director of Northern Indiana Public Service Co., Indiana Service Corp. He is a member of A.I.E.E., N.S.P.E., Wisconsin Soc. P. E., Western



Distinguished MSU Alumni—Left to right: Louis H. Carapella, Joseph R. Gwinn, Ted Smits, Ronald K. Evans, Arno H. Johnson and Clyde E. Weed.



Another Antarctic Expedition calls on COLLINS for communication

U.S. Navy Task Force 43 is establishing several bases in Antarctica in conjunction with the International Geophysical Year activities. Two bases will be built next year, one of them at the South Pole. The expedition, appropriately entitled "Operation Deepfreeze," is under the direction of Rear Admiral Richard E. Byrd and commanded by Rear Admiral George Dufek. For radio contact between bases and the outside world, the commercial and amateur communication equipment will be Collins.

The name Collins has figured prominently in polar expeditions since 1925. During Admiral Byrd's expedition of the early 30's, Collins transmitters were used in the first Arctic/Antarctic communication link—from the Byrd Expedition (Antarctic) to a CBS station in Northern Alaska. The Collins equipment is specially packaged for air drop and long sledge journeys. Superior performance and reliability, proven time and again, make Collins the logical choice when the need for radio communication is vital.

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Society of Engineers. An Assoc. member Wisconsin Utilities Assn., Wis. Independent Tel. Assn., Independent Pioneer Tel. Assn. Mr. Hartt is a Registered Professional Engineer of Oregon, Washington, Wisconsin, Pennsylvania, and Illinois. He is a Registered Electrical Engineer, Michigan Clubs, Union League (Chicago), Attic (Chicago), Madison Tech. (Madison, Wis.)

In 1950, Mr. Hartt was given the Alumni Award for Distinguished Service by the Washington, D. C., Alumni Club of Michigan State College.

ARNO HALLOCK JOHNSON, '22

After graduation from State, Arno went to Harvard School of Business for a M.S. degree. He is an economist, Marketing Research Specialist, Teacher, and Author. He is Research Supervisor for Harvard Bureau of Business Research, Market Analyst, Director of Research and Vice-President of J. Walter Thompson Company of New York, Montreal, Canada, and London, England. He is also Economic Advisor to U. S. Treasury Department. Author of numerous articles and works on economic and marketing subjects and an outstanding leader in marketing and distribution research and policy problems. He received the first American Marketing Association Annual Award for Leadership in Marketing. He has also received citations to Hall of Fame in Distribution for distinguished contributions to the advancement of Distribution. He is a member of the Market Research Council of New York; American Marketing Association; National Sales Executives; Editorial Board, Harvard Business Review; American Statistical Association; Alpha Delta Sigma and Pi Alpha Mu.

T. F. BURRIS, '24

Chief Engineer for the C & O Railroad with office in the General Motors Building, Detroit. Before going with C & O he was Division Engineer for the Pere Marquette. He has been with the railroad since graduation and held many responsible positions with the C & O before being named Chief Engineer. He has been active in civic affairs and has always maintained his interest in young Engineers. It might interest you to know that he not only played football, but was a member of the first Hockey team at State.

STANLEY B. HUNT, '29

Mr. Hunt is Chief of Engineering District in charge of the St. Lawrence Seaway project. Previous to World War II, he was U. S. Junior Engineer. When he left the Service, he held the rank of Lt. Col., Engrs. Corps. Since 1946 he has been in his present position with headquarters at Foot Bridge, New York.

ARTHUR F. VINSON, '29

Vice President-Manufacturing for General Electric Company. Mr. Vinson joined G.E. as a student engineer and held successive positions as planner, time-study, and process engineer, d-c motor section head and inventory control supervisor. Mr. Vinson also served as manager of employee and community relations of the Small Apparatus division and manager of Wage Administration of the employee and plant community relations services division. He went with General Electric upon graduation and has always been with them.

RICHARD W. COOK, '33

Director of Production, U. S. Atomic Energy Commission. Present reserve commission, Colonel-CE; Legion of Merit for Service with Manhattan District; Army Commendation Ribbon for Service with Washington Engineer District, World War II. He has worked for the nation's atomic program since 1944. Has been director of AEC's production division for 3 years, and will continue as Acting Director of Production in addition to a new assignment. He is a member of many professional and civic organizations.

LOUIS A. CARAPELLA, '37

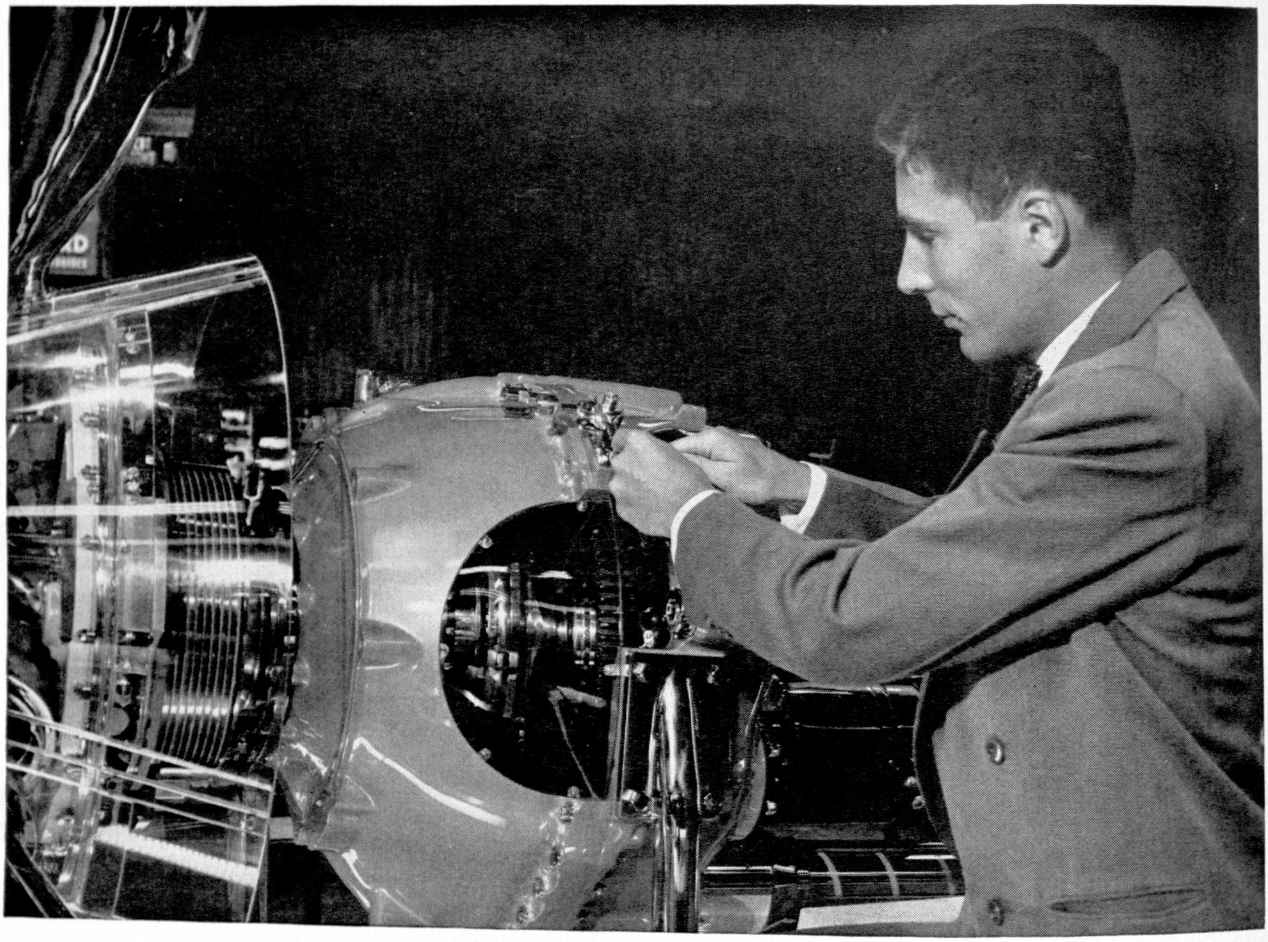
Mr. Carapella is Manager of Alloy Fabrications Section, Westinghouse Atomic Power Division at Pittsburgh. He received his B.S. degree in Metallurgical Engineering cum laude in 1932, his M.S. from M.I.T. in 1939, and his Doctorate from Harvard in 1941. He was Head of Metallography Section, Naval Research Bureau, Washington, D. C., from 1941-43. He is the author of many technical publications and member of numerous professional organizations including a Fellow in The Institute of Metals, London, England.

MAURICE DAY, '37

Mr. Day received his B.S. in Chemical Engineering in 1934 and his Doctorate in 1937. He has spent the major part of his professional career with U. S. Steel, beginning his career at Gary, Indiana, in 1937. From there he went to the Research Laboratories at Kearny, N. J. Three years later he became Technical Trade Representative of the Chicago unit, and in 1947

(Continued on page 63)

Head of Saint Laurence Seaway Project Stanley B. Hunt.



Peaceful Use . . .

BRITISH TEACH ATOMIC POWER

By Tom Margerison

Reprint from Industrial Science and Engineering

Among the buildings which cluster around the security fence at Harwell, Britain's Atomic Energy Research Establishment, are three rough wooden huts, which would look more at home in a garden or on a golf course. These three huts contain one of the few schools in the world devoted to the teaching of the peaceful uses of atomic power. This one is Britain's Reactor School. Another is the Oak Ridge National Laboratory at Oak Ridge, Tenn.

The British Reactor School was started in September 1954 to train men who are building and who are going to operate the new atomic power stations. All the pupils are qualified engineers. Many of them occupy senior positions in their firms.

Americans may apply for entrance to the School, as may students from Europe and the Commonwealth. At the course beginning in September, 1955, there were eight Europeans, two Indians, one Pakistani, one Argentinian, and one Brazilian.

Students spend three months at the school. They are taught the principles of nuclear physics and the processes which go on in the nuclear reactor. They study the problems of designing a reactor which can be made to evaporate steam to drive a turbo-generator. They learn how much shielding is required for personnel safety. They are shown how to handle radioactive materials with special manipulators which can be worked from behind a lead wall.

The many engineering and metallurgical problems which arise in designing atomic power stations are covered in the course. One of the main difficulties is removing the heat from the center of the reactor, which is highly radio-active, and using it to produce steam. Most of the course concerns gas-cooled reactors because most is known about their design and operation. However, other methods of cooling, using water under very high pressure, or liquid metals, such as sodium or lithium, are discussed.

The application of nuclear reactors in power stations is also an important topic. Many of the students are electrical engineers with years of experience in the design and operation of conventional power stations. Therefore, in some respects the teachers learn from the students.

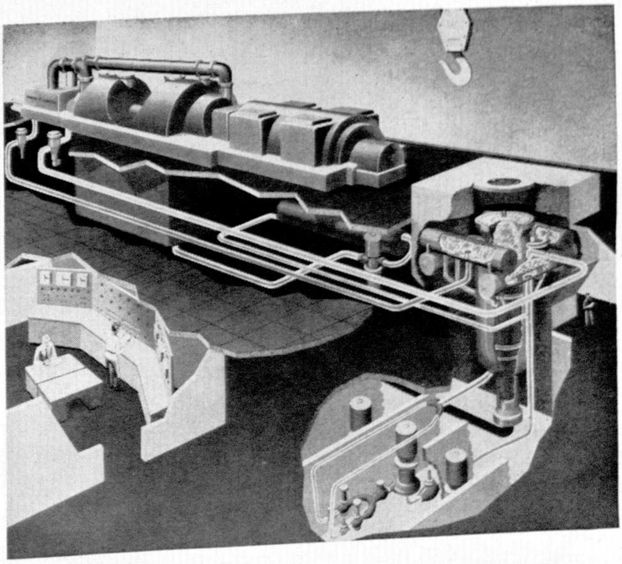
Power stations become more efficient the hotter the steam they use. One trouble with the atomic power station of present design is its relatively low efficiency in using the heat available. One possible method, which is being discussed at the school, is to raise the temperature of the steam produced by the nuclear reactor with an oil-fired superheater. This combination of oil-firing and atomic power could lead to very efficient stations which would produce electricity more cheaply than either method alone.

Students Visit "Bepo"

None of the work of the school is carried on within Harwell itself, but visits are arranged to see the nuclear reactors, a short distance from the school. "Bepo," the largest reactor, is similar to the ones which are going to be used for power production. "Bepo" produces some power which is used to heat the laboratories, but its main purpose is for experiments.

The headmaster or manager of the school is Dr. Kenneth Bobin. The 33 year old scientist has been in the British atomic energy project since it started in 1946. Previously he had worked for two years at Chalk River, the Canadian atomic research laboratories. He was one of the first members to join Sir John Cockcroft at Harwell. Recently, he has spent

(*Continued on page 43*)



An artist's conception of a new 180,000 kilowatt dual-cycle boiling reactor shows it coupled to a turbine-generator for a utility power plant. Water is boiled directly inside the reactor (right) to produce steam for the turbine-generator (upper left).

BRITISH TEACH

(Continued from page 41)

three years in the United States as atomic energy representative with the United Kingdom Scientific Office in Washington.

Dr. James Hill, senior lecturer at the school, is also one of the pioneers at Harwell. He joined in April 1946, a month after Dr. Bobin.

Each session contains between 30 and 40 students and three courses are to be held each year. Many of the pupils are much older than their teachers, although a few have come from universities after graduation.

In each course to date have been four Australian engineers who form part of the nucleus of the new Australian Atomic Energy Commission which has recently been established. After they have finished the course they will spend the rest of two years at Harwell or in one of the atomic factories. Harwell is to help the Australian A.E.C. in the design of one of its reactor projects.

Students from overseas are admitted only if they are proposed by their governments. (Interested Americans may apply for information to the United Kingdom Scientific Office, 1907 "K" St., N.W., Washington 6, D. C.) This will be part of Britain's contribution to help the world-wide development of atomic power.

Although, at the moment, the emphasis is entirely upon land-based power stations, the course gives a fundamental basis for later developments in mobile power units. It may be significant that a number of Britain's aircraft firms have sent engineers to study at the school. Railway locomotive and ship-building firms are also taking an interest.

Although Britain is too small a country to make atomic powered locomotives worthwhile on her railways, they would have very great advantages over steam or diesel engines on the long routes in other countries. The main advantage of such locomotives is their ability to travel extremely long distances without refueling.

From the knowledge they gain at the Reactor School, engineers are able to assess more accurately the possibilities of such developments.

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

° ° °

A chaperone is a force acting on a couple to maintain it in a state of equilibrium.

At David Sarnoff Research Center, Princeton, N. J., RCA tests one of loudspeakers used in new high fidelity "Victrola" phonographs.

SLIDING DOWN THE WAYS at Groton, Conn., goes the USS Nautilus, newest and fastest member of our underseas fleet. During welding, Worthington heavy-duty turning rolls rotated the hull sections.

How the world's first atomic sub was welded

Welding the hull of the USS Nautilus, world's first atomic submarine, presented a tough problem.

Submerged-arc automatic welding seemed to be ideal for the job. Question was—could you rotate the hull sections of the Nautilus to take advantage of this fast, high-quality welding method?

Worthington's answer to General Dynamics Corporation's Electric Boat Division, builder of the Nautilus, was the largest turning roll ever built.

The result? Welding of the Nautilus hull was accomplished in record-breaking time — and cost less than originally estimated. Unchanged, the Worthington roll set-up is also being used in the construction of the nation's second atomic sub, the USS Sea Wolf.

Turning rolls for submarines aren't all that Worthington makes. The long list of Worthington-designed, Worthington-built equipment includes air conditioning units, construction machinery, compressors, Diesel engines, steam power equipment and, of course, pumps of all kinds. For the complete story of how you can fit into the Worthington picture, write F. F. Thompson, Manager, Personnel and Training, Worthington Corporation, Harrison, New Jersey. You may be glad you did.

4.25 B

See the Worthington representative when he visits your campus

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Investigation of Unknown Planet

by ERNEST LAPENSEE

Date B4 78 kgh3

OBJECT: To investigate the planets of another sun to determine the possibility of future settlement.

EQUIPMENT: 1 spaceship MA 164328, and the usual spaceship accessories (1 life raft, 2 heavy demolition ionization guns, 1 planet disintegrator bomb, etc.)

PROCEDURE: After blasting off from space platform number 3 at time $14^h\ 30^m$, date B4 78 kgh3 the crew went into suspended animation while the automatic pilot took the ship to the G type star GKX43365. The position of the star at time of departure was: declination +40° 15′, latitude 48° 29′, altitude 149° 28′, distance 23.340 parsecs.

When the destination was reached it was found there are 9 planets of assorted sizes circling the sun. However, the only one which is habitable by our people was found to be already inhabited by one semi-intelligent form of animal life and an assortment of animals of slightly less intelligence. For the remainder of this report the semi-intelligent animals will be referred to as GAROOKS. At this point the SOP (standard operating procedure) for planets containing any intelligent life was adopted.

The ship was landed in a large uninhabited sandy section and submerged beneath the surface. The group donned Light Diverter hoods, causing invisibility, and set out to study Garook specimens.

RESULTS:

Two years were spent studying Garook habits, emotions, intelligence, impulses, etc. Most Garooks were found to be very crude. Their entire life is devoted primarily to the seeking of physical pleasure (better food, better home, less work, etc.) Their emotions are amazingly complex for such a simple life. Most Garooks are too egocentric to admit the possibility of an intelligence greater than their feeble intelligence. They place much emphasis on physical strength. They have many contests of physical strength and skill to determine the victor.

CONCLUSION:

This planet is ideal for colonization. Our people can live in harmony with all the life forms on this planet with the exception of the Garooks. Because they are approximately 3 times larger than we are, they will continually try to destroy us. All Garooks will have to be eliminated before colonization begins. This will be taken care of immediately after taking off. The entire planet will be covered with a gas which will affect only Garooks. This gas will cause all Garooks to become permanently sterile. This is in keeping with our policy of violent annihilation only when attacked. Colonization may begin in about 100 years.

PHYSICAL DESCRIPTION OF A GAROOK:

Height: 5 to 6 feet tall.

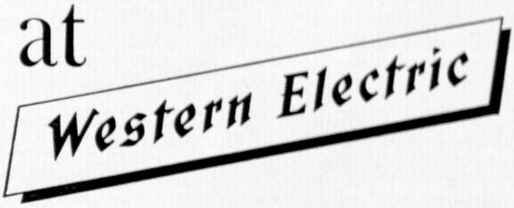
Weight: 100 to 200 lbs.

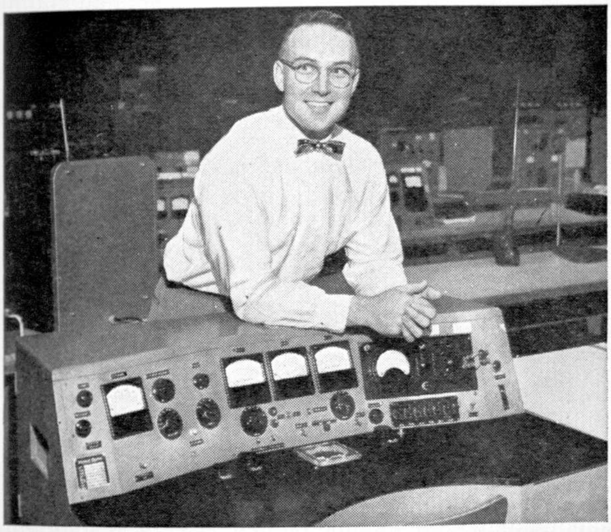
Stands upright on hind legs.

Male is usually 4 to 5 inches taller and about 50 lbs. heavier than the female and is therefore considered superior.

The above document was found during an examination following an atomic blast in the desert of New Mexico. It was incased in a very small capsule. The capsule, being investigated by scientists, is approximately 3 inches long and ½ inch in diameter and is made of a substance foreign to our soil. Also found in the area were bits of an unknown metal which are very light yet amazingly strong. Investigations are continuing.

Young engineers making news at





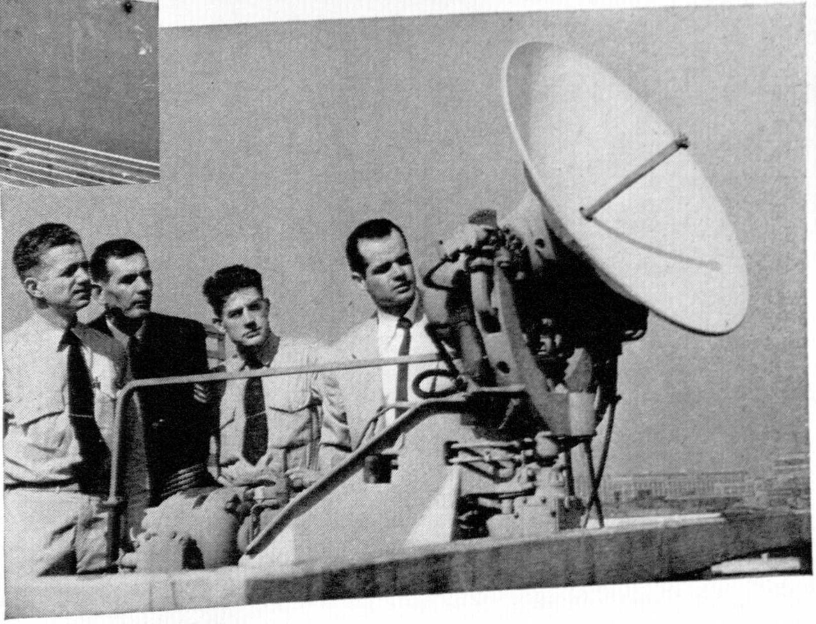
Richard C. Shafer, B.S. in mechanical engineering at Lehigh, was one of 16 engineers assigned to one of Western Electric's toughest post-war projects — developing manufacturing techniques for mass-producing *(with great precision!)* the tiny but amazing transistors which are already causing a revolution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

MACKINAC BRIDGE

(Continued from page 7)

ducible in the laboratory under controlled conditions for theoretically maximum pressure is 23,000 pounds per lineal foot. We multiplied this higher figure by five, and we designed the piers to be safe for a hypothetical, impossible ice pressure of 115,000 pounds per lineal foot, in addition to all of the usual, conventional factors of safety followed in the best engineering practice.

With the maximum possible ice pressure multiplied by five, and the safe foundation pressure divided by four as a basis for design, the combined factor of safety is *twenty* for the design of the piers against any possible ice pressure. For still further safety against any possibility of ice damage, the concrete of the piers is protected by steel sheet piling, steel caissons, and armor plate.

Because the public had been told that no structure could resist the force of storms at the Straits, the design was made ultra-safe against wind pressure. The greatest wind velocity ever recorded in the vicinity is 78 miles per hour; this represents a wind force of 20 pounds per square foot. We multiplied this force by 2½ and designed the bridge to be ultra-safe against a wind pressure of 50 pounds per square foot.

The Most Stable Suspension Bridge

The main span at Mackinac is a suspension bridge, which is inherently the safest possible type of bridge. The stiffening trusses are 38 feet deep, or 1/100th of the span length. This is the same ratio adopted (after years of exhaustive aerodynamic tests) for the proposed Severn River Bridge in England, and 68 percent greater than the ratio of the Golden Gate Bridge.

Even without this generously high depth-ratio, the Mackinac suspension span would have more than ample aerodynamic stability. In fact, by utilizing all of the new knowledge of suspension bridge aerodynamics, the Mackinac Bridge has been made the most stable suspension bridge, aerodynamically, that has ever been designed.

This result has been achieved, not by spending millions of dollars to build up the structure (in weight and stiffness) to resist the *effects*, but by scientific design of the cross-section to eliminate the *cause* of aerodynamic instability. The vertical and torsional aerodynamic forces tending to produce oscillations are eliminated.

An important feature contributing this high degree of aerodynamic stability is the provision of wide open spaces between the stiffening trusses and the outer edges of the roadway. The trusses are spaced 68 feet apart and the roadway is only 48 feet wide, leaving open spaces 10 feet wide on each side, for the full length of the suspension bridge. The effectiveness of this feature was demonstrated to the profession by the writer in 1940, and this feature has since been used in the construction or reconstruction of all large suspension bridges.

For further perfection of the aerodynamic stability, the equivalent of a wide longitudinal opening is provided in the middle of the roadway. The two outer lanes, each 12 feet wide, are made solid, and the two inner lanes and the center mall (24 feet of width) are made of open-grid construction (of safest, most improved type). Wind-tunnel tests have confirmed the high aerodynamic stability of this design of cross-section, combining the two outer openings with an opening in the middle of the roadway.

In addition to the foregoing design features yielding assured aerodynamic stability, maximum torsional stability has been secured by providing *two* systems of lateral bracing, in the planes of the top and bottom chords, respectively. (This feature has recently been added on the Golden Gate Bridge at a cost of $3,500,000.)

The Mackinac Bridge represents a triumph of the new science of suspension bridge aerodynamics. The design was predetermined scientifically in final form. Now, two years after determination of the design and award of construction contracts, extensive wind-tunnel tests have finally been completed on a large-scale dynamic model of the bridge. No modification of the design has been found necessary or desirable. The wind-tunnel tests show conclusively, as predicted by the writer, that the Mackinac Bridge, as designed, has:

1. Complete and absolute aerodynamic stability against *vertical* oscillations at all wind velocities and all angles of attack.

2. Complete and absolute aerodynamic stability *against* torsional oscillations at all wind velocities and all angles of attack.

3. Complete and absolute aerodynamic stability against *coupled* oscillations (combining vertical and torsional) at all wind velocities and all angles of attack.

Professor F. B. Farquharson states in his report that: "Tests at angles of attack up to 20 degrees and over the full range of velocities available (191 miles per hour) have failed to develop any indication of instability."

What Makes It Big

The total length of the bridge (including the approaches) is 26,444 feet (5 miles and 44 feet).

The total concrete in the substructure (anchorages, piers, and foundations) is 445,000 cubic yards. Of this amount, 355,000 cubic yards are placed under water.

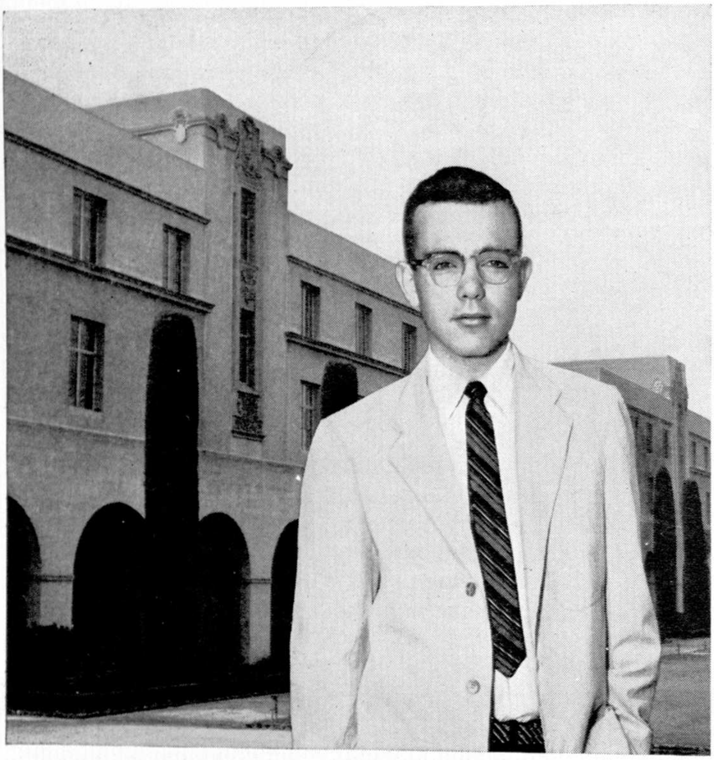
The total weight of the steel superstructure (cables, structural steel, and roadway) is 66,500 tons.

The 33 spans are carried on 34 piers. The two main piers are carried down to depths exceeding 200 feet. (Pier 19 through 140 feet of water and 70 feet of overburden, and Pier 20 through 100 feet of water and 105 feet of overburden.)

The substructure contract (lump sum) is $25,735,600, awarded to the Merritt-Chapman & Scott Corporation.

The superstructure contract (structural steel and cables) is $44,532,900. This is the largest single con-

(Continued on page 55)



John E. Young is working toward his B.S. in chemistry from California Institute of Technology this June. He has maintained honor standing in classwork while serving on the school newspaper, in the debating society, and as treasurer of the student body. John is interested in chemical research and development.

John Young asks:

How does research differ from development work at Du Pont?

John Aaron answers:

John B. Aaron worked for Du Pont as a summer laboratory assistant even before he graduated from Princeton with a B.S. in 1940. After military service he obtained an M.S.Ch.E. from M.I.T. and returned to Du Pont in 1947. Over the years he has had many opportunities to observe Du Pont research and development work. Today John is process and methods supervisor at the Philadelphia Plant of Du Pont's Fabrics and Finishes Department.

Well, John, it's hard to define the difference in a way that will satisfy everybody, because one always finds a lot of overlapping between research and development work. But most people agree that there are differences, especially in time sequence. Research work comes first, because one of its main objectives is to establish or discover new scientific facts that will supply the foundation for new industrial developments. In other words, research men seek new knowledge about matter, generally working with small quantities of it.

Development work comes later, and Du Pont has two main types. First, there is *new process* development. Here scientists and engineers modify, streamline, and augment the findings of research so that new chemical products can be profitably made on a large scale—or existing products can be made by newer and more efficient methods. Pilot-plant and semi-works operations are usually included under this heading.

Second, an important kind of development work is directed toward improvement of *existing processes and products*. Here the men study how to obtain yield increases, utilize by-products, increase outputs, and solve sales service problems as they arise. This may require considerable research, and that brings us back to the overlapping I previously mentioned.

There are genuine differences, John, but a good deal of similarity, too—especially in the constant need for imagination and creative effort. I think you'll find that research and development work are equally challenging and rewarding at Du Pont.

WANT TO KNOW MORE *about working with Du Pont? Send for a free copy of "Chemical Engineers at Du Pont," a booklet that tells you about pioneering work being done in chemical engineering—in research, process development, production and sales. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Bldg., Wilmington 98, Delaware.*

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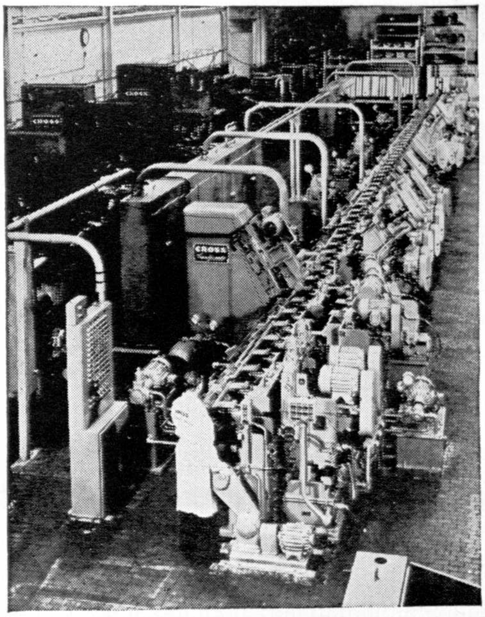
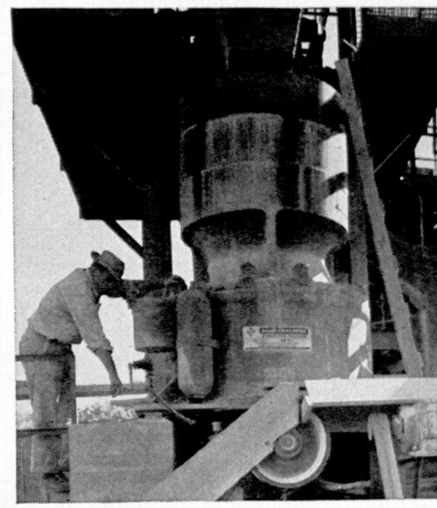


MANUFACTURING — There are 51 Allis-Chalmers motors in this lineup of machine tools designed for high automobile production.



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

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

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

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

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

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

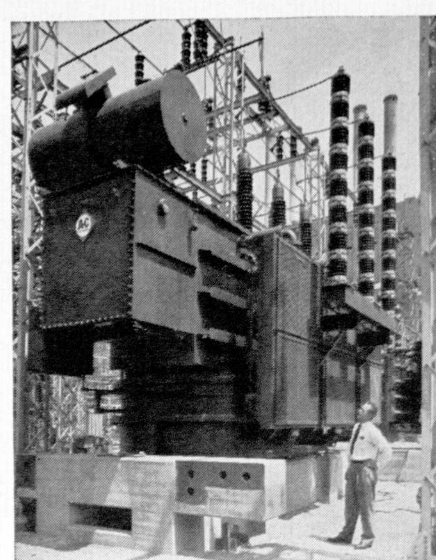
Here's what Allis-Chalmers offers to Young Engineers:

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

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

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

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



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

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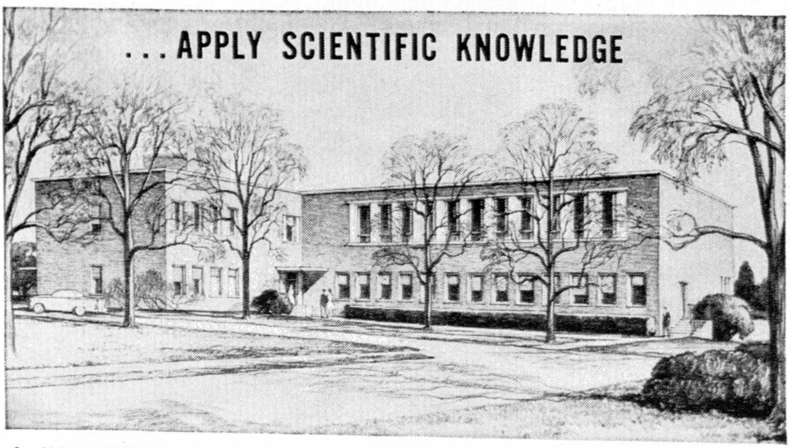
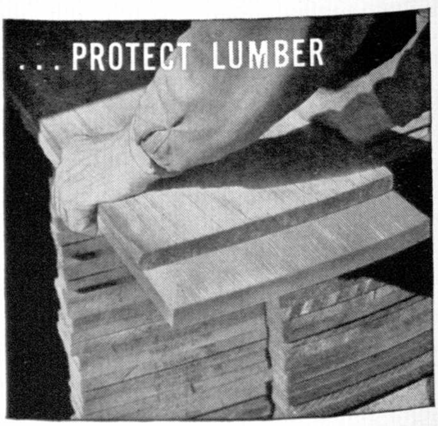


MORE THAN 17,000 VOLUMES of scientific literature and tens of thousands of company research reports will be housed in this new $1,000,000 Technical Information Center at the Hercules Experiment Station near Wilmington. In addition, the structure will provide quarters for the many technical specialists who serve the scientific information needs of the Hercules research staff—making the Center one of the nation's most complete information services to an industrial research organization.

WHICH HAD THE TREATMENT? The clean, unsplintered piece has been treated with Hercules Paracol® wax emulsion, making it possible to use every inch of lumber that has been pre-cut at the mill. The untreated piece (top) is badly "checked" and a portion of the end must be discarded before it will be suitable for use.



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HERCULES
CHEMICAL MATERIALS FOR INDUSTRY

MACKINAC BRIDGE

(Continued from page 51)

tract the United States Steel Corporation has ever received; in fact, it is the largest single contract in the history of bridge engineering.

Although the suspension bridge appears to dwarf the other spans, continuous-truss spans of notable length are used over a secondary gorge in the crossing. Twenty spans over the deep portions of the waterway range in length from 560 to 330 feet. These span lengths were economically determined by the deep and massive piers required to withstand the ice pressure (with the large factor of safety adopted).

The use of the Prepakt method for placing concrete in the foundations for the Mackinac Bridge has enabled a new world's record to be established for underwater concrete placement from a single floating plant: 6,250 cubic yards in a 24-hour day.

The wonderful progress that has been recorded on the work despite all difficulties has been made possible by the cooperative teamwork of officials, engineers, and contractors. On this project we have been fortunate in working with the Mackinac Bridge Authority, under the chairmanship of Prentiss M. Brown. This Bridge Authority has been outstanding for caliber, for competence, for judgment, for integrity, and for ability to put a project through despite all obstacles. Under this inspiring leadership, no effort is being spared to produce the finest, safest and most beautiful bridge that money, skill and brains can build.

MEXICO

(Continued from page 15)

tory) that can be put under up-to-date systems of cultivation.

In one of his first messages to the country our president indicated that the basic objectives of the government is to strive "for a more equitable distribution of the national wealth in order to unite the people around the principle of social justice which has been a permanent aspiration." By following a logical plan, this government certainly is doing its best to lay the foundation on which shall rest the future prosperity of the country. This plan is including an integral development of agricultural resources, the construction of thermal and hydroelectric plants, a better network of communications, terrestrial, maritime, and fluvial; all being carried on at full speed.

EE: "Well, what would you like to drink?"
Coed: "I guess I'll have champagne."
EE: "Well, guess again!"

* * *

The girl on the bus was reading about birth and death statistics. Suddenly she turned to the man beside and said, "Do you know that every time I breathe a man dies?"

"Very interesting," he returned. "Why don't you try Sen Sen?"

EMPLOYEE

(Continued from page 21)

young people have a tendency to hang on to the first job long beyond the time when they should have quit for their own good.

One should quit when self-analysis shows that the job is the wrong job—that, say, it does not give the security and routine one requires, that it is a small-company rather than a big-organization job, that it is at the bottom rather than near the top, a specialist's rather than a generalist's job, etc. One should quit if the job demands behavior one considers morally indefensible.

One should also quit if the job does not offer the training one needs either in a specialty or in administration. A job in which young people are not given real training—though, of course, the training need not be a formal "training program"—does not measure up to what they have a right and a duty to expect.

But the most common reason why one should quit is the absence of promotional opportunities in the organization. That is a compelling reason.

I do not believe that chance of promotion is the essence of a job. In fact there is no surer way to kill a job and one's own usefulness in it than to consider it as but one rung in the promotional ladder rather than as a job in itself that deserves serious effort and will return satisfaction.

The absence of promotional opportunities is demoralizing. And the sooner one gets out of a demoralizing situation, the better. There are three situations to watch out for:

The entire group may be so young that for years there will be no vacancies.

Another situation without promotional opportunities is one in which the group ahead of you is uniformly old—so old that it will have to be replaced long before you will be considered ready to move up. The only organization that offers fair promotional opportunities is one in *which there is a balance of ages.*

And finally there is the situation in which all promotions go to members of a particular group—to which you do not belong. Some chemical companies, for instance, require a master's degree in chemistry. Some companies promote only engineering graduates, some government agencies only people who majored in economics, some railroads only male stenographers. On the whole there are proportionately more opportunities in the big organization than in the small one But there is very real danger of getting lost in the big organization—whereas you are always visible in the small one. A young man should therefore stay in a large organization only if it has a definite promotional program which ensures that he will be considered and looked at. This may take several forms: it may be a formal appraisal and development program; it may be automatic promotion by seniority as in the prewar Army; it may be an organization structure that actually makes out of the one big enterprise a number of small organizations in which everybody is again clearly visible (the technical term for this is "decentralization").

Let me repeat: to be promoted is not essential, either to happiness or to usefulness. To be considered for promotion is.

Your life off the job

I have only one more thing to say: It is also necessary that you have a meaningful life outside the job.

I am talking of having a genuine interest in something in which you, on your own, can be, if not a master, at least an amateur expert. This something may be botany, or the history of your county, or chamber music, cabinetmaking, Christmastree growing, or a thousand other things. But it is important in this "employee society" of ours to have a genuine interest outside of the job and to be serious about it.

I am speaking of keeping yourself alive, interested, and happy during your working life, and of a permanent source of self-respect and standing in the community outside and beyond your job. You will need such an interest when you hit the forties, that period in which most of us come to realize that we will never reach the goals we have set ourselves when younger.

The man who will make the greatest contribution to his company is the mature person—and you cannot have maturity if you have no life or interest outside the job. Our large companies are beginning to understand this. It will make you happier, it will make you more effective, it will give you resistance against the setbacks and blows that are the lot of everyone.

Being an employee means working with people; it means living and working in a society. Intelligence, in the last analysis, is therefore not the most important quality. What is decisive is character and integrity.

There are many skills you might learn to be an employee, many abilities that are required. But fundamentally the one quality demanded of you will not be skill, knowledge, or talent, but character.

— — —

For years the bum slept under bridges and in ditches. Then one day he switched to culverts and became a man of distinction.

° ° °

Her lips clung tenaciously to his . . . once more she had forgotten to remove her chewing gum.

° ° °

Runyan was busily engaged with a spade in the mud beside his car when a stranger hailed him.

"Stuck in the mud?" asked the stranger.

"Oh, no," he exclaimed cheerily, my motor just died and I'm digging a grave for it."

° ° °

A man who horses around too much may some day find himself a groom.

° ° °

"Hey buddy, you got a watch; what time is it?"

"Quarter to."

"Quarter to what?"

"Dunno—times got so bad I had to lay off one of the hands."

Index To Advertisers

*Inside front cover
**Inside back cover
***Back cover

NEW DEVELOPMENTS

(Continued from page 29)

Safer Windshields

Safer, ice-free aircraft windshields now are being built as the result of a 4½-year research program concluded recently at the Armour Research Foundation.

The project was undertaken so designers could specify failure-proof windshields that would never shatter, but only crack under the worst military and climatic conditions.

Two of several important developments resulting from the project were:

1. A system was developed for measuring over-all optical quality of windshields as they were affected by imposed laboratory conditions. The system employs a rectifying plate that corrects for distortion directly, thus alleviating the necessity of mathematical corrective calculation after test photographs are made.

2. A windshield mounting employing a synthetic fiber cloth was developed. The fiber, replacing aluminum in some applications, improved stress isolation of the windshield, necessary in conditions of intense airframe distortion and vibration.

Most of the research was undertaken to find a pressure-proof, distortion-free, anti-icing windshield that would be satisfactory for global operation.

One experiment sought to keep the temperature on the outer surface of the windshield at about 40 degrees F. to prevent ice from forming.

In others, scientists had to consider air friction, evaporation, thermostatic arrangements for controlling the heat, stresses, and other complex factors.

Safety also entered the picture in the case of pressurized cabins or cockpits.

In order to establish design limits for concepts determined throughout the program, engineers simulated flight conditions, putting their windshields through vigorous tests.

Experimental models were subjected to low temperatures, thermal shocks such as might be encountered in flying into a super-cooled cloud, stresses caused by the heat input in de-icing, more stresses induced by cabin pressurization—still others due to airframe distortion, speed, or air gusts.

To perform many of the tests, special heat transfer and stress equipment had to be devised. Often water was used as the heat transfer medium instead of air because it is easier to control and regulate.

The stress analysis studies were similar to those used by industry to achieve stronger, lighter machine parts.

In one test, alcohol, cooled to 90 degrees below zero F., passes across one side of a pane of glass. Heat, supplied electrically, is stepped up slowly on the other side until the temperature rises to about 500 degrees F. and the glass cracks—like a milk bottle breaking when filled with boiling water.

Although windshields never may meet these extreme temperatures in use, information on temperature differences and resultant failure is valuable to designers and engineers.

Benefits of the windshield research are expected to be made available to civilians early next year.

New Plug for Oil Wells

A new and improved bridge plug for use in blanking off oil well casing sections has been developed for the petroleum industry.

The bridge plug is used when it becomes necessary to seal off the perforations which are made in the casing to allow the oil and gas to flow or be pumped to the surface. This need might arise out of depletion of the oil or gas sand, or a defective cement job, allowing water from an adjacent sand to enter the casing.

A bridge plug must then be set in the casing immediately below the perforations to provide a stable base against which to pump cement to force through the perforations for sealing. The all metal plug is lowered into the casing on an electric wire line and a charge of explosive contained in the plug is exploded. The resultant expansion effectively seals the casing, permitting the cement to be pumped down to seal the perforations.

Of critical importance in the operation is absolute control over the detonation of the explosive. Premature firing would set the plug before it reaches its destination, making costly recovery operations necessary.

Since the plugs are sometimes set at depths as great as 15,000 feet where temperatures reach up to 350 degrees, the insulating material on the electrical detonating mechanism must have high heat-resistance.

Hycar American rubber is coated over the detonating unit. According to engineers, Hycar's high heat-resistance and excellent dielectric qualities have been of vital importance to the accuracy and efficiency of this product.

Mount Palomar's 'Horseshoe'

Plastic models of huge movable parts of powerful generators and bearings are the subject of concentrated study. Among the demonstration models is this replica of one of the two principal bearings which support the mammoth 200-inch telescope atop Mt. Palomar, near Pasadena, Calif. A research engineer here moves the "horseshoe" with ease as oil is forced into the pads—or receptacles—from the reservoir beneath them. Without the oil, friction between the two surfaces, both on the model and on the telescope, would cause the bearing to stick firmly. Engineers designed the flotation method so that with a film of oil, three-thousandths of an inch thick, the huge 500-ton telescope could be moved with a ½-horsepower motor—only slightly larger than the motor in a washing machine. This oil flotation process is the same as is sometimes used in construction of waterwheel generators.

(Continued on page 63)

"May I have another cookie?"
"Another cookie what?"
"Another cookie, please?"
"Please what?"
"Please Mother."
"Please Mother what?"
"Please Mother dear."
"Hell no, you've had six already."

* * *

Don't be afraid to use your brain, it's the little things that count.

* * *

He: "How about a kiss baby?"
Gold Digger: "Not on an empty stomach, sugar."
He: "Of course not – on the mouth."

* * *

She was only an oculist's daughter – Two glasses and she made a spectacle of herself.

* * *

An inspector making a tour of an insane asylum noticed an inmate who had nothing on but a hat.
"Why is it, my good man, that you are not wearing your clothes?"
"Well sir, nobody ever comes here."
"Then why are you wearing the hat?"
"Well, somebody might."

* * *

A pinch of salt is greatly improved by adding a glass of beer.

* * *

"Hello?"
"Hello, is this Dr. Wasserman?"
"Yes, it is."
"Are you positive?"

* * *

"May I have this dance?"
"I'm sorry, I never dance with a child," said she, with an amused smile.
"Oh, a thousand pardons," said he. "I didn't know about your condition."

Solar Batteries

A pocket-size solar-powered radio receiver, weighing only 10 ounces and capable of working more than eight months in total darkness without recharging, has been developed. Major advantages over solar-powered receivers previously announced are size and length of operation in absence of light.

It is pointed out that highly efficient solar batteries such as those used in the receiver are still too expensive to justify manufacture of devices in which they play an important part. There are no immediate plans for production.

The solar receiver will operate continuously in daylight and will run 500 hours in darkness without recharging. If used at the rate of two hours a day, which is considered normal usage for a portable radio, it would work for a minimum of 250 days in absolute blackout.

Long operation in total darkness is made possible by the use of a miniature storage battery which is contained in a transparent plastic case along with four transistors, seven solar cells and other components. The case is 5½ inches wide, 1¼ inches thick and 3 inches high.

The present size makes it convenient for the user to place the receiver in a suit pocket and to hear programs with a miniature ear-plug. The size could be cut in half by substituting sub-miniature components now in existence which were unavailable when developmental work was being conducted.

Only two manual controls are needed—a turn-on knob which also adjusts volume and a knob for station selection.

Under normal daylight conditions, light rays strike the selenium cells which convert solar energy to electrical current. The electrical energy travels directly to transistors in the daytime, powering the receiver. Simultaneously, the miniature storage battery builds up a supply of energy to be employed when sunpower is lacking.

Artificial light, such as a lamp containing a 100-watt bulb, may be used instead of sunlight. Smaller artificial sources, such as matchlight or candlelight, do not provide the necessary light power.

Solar Batteries for Household Use

Solar batteries of silicon probably will someday furnish enough power for household use in sunny areas, but do not appear practical for powering autos and other vehicles.

There is enough surface area available on house roofs to make this energy conversion method practical. But the optical method would not provide sufficient power for vehicles.

However, there is no way of predicting when such systems would be economically feasible.

A practical type of solar energy converter might be made to yield up to three times home power needs "to take care of emergencies, peak loads or protracted spells of dark weather."

This capacity might also have to be increased to take care of the fact that the efficiency predicted for such household solar batteries would not be feasible.

The sun-gathering surface of such a solar converter would take up 30 to 100 square feet to produce enough household power.

This area and more is very easily attained on a roof, with most home roofing areas running in the order of 1,000 square feet. Thus, given a good supply of high-purity silicon and mass production methods, there is no technological reason why such a system should not work.

ALUMNI

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was transferred to Pittsburgh as a Metallurgical Engineer. He has recently been named Vice-President of Research and Development of Crucible Steel Company of America.

During World War II, Dr. Day held down the dual posts of consultant to Detroit industries using steel in ordnance work and consultant to the chief of ordnance in connection with the nation's steel helmet program. He is now a member of the Military Ordnance Department Metallurgical Advisory Committee for Large Guns, and the American Ordnance Association Committee for Small Arms and Ammunition. He is a former chairman of the Chicago Chapter A.S.M.

CHRISTIAN F. BEUKEMA, '40

Christian F. Beukema, Civil Engineer, formerly associated with U. S. Steel Corporation's raw materials division in Pittsburgh, was named President of Michigan Limestone Division in Detroit, on February 3, 1955.

A native of Grand Haven and a graduate of State in 1940, he joined Michigan Limestone at Rogers City, Mich., serving in the field of maintenance and construction engineering.

In 1941, Beukema was called to active Army duty, advancing to the grade of major before returning to Michigan Limestone in 1945 as construction engineer. In 1949, he went to U. S. Steel's headquarters in Pittsburgh as special assistant to the late John G. Munson, vice-president—raw materials, in the planning of a long-range program of iron ore development for the corporation. In this connection he spent considerable time in South America promoting the interests of the Company.

In 1951, he was advanced from the post of senior staff assistant in raw materials division to the post of director of planning in the same division. In 1954, he was made Vice-President of Michigan Limestone, with headquarters in Detroit, Michigan, and in February, 1955, he was promoted to his present position. Chris is active in alumni affairs and is a frequent campus visitor.

Editorial

Sometime or another—every one of us here at college has contemplated, or been asked the question of just why we are enrolled in this institution of higher learning. Invariably the answer or the prime reason given is to obtain an education. This seems to be an oversimplification. College is looked upon by many to be a period of preparation for life. This outlook leads to serious negligence. There are other aspects of our development that we cannot afford to neglect during our four-year stay at college.

Upon graduation from high school the ties of home are severed. Dependence gives way to independence. We begin to live. Our destiny falls entirely into our own hands. You are one of those who chose college as your next step. Not for the education as an end, but as a means to success. Your struggle for that end begins at this point. This "struggle" is what we refer to as "life."

We are now "living." Not preparing for "living." The governing rules are not the same as those of the previous period. Responsibility becomes heavy. Punishment replaces reprimand. We live by the same rules as society in general dictates for its older members. Education appears in a different light. We are not excused for our actions on the grounds of ignorance. We are expected to know, and if we don't, we suffer the consequences.

College students are prone not to acknowledge this fact. Doing well in their studies is believed to be the basis for measuring progress. In our present status, it is only one factor. Our everyday actions are just as much a part of success. Relations with other people may very well be more important. Though intangible, it may take more time and practice to learn the art of good human relations than it does to master your studies. Yet students will procastinate this art until graduation and spend excessive hours in their rooms with the books.

In our society, good citizenship is expected of the leaders. But students will render themselves immune to the effect of current events and ignore the daily newspaper. They feel no need to be informed on the happenings in the outside world.

A characteristic of the successful man is participation in community affairs. Our community offers opportunity for recognition and practice. Relatively few take advantage of this opportunity. However, these same participants in extra-curricular activities will probably be the future leaders in their post-graduation communities.

Even our personal habits are subject to the standards of this society we exist within. If success is based on more than financial gain, and we aspire to be leaders, then we must learn now to acquire those qualities that are looked for in their leaders by the followers.

H.N.