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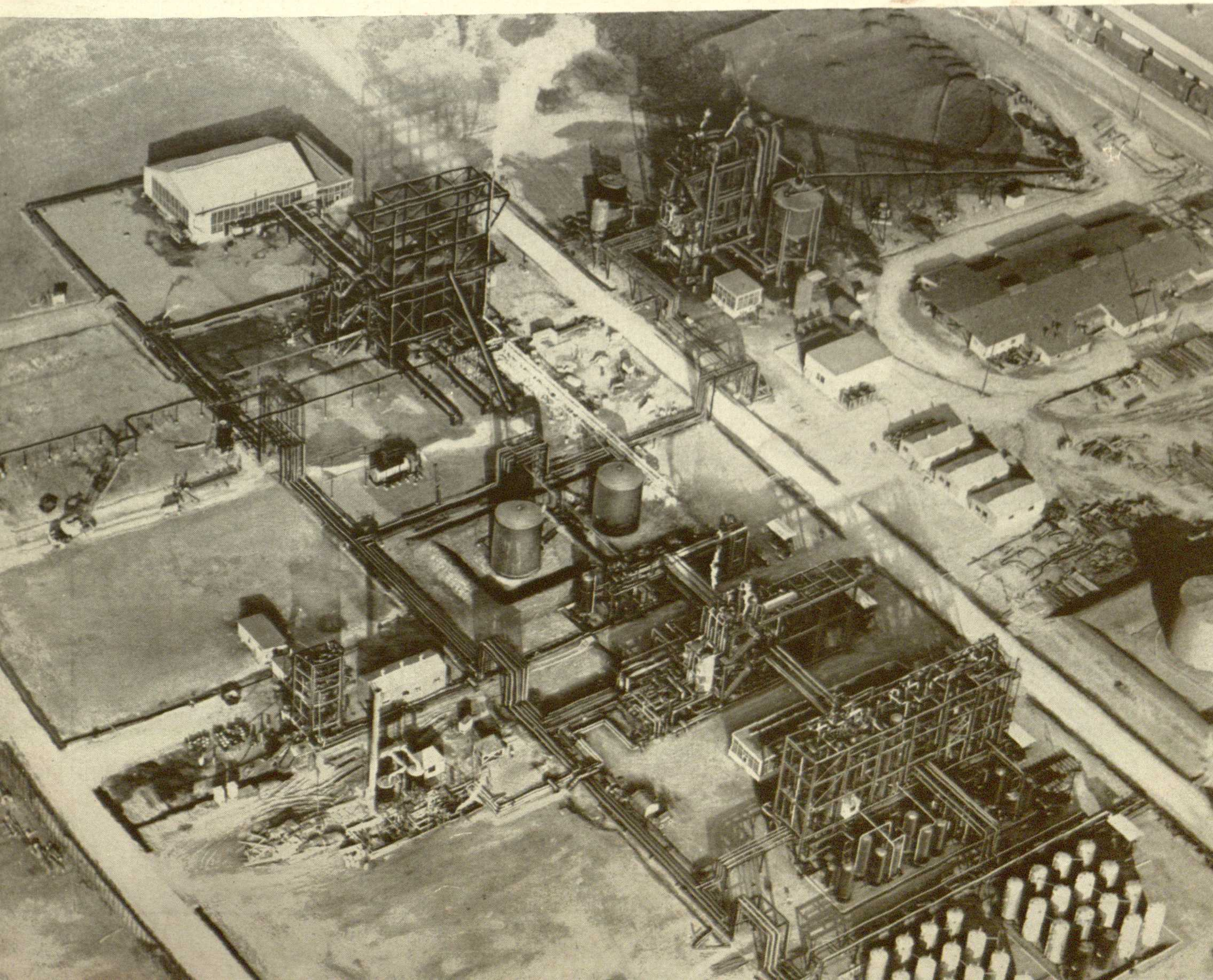
Spartan ENGINEER

Vol. 6 No. 2 JANUARY 1953



How two inches of steel made a yardstick

HERE is one of the busiest machines in our research laboratories. It is a *constant-pressure* test lathe that quickly provides an indication of how fast a steel can be machined.

This unique testing device consists of a standard lathe fitted with special control equipment by which the horizontal pressure on the cutting tool is kept constant during the machining operation. By actually machining a test bar on this lathe and measuring the number of revolutions necessary to advance the cutting tool exactly two inches, we obtain—in a matter of minutes—a precise record of the steel's machinability.

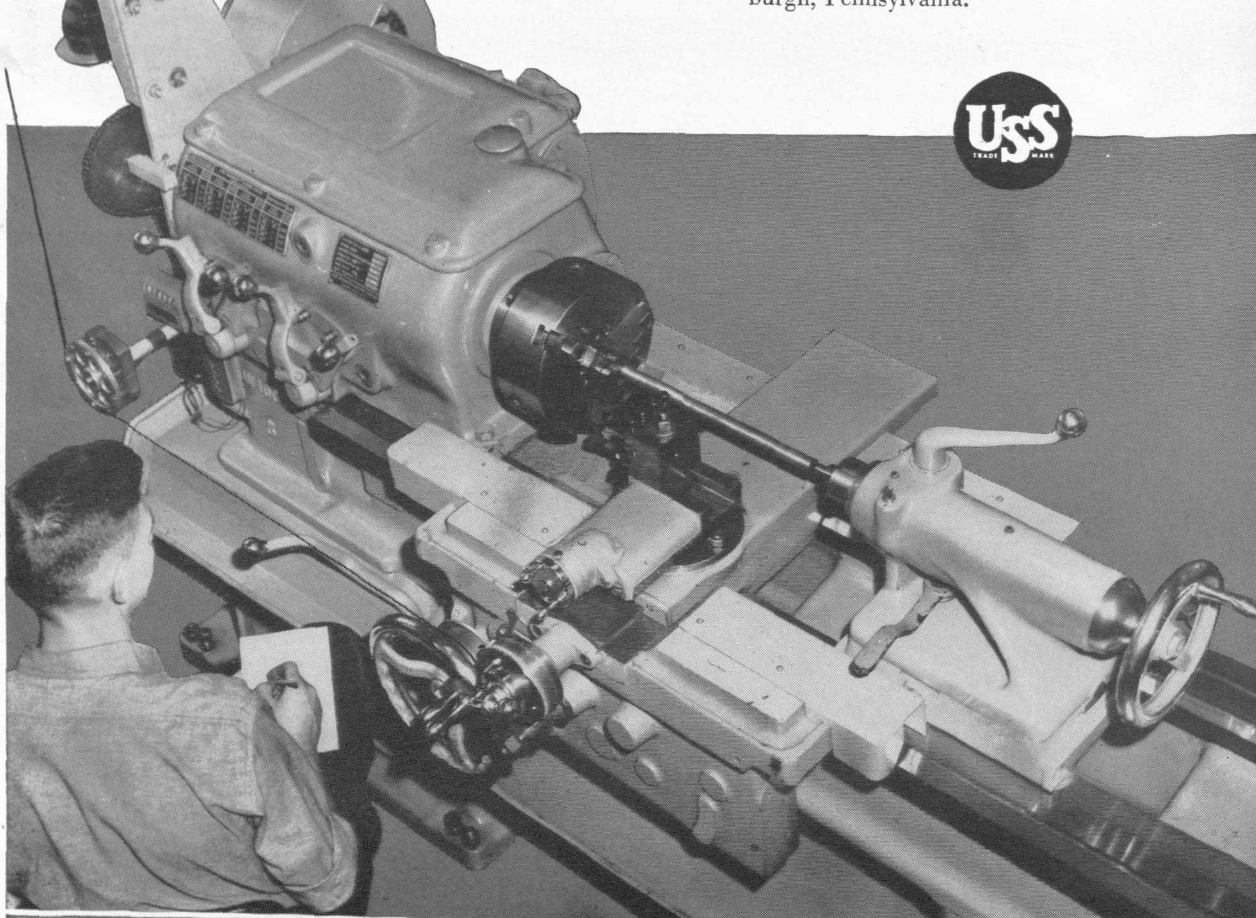
Before this development, the normal way to test machinability was to machine a sample of steel until the cutting tool failed. This sometimes took days and often required more steel than was available. Now, with the constant-pressure lathe, many steel compositions can be *accurately* checked in that time.

Typical of what this has meant to steel users is our development of MX Free-machining Bar Stock.

Bar stock is used in producing the millions of machine parts that are made on screw machines—those high-speed automatic machines that can simultaneously perform many operations such as drilling, forming, threading, chamfering and tapping at a rate of 1000 or more parts per hour. Here, machinability is of first importance, and often spells the difference between profit and loss.

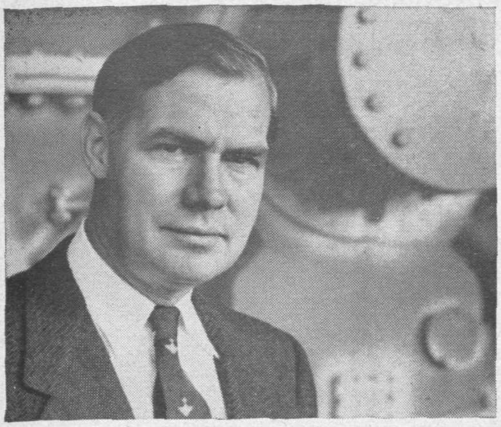
So when we set out to give the screw machine industry steels that would have the utmost in machinability, we called on the constant-pressure test lathe to speed up this research. With its help, hundreds of compositions were quickly and accurately screened. The result was MX—the fastest-cutting Bessemer screw stock yet developed, one that has enabled many screw machine operators not only to increase production and reduce tool wear but to cut their costs as well.

The constant-pressure test is a good example of the many research projects sponsored by United States Steel. In the field and in the laboratory, U. S. Steel metallurgists are constantly at work on problems pertaining to the manufacture and the use of steel. United States Steel Corporation, Pittsburgh, Pennsylvania.



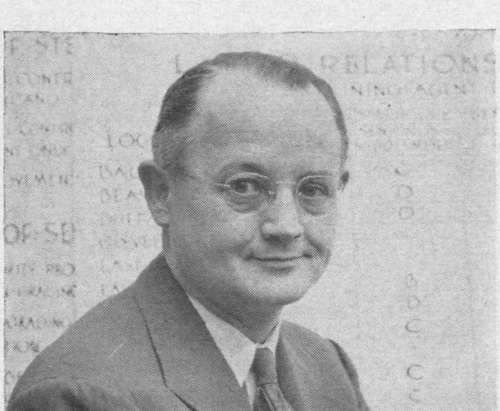
USS TRADE MARK

UNITED STATES STEEL



Lee A. Kilgore, *Assistant Manager*
Westinghouse Generator Engineering
A graduate of the University of Nebraska, he enrolled in the Westinghouse Graduate Student Training Course in 1927. He has contributed much to the design and development of large generators, motors and rectifiers and has authored many technical articles on these subjects.

W. H. Dickinson, *Director*
Westinghouse Headquarters Manufacturing Engineering
Enrolled in Westinghouse Graduate Student Training Course after graduation from Texas A & M in 1930. He came up through a variety of manufacturing positions in the company and was appointed to his present post in 1951.



Clark C. Frame, *Director*
Westinghouse Labor Relations
Enrolled in the Westinghouse Graduate Student Training Course after graduation from Penn State in 1930. Prior to appointment to his present post, he was Manager of Industrial Relations for Westinghouse East Pittsburgh divisions.

Their formula for success will work for you

"Find out early what your talents are, what you want to do, and set your sights accordingly." That, essentially, is the success formula practiced by these Westinghouse executives.

But how do you put this formula to work? How can you be sure of choosing the right career? At Westinghouse, you'll find the answer in the Graduate Student Training Program . . . the same program that launched these men on their careers. This program gives you a clear understanding of the company and its products . . . lets you try out many types of work through planned work assignments . . . and offers the benefit of personal counsel in selecting the right field for your career.

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For information on opportunities at Westinghouse in engineering, research, manufacturing, sales and business administration, send for our 34-page book, "Finding Your Place in Industry".

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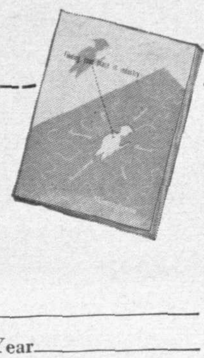

To obtain copy of "Finding Your Place in Industry", consult Placement Officer of your University, or mail this coupon to:

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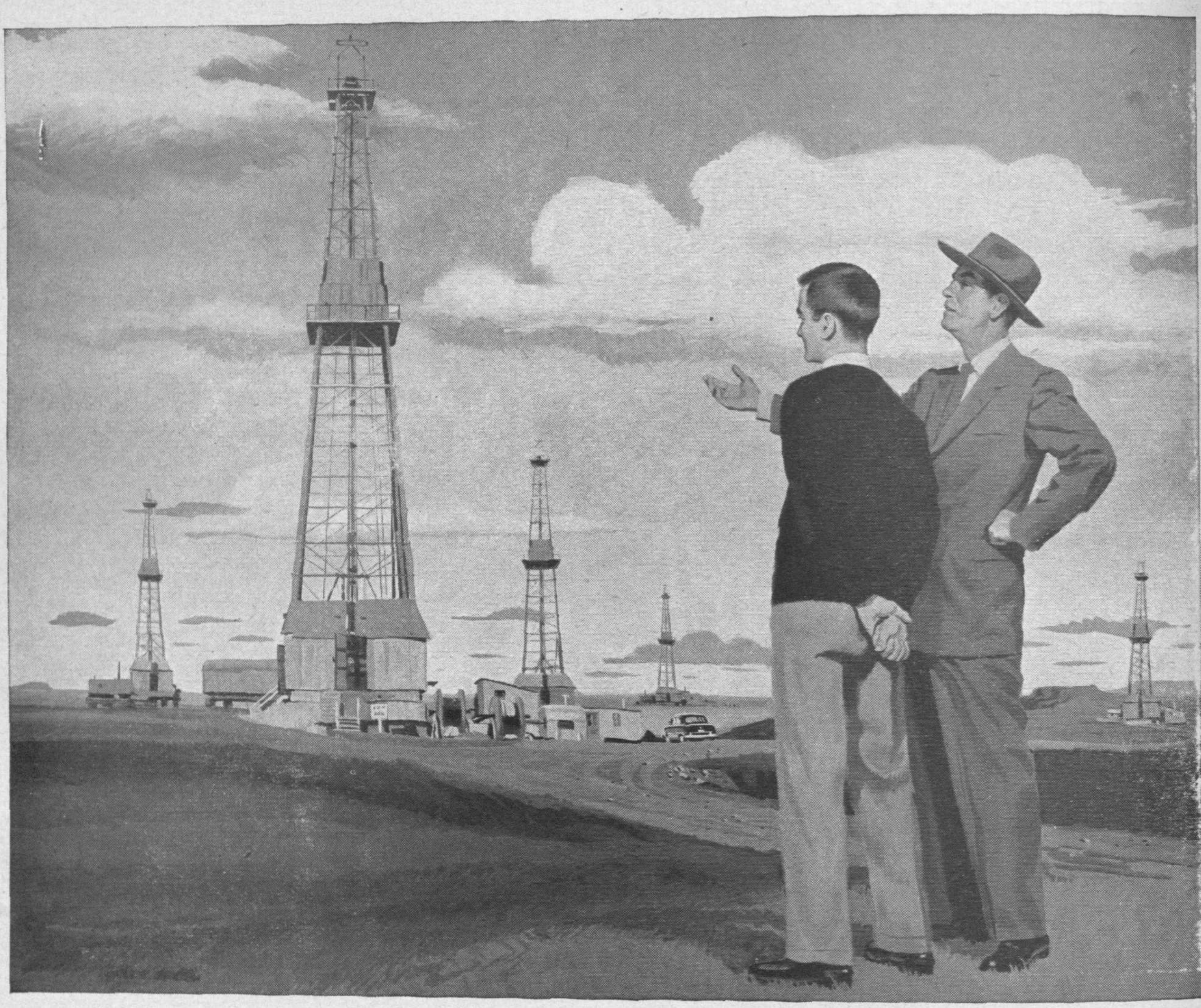


To a Young Man who wants "Room to Grow"

That's one of the attractions of the oil business as a career: big and substantial though it is today, prospects are that it has a long way yet to grow.

The discovery of new sources of petroleum and new *uses* for petroleum has gone ahead faster during the past five years than in any other comparable period. Phillips Petroleum Company gross income increased from $222 million in 1946 to $611 million in 1951. And 8,300 new job opportunities were created.

The *primary* business of Phillips Petroleum Company is producing, refining and marketing fuels and lubricants. Yet Phillips is one of the most widely diversified oil companies, and we offer opportunities for the technical graduate in many other fields: development of chemical derivatives from petroleum, ammonia and sulfur compounds, rubber synthesis, atomic research, geophysics and analytical techniques.

If you're looking for a "career with a future" we invite you to write to our Employee Relations Department for further information about opportunities with our company.

Phillips 66

PHILLIPS PETROLEUM COMPANY, Bartlesville, Oklahoma

Oh say can you see–

"That's Jonesey—putting out his flag again.

"He hasn't missed one Sunday in the eight years we've been neighbors. I used to kid him about it a lot. Asked him why didn't he buy a cannon to shoot off with it. He took it good-natured-like. But we got to talking last week about war in general. That was the first time I even knew he had a son.

"His boy, Joe, enlisted right after Pearl Harbor and got overseas fast. When young Joe came back, Jonesey met him at the railroad station, stayed up with him all night and rode out with him to the cemetery on the hill. After it was all over, the sergeant gave Jonesey the flag that had covered Joe. *That's it over there.* I don't kid Jonesey any more.

"Instead, I've been listening respectfully when he talks about the flag . . . only when *he* says it, it's Flag. With a capital F. Same capital F he puts on Freedom, which is what he really means. Jonesey sure made me think about Freedom a lot. For instance . . .

"When I vote, nobody knows where I put my X's. Nobody puts me in jail for picking out my own church. And no teachers tell my kids to spy on me and turn me in because I squawk about taxes or high prices. And when I told my boss I was quitting to open a little grocery with the dough I'd saved in war bonds, he wished me luck and said he'd have his missus buy their groceries from me.

"*That's* what Jonesey meant when he said our Freedom is right under our noses. Can't feel it or see it. But it's there just the same, wrapped up in every star and stripe in that Flag across the street.

"And, if you'll excuse me, I'm going outside and hoist *my own* Flag, too . . . just bought it last night. 'Oh say can you see?' *I sure can . . . now!*"

REPUBLIC STEEL

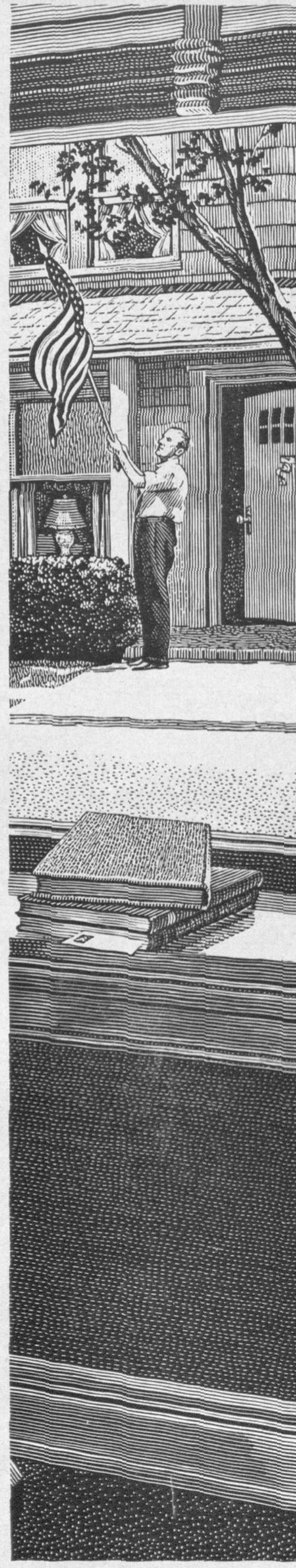
Republic Building, Cleveland 1, Ohio

REPUBLIC STEEL

Republic BECAME strong in a strong and free America. Republic can REMAIN strong only in an America that remains strong and free . . . an America who owes much of her prosperity to her many huge industries that provide her people with the world's finest living. *Through these many industries, Republic serves all America.* A typical example can be found in the Petroleum Industry whose products furnish much of the nation's power, heat and light. In this production, too, steel plays a vital role . . . carbon, alloy and stainless . . . much of which comes from the many mills of Republic.

* * *

[*For a full color reprint of this advertisement, write Dept. H, Republic Steel, Cleveland 1, Ohio.*]



Spartan ENGINEER

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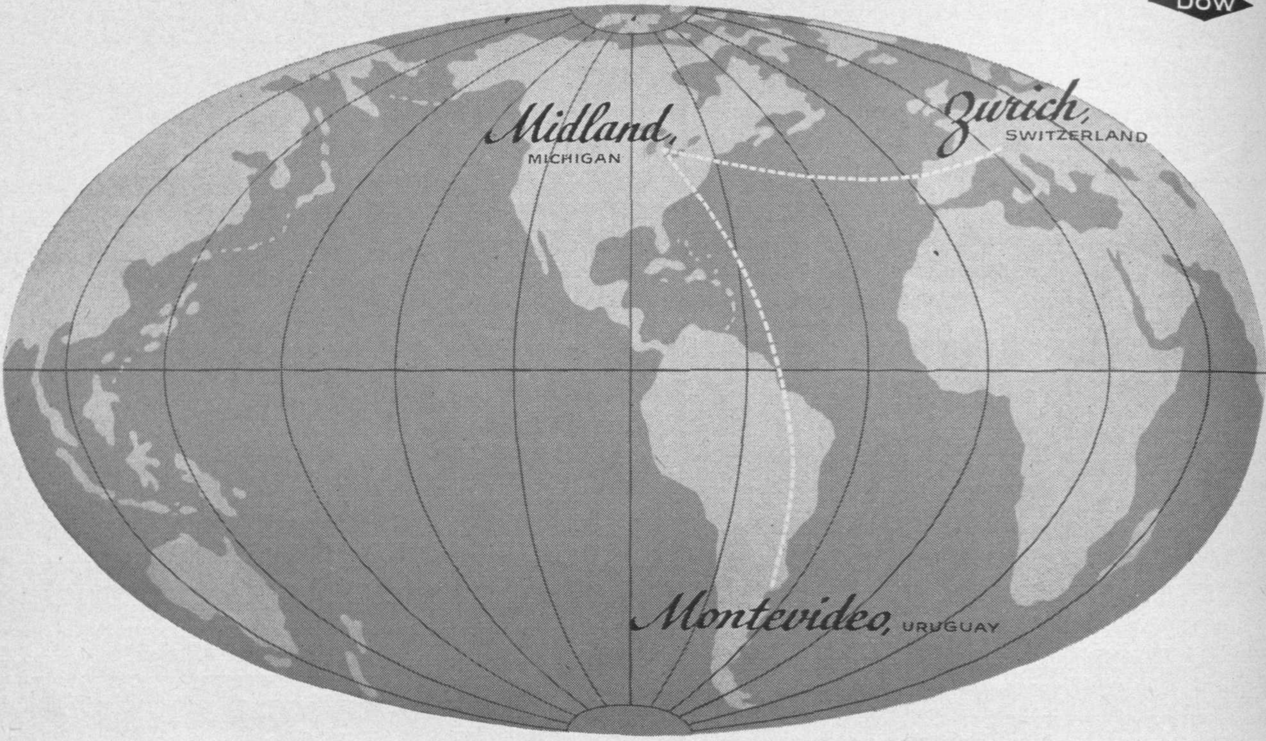

DOW ADDS NEW EXPORT COMPANIES

Dow has recently formed two subsidiary export companies to serve foreign industry's increasing demands for high-quality chemicals.

In the Western Hemisphere, Dow Chemical Inter-American Limited with sales offices in Montevideo, Uruguay will supply chemicals to Mexico and to many countries in Central and South America.

Industries in other continents—Europe, Asia, Africa, and Australia—will be served by Dow Chemical International Limited. Its first sales office will be in Zurich, Switzerland.

These two new export companies are only one example of the continued growth taking place at Dow. Each year finds new Dow plant facilities, increased production, new products developed . . . an over-all growth and expansion that requires a steady influx of men of varying talents, as well as providing excellent opportunities for those within the Dow organization.

Dow's Booklet, "Opportunities with The Dow Chemical Company," especially written for those about to enter the chemical profession, is available free, upon request. Write to The Dow Chemical Company, Technical Employment, Midland, Michigan.

You can depend on DOW CHEMICALS

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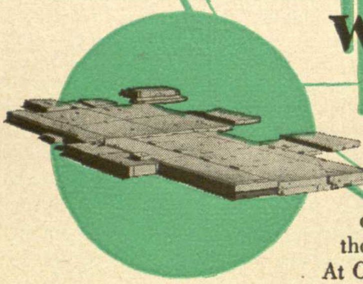

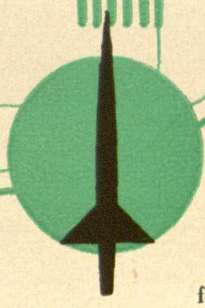

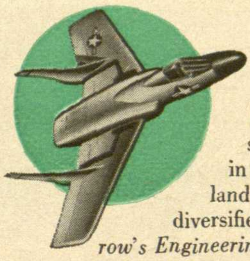

FREEDOM FROM — OR TO —

By LORIN G. MILLER
Dean of Engineering

Our nation was founded upon the principle of freedom, and freedom according to Webster is "exemption from restraint." In recent years we have heard much about freedom from want, from fear, from religious restraint and from **censorship** of our speech. We have fought a war to guarantee to our citizens freedom from slavery. We have passed laws intended to insure us immunity from the many ills incident to a society of ambitious people. Much of our success in attainment of the highest "standard of living" the world has ever known is due to this principle of freedom with which our founding fathers were so imbued.

A greater privilege is implied in our understanding of freedom. Not only are we protected **from** unscrupulous, unprincipled, unthinking people and careless or vicious acts, we are free **to** act and perform in such a manner that the welfare of our neighbors and associates as well as our own is promoted. We are free to vote, to invest, to research, to assemble and to promote. This implication of our freedom to perform acts which fit our abilities is the greatest of the blessings given us by the founding fathers.

But the freedom to perform is not without its obligations. Edwin Markham in "The Man with the Hoe" has given us a picture of this worker when he says,

"Bowed by the weight of centuries he leans
Upon his hoe and gazes upon the ground
The emptiness of ages in his face
And upon his back the burden of the world."

Not only are we permitted to produce, allowed to invent, privileged to supply, we are charged with the responsibility of seeing that the necessities of life are provided for those who, through no fault of their own, are in need. It is a serious charge and the obligations are being only partially discharged. We have serious need for greater production per acre, per kilowatt hour and per man hour.

It is a pertinent fact that there is much work to be done and too little time in which to do it. The word work is mentioned with hesitation. It is not a universally popular subject. Our Biblical forefathers were told, "In the sweat of thy face shalt thou eat bread," which being freely paraphrased could mean that those who are not willing to work should not be privileged to eat. In a recent address before the George State Chamber of Commerce, Benjamin F. Fairless, President of the United States Steel Corporation, said, "The only reason why people work on this earth is to gain a reward for their labor. If they work for other people, that reward is called a wage or salary. If they set up a business of their own and work for themselves their reward—when they get it—is called a profit." Years ago Adam Smith, the great economist, opined that "It is not from the benevolence of the butcher, the brewer or the baker that we expect our dinner but from their regard of their own interest." J. S. Mill states that only "the prospect of bettering their own condition" would conquer the natural sloth of most men. Our conclusion is that with an abundance of work, with pressing need for its accomplishment and a natural aversion by man to exertion, some type of incentive must be in evidence.

When a young engineer accepts a position with a firm doing the type of work in which he is interested and in which he feels he has talent, he is usually satisfied with his status in the organization. He has confidence in the personnel policies of the company. He is proud to be classified with the type of men with whom he will be associated. He is anxious to begin to have a part in the product. The incentive to work is great. Sometimes, however, after a few months some one is promoted past him, another gets an increase in salary above his, and still another is made head of his project. At the same time the project seems to make no progress and the work becomes repetitive and tiresome. The incentive to work is lessening. After a few years the routine gets monotonous. The transportation problem is annoying, the noises and odors of the plant are nauseating and the home workshop or model railway is more attractive. The incentive to work, really work, is gone. Assuming that the young engineer was not a "misfit," and usually he is not, and also assuming the operations of the firm were for its best interest, and in the majority of times they are, the fact remains that both the young engineer and the firm are losers, heavy losers, and the young man has the most serious injury.

Herbert Hoover has said, "It has been dinned into us that this is the Century of the Common Man. Thus we are in danger of developing a cult of the Common Man, which means a cult of mediocrity." Now mediocrity can be achieved two ways. The untalented by working hard may get there, or the talented by travelling the uncharted, uninspired route of "do little" will land there. The obvious path to achievement makes the Job the incentive. Plan something, learn something, accomplish something each day. Accept as blessings the "freedom from" but put your faith in your future in "freedom to." Julian Ralph gave encouragement to most of us when he said, "I do not despise genius—indeed, I wish I had a basketfull of it instead of a brain, but yet, after a great deal of experience and observation, I have become convinced that industry is a better horse to ride than genius."

GIRL ENGINEERS at MSC

By PHIL SANFORD
Chemical Engineer '54

Engineers at Michigan State College have two special reasons to be proud of their school—for they can boast of having among them two coeds.

The two girls are Alice Jacobson, a sophomore in chemical engineering, and Virginia Kueny, in her first year of electrical engineering. Both girls call Michigan their home state, Virginia hailing from North Muskegon, and Alice from Lansing.

Alike in the respect that they are both "lady engineers," the two girls present a rather surprising similarity in background, likes and dislikes, and objectives for the future.

Neither of the two could give specific reasons as to why she chose to study engineering. Alice said, "I guess it was because I like chemistry and math." Virginia listed two "maybe" factors: in high school, she had heard of the demand for engineers, and also that some companies will hire women over men.

VIRGINIA KUENY

From North Muskegon, Virginia is a freshman in electrical engineering. Several factors entered her decision to study engineering, one, the current shortage of engineers.

ALICE JACOBSON

Alice is a sophomore studying chemical engineering, says she entered this field of study because she liked chemistry and mathematics.

Both girls have fairly concrete ideas concerning after graduation. Alice said she thinks she would like to go into textile manufacturing, and admitted that perhaps the location of many textile mills—in New York and New England—had something to do with that decision. Virginia thinks she would like to work on circuit design after she is graduated. This could be, she said, in either a utility or a consulting engineering firm.

Alice and Virginia each have an interest in their respective societies. Although not in the American Institute of Chemical Engineers, Alice thought she might become interested in it sometime. She did, however, note being amused at mail from the Institute and other college functions addressed to her as, "Mr. Alice Jacobson." Of this, Virginia could report nothing. She did say that she had been to one meeting of the American Institute of Electrical Engineers—and although she said she couldn't understand what the speaker was talking about, she probably will join the Institute.

Although both girls have noticed antagonism toward them from some quarters, neither seems to be particularly bothered by it. In fact, both said this attitude on the part of a few individuals made them more determined than ever to become successful engineers.

Alice said she was somewhat surprised, though, when talking to representatives of a chemical company at the Career Carnival here last November. One man, apparently a salesman, told her she could probably get a job with their company as a supervisor: "walking around in overalls all day, climbing ladders, etc." The other man, an engineer, pointed out that his company didn't even allow women in their plant . . .

Turning to their actual schoolwork, both Virginia and Alice could report being especially fond of one or two subjects, and particularly disliking some. Virginia's favorite subject so far has been "manufacturing processes," which includes work in, among others, the sheet metal shop, machine shop, forge, and the foundry. Virginia also liked her one course in mathematics, and is "looking forward to calculus." Alice, true to her preliminary likes, chose chemistry as her favorite sub-

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THE ENGINEER AND THE PHYSICIST

By RICHARD SCHLEGEL
Asst. Prof. of Physics and Mathematics

Traditionally the engineer has been a man of practice and achievement who has little to learn from the physicist, who, in turn, has traditionally felt his kinships to be with the philosopher and mathematician rather than with those who build and manufacture.

The Roman engineers who constructed roads and bridges and circuses that are still in use today were superbly successful, and yet they knew little and probably cared less about physics as a theoretical science. Further, the Roman society which supported and encouraged them had no conspicuous concern for the study of physical science. The other great ancient Mediterranean culture which contributed much to our Western civilization—the Greek—was absorbed in philosophy and science to a degree that is almost incredible to us today, and the first complete treatise on physics, Aristotle's **Physica**, appeared in that Greek society. And yet the Greeks were indifferent engineers who apparently made little contribution to the arts of fabrication.

For many centuries the engineer was essentially an artisan or technician. This fact does not imply any aspersion on his intelligence or capability. The achievements of the past tell us that ingenuity and even genius must often have been a characteristic of the engineer. But his training was a learning of specific **techniques** from older workers. This must still be training procedure today to a considerable extent, but another factor of major importance has been added, namely, the teaching of general principles in terms of which engineering problems may be investigated and solved. The Roman engineer learned many facts about how to carry out this and that definite assignment, and thick manuscripts of compilation of these facts were produced, for example, Vitruvius' great work on construction and architecture. One can hardly, however, conceive that any Roman engineer would have set up a development or research project, in which, guided by his knowledge of physical science, he would attempt to find some new and better way of achieving an engineering goal.

The change that has occurred in engineering may be simply characterized by saying that engineering, originally based chiefly on a knowledge of techniques, is now in large measure dependent upon a knowledge of science and how to apply science. The natural philosopher, probably once regarded by the engineer as being as alien to his activity as a painter or a poet, has become a fellow worker to the engineer. This new relationship is the key topic of this paper.

The lack of cooperation between physicist and engineer in historic periods was certainly not a result of the engineer's overlooking a useful source of knowledge. Actually, it has been only in the past few centuries that physics has been able to offer specific, definite information in any field whatsoever to the engineer. Previous to, say, the sixteenth century, natural philosophy for the most part existed only as a body of rather general ideas, many of them highly speculative and without empirical confirmation. Such a period of philosophical inquiry would seem to be necessary in the development of a new intellectual field, like science, but it was not a period which offered much by way of assistance in the control of nature.

With the development of mechanics in the 16th and 17th centuries as a mathematical science—the science that is based essentially on Newton's Laws—there became available for engineers a body of scientific knowledge that was of major importance in the handling of physical matter. That is, the engineer could then learn from the physicist a body of principles, presumably applicable to matter everywhere and anywhere in the universe; armed with these principles the engineer could attack new problems that went far beyond the range of previous experience in specific situations.

The development of quantitative physical science of course did not stop with mechanics. In the 18th and 19th centuries there were developed, among others, an exact science of heat and energy (now known as thermodynamics), of electrical and magnetic phenomena, and of chemical change. These growths in our knowledge of nature were of fairly obvious value in the control and use of nature for man's purposes, and they have given rise to branches of engineering that go altogether beyond the traditional branches of civil and military engineering.

The engineer's transition from his position as a skilled artisan to that of an applied scientist gave his profession the same quality of continual change and development that characterizes science generally. As new scientific knowledge is gained, new domains for application appear. And in the engineer's own field of application the research and devolpment methods of the scientist are utilized. Basic ideas and principles are given to the engineer by the physicist or chemist, but engineers engage in "engineering research" that is altogether comparable to "scientific research," with the difference that the engineer's research generally has an emphasis on how knowledge may be utilized in useful manufacture or construction, while the scientist's emphasis is presumably on learning more about nature's ways simply for the sake of the learning.

The use of research methods in engineering, coupled with the research results coming from the basic sciences, mean that the engineer is faced with bewildering complexity and change in his profession. Obviously, he cannot rest at ease with what he learned from the textbooks and manuals of his college years. That is, he cannot do so if he is to continue to function in any kind of creative manner in engineering activities that are contemporary to him. There are important implications here for the training of the engineer. College work will give him a good start in understanding, and taking a part in, the development of engineering in his day if it has stressed the fundamental aspects of science and the applications of science. A different kind of education, which stresses training in the techniques of specific engineering activities of the day rather than fundamental knowledge, is surely not engineering training at all, but rather trade-school training, intended to fit a person only for one given job.

Science of today grows out of what was science in the year before. Hence the engineer who has a good grounding in the science of today has at least made a good start in understanding new scientific developments that have implications for engineering. To a physics teacher, it seems that engineers will be soon lost indeed, as engineers, if they have not been given a knowledge of the fundamentals of physics. Their training in physics, as in the other physical sciences, should not be merely in the parts of physics which are obviously of specific use in engineering today, but should in at least some degree be a training in all of the fundamentals of physics—a training that will give insight into what physics is and what are its present trends and potentialities. The engineer's education in physics, among the various pure sciences, does seem to be his most important education, for the various engineering specialists, excepting perhaps chemical engineers, are essentially applying the science of physics in their work.

What do these generalizations about science and engineering mean in the engineer's actual day to day job activities? The writer has little qualification for attempting an answer to that question. But, for what little worth it might have, he will recount some experiences that he had, working with engineers, at the University of Chicago Metallurgical Laboratory during the years 1943 to 1945.

This laboratory, which had been purposefully given the misnomer "Metallurgical," was set up by the United States Government for the investigation of questions pertaining to the construction of nuclear chain reactors. As is well known, the nuclear physicists of this laboratory established the first nuclear chain reaction in a squash court under the university's Stagg field football stadium on December 2, 1942. The success of this first nuclear reactor, or "pile," as the lattice-work of uranium and carbon blocks was called, gave a basis for planning a much larger reactor.

A site was secured in the semi-desert country of eastern Washington, at Hanford, on the Columbia river, and the Metallurgical Laboratory was given the assignment of making plans for the "Hanford pile." These plans were to include not only the reactor unit, but also methods for extracting the plutonium which is formed from uranium during the chain reaction process. The plutonium was to be delivered to the center which was being established at Los Alamos, New Mexico, for fabrication into a bomb.

It seems rather hard to believe, but at the Metallurgical Laboratory, in both oral and written communications, various significant geographic locations were always referred to by names like "Site X" or "Site Y", and key materials like uranium and plutonium were also given pseudonyms. There was something of the quality of a boy's "spy and counter-spy" game among adult men and women about the laboratory. The writer has a delightful recollection of a distinguished chemist who periodically had to make a trip to a southern laboratory; in his zeal for security, he invariably went to the railroad station loaded with skis, heavy clothing, and other paraphernalia that would indicate his traveling to the north.

The actual construction and operation of the Hanford pile was to be carried out by the duPont Company. Their vast engineering experience and skill was combined with the science of the physicists, chemists, and mathematicians at the Metallurgical Laboratory, for the purpose of building, in as short a time as possible, an entirely novel kind of industrial plant.

One of the writer's assignments at the Metallurgical Laboratory was to work with a group of physicists and engineers in an investigation of heat transfer problems in the proposed Hanford pile. Large amounts of heat are generated in the carrying on of a nuclear chain reaction, and at Hanford this heat was to be carried off by diverting some of the flow of the Columbia river through the pile. But how fast must the water flow through the pile so that the heat, forming at a high time rate, would be safely carried away? The design of the water passages was necessarily somewhat unusual; would there be "pockets" where heat would not be carried away, with the resulting formation of steam, perhaps followed by a disastrous explosion? Because of the novel situations involved, a book like McAdams' **Heat Transmission**, although helpful in presenting fundamental notions of heat transfer, would not give solutions with the accuracy required. Hence, the problems were attached in several ways. Scale models were made and temperature distributions measured with heat productions that simulated the productions calculated for the pile. Measurements of heat transfer coefficients were carried out for the unusual flow conditions in the pile and the temperature distributions in the pile were mathematically calculated from expected boundary conditions and the fundamental heat flow equation of Fourier.

What was expected of an engineer in this work? Clearly, in order to contribute his share, he must have known sufficient physics to be able to gain an understanding of why, and at what places, heat would be generated in the pile. He must have thoroughly understood the mechanisms and equations of heat transfer, so that this knowledge could be used in studying a highly novel heat transfer situation. Knowledge of heat transfer equipment then in use was, obviously, of little value in solving this engineering problem.

Another problem that was faced by the Metallurgical Laboratory engineers and scientists was that of properly jacketing the pieces of uranium that were to be placed in the pile. These uranium slugs must be cooled by losing their heat to running water, but because of the possible corrosion of uranium it was not feasible to place the slugs in direct contact with water. The jacketing of the slugs with, say, aluminum would not appear to be a difficult problem. But a leaking jacket would allow water to come into contact with the uranium, and resulting corrosion and swelling might lead to a water flow stoppage that would result in steam formation with ensuing damage. How much leakage might be allowed? How large must a tiny hole be, to permit a disastrous leak? What are the various jacketing possibilities and which gives the most promise of being "leak-proof"? These problems challenged, to the full, engineers' and scientists' understanding of how matter behaves. Probably no other problem in connection with the Hanford pile was so troublesome, and indeed it was suggested by some, apparently in all seriousness, that the entire project would have to be abandoned because of the difficulty of the jacketing problem.

The writer has mentioned only two of the many kinds of problems that faced designers of the first large reactor pile. There was a special urgency and drama about the

(Continued on Page 46)

MORE AROMATICS BY COAL HYDROGENATION

By TOM CLARK

Chemical Engineer '54

Coal hydrogenation is now a reality! A process now being developed by the Carbide and Carbon Chemicals Company will make it possible to produce greater amounts of aromatic chemicals for the whole chemical industry.

"Coal hydrogenation" is a term that has been tossed around so much that by now the uninformed layman might suppose that it has been a long accomplished feat. Actually, until now it hasn't been economically successful.

In the early history of coal hydrogenation, the process was used to produce fuels. The production of fuels by the destructive hydrogenation of coal was developed first in Germany during World War I by the noted German chemist Dr. Friedrick Bergius. Later, Hitler built 12 coal hydrogenation plants which produced over 24 million barrels of synthetic oil for fuel thirsty Germany. In other nations the production of synthetic fuels could not compete economically with petroleum fuels.

Aromatic chemicals are part of the intermediate product in the production of synthetic fuels. The word aromatic was coined by the old-time chemists because some of the compounds in this class of chemicals had a pleasant odor, but this doesn't hold true for all of them. Aromatic chemicals are organic chemicals in which the carbon atoms of their molecules are arranged in hexagon fashion. They are important in industries producing plastics, rubber, dyestuffs, perfume, paint and synthetic detergents, to name a few. For several years these industries have been hampered by the limited supply of coal chemicals and the demand for these chemicals has increased sharply since World War II. New uses for the aromatics have increased the demand 25 to 36 per cent per year. The increase in the present supply of these chemicals at the same time has only been three to five per cent per year.

At present the aromatics are produced as a by-product of the coke ovens. In this process, bituminous coal is heated to a temperature far too high for optimum yield of coal tar, the chemical-containing fraction. The steel industry is interested only in the coke since it is a much better reducing agent for its furnaces than the original coal and the production of coal tar is of secondary importance. Except for a few limited fractions of petroleum, which yield benzene, toluene and cresylic acids, the coke ovens are the only source of the aromatics.

To visualize the workings of coal hydrogenation, picture the carbon in coal as bonded in a multiple hexagon pattern to form a giant molecule or polymer. Each piece of coal might then be considered as a big, fat lump of complex hexagon molecules. Drawn out, the structure of one molecule of coal looks like a chicken coop fence or a tile bathroom floor. From this idea, chemists have taken to calling the study of coal derivatives, "chicken-wire chemistry." In the hydrogenation of coal then, the hydrogen acts as the wire cutter that cuts down the giant coal molecule into the aromatics, aliphatic hydrocarbons and synthetic fuels.

CARBIDE'S PROCESS

The outstanding feature of the Carbide and Carbon Chemical Company's coal hydrogenation process is that it will produce no recognizable fraction of synthetic fuels and only insignificant amounts of aliphatics. It is possibly the world's first high-pressure coal hydrogenation process designed to produce chemicals as the primary products.

The process developed by Carbide is now being carried out in a pilot plant at Institute, W. Va., which cost $11 million and 4½ years to build and design. The plant which has now been in operation less than a year processes 300 tons of coal daily. The Carbide people have gotten over their first hurdle by having a foundation of research with which to start a workable process. Their second hurdle—this plant—will provide coal chemicals for sales development work; operating and engineering experience for future plants with improved designs; commercial amounts of raw materials for new chemical products. The whole project is in a sense a long-term calculated risk on the part of the Carbide people.

A hydrogenation process is basically the same whether you are producing synthetic fuels or chemicals. The basic steps involved are these: grind up the coal, make a paste of it with oil, contact this paste with hydrogen at a high temperature and pressure, and separate out the complex chemical fractions formed. It is the Carbide kind of engineering ingenuity that makes the difference.

Here is what the Carbide people do to coal: Coal is crushed to about the size of wheat grains, ground, dried and then mixed with oil to make a paste. Actually, the coal pretty much dissolves to form a mixture of coal-in-oil. The gritty mixture is then pumped into the hydrogenator. Gaseous hydrogen is introduced. The temperature is raised to 840-1000°F and 4000 to 6000 psi. The coal and hydrogen react to form a liquid under these conditions in the presence of only about 0.5 per cent catalyst. This is the "chemical manufacturing" step. From here on, the job is one of separating the products of the reaction. To do this, the reaction mixture goes to the "hot separator" to take out the unreacted oil and solids. The distilled products are then condensed in the "cold separator;" this removes the gases from the liquid stream.

There are then three streams of products coming from the hydrogenator. They are: the stream containing the heavy ends, the gaseous and the liquid chemical stream. The unused oil is separated from the first stream and is recycled. The heavy ends that remain may be coked to produce a product comparable to petroleum coke for use in graphite electrodes. The gaseous stream contains largely the unused hydrogen along with varying amounts of methane, ethane, propane, butane and smaller amounts of ammonia and H_2S. The methane-to-butane gases are the raw materials for most aliphatics. It is possible then that someday Carbide could bank on coal as a basic source for any chemical, aliphatic or aromatic. The third stream from the hydrogenator contains the important aromatic chemicals. The light oil from this stream is in turn broken down into an acid fraction (phenolics), a basic fraction (nitrogen compounds) and a neutral oil (hydrocarbons).

The aromatic hydrocarbons are separated by distillation into various products. One of these—naphthalene—is purified by crystallization.

The phenolic portion is separated by continuous distillation into two fractions; one contains the high-boiling phenols while the other is made up of phenal, cresols, xylenols and cresylic acid. Each portion is then fractionated and refined into individual chemicals.

Crude hydrocarbon fractions can be refined into high-grade aromatic solvents and other products. The nitrogen compounds portion is separated by batch distilation to yield aniline, tolidine, xylidine and other nitrogen products.

Most of these chemicals from coal now have scores of important uses in industry. As soon as this process is put into large scale production, our chemical consuming industries can be assured of a dependable supply of coal chemicals independent of any other industry's need for coke. Already, Carbide has identified more than 100 products in the hydrogenation stream which they think can be produced in commercially significant quantities. These products will fit into the whole spectrum of organic chemical products, from explosives to paints and finishes, many in an entirely different way, creating new markets.

THE FUTURE FOR AROMATICS

From here on in the development of coal hydrogenation at Carbide will be an integration of research in the laboratories, market analysis by the sales staff and experimentation with the process itself at Institute. The production department will work to find out what compounds can be produced in significant quantities by the plant and the effect of varying conditions on relative yields. The research department will then try to find out how these products can be isolated and refined and, more important, how they can be used. And the sales department will try to find out how much of any product can be sold at what price.

The production department knows now that their process will turn out such widely used chemicals as benzene, phenol and toluene in very large quantities in addition to a considerable amount of higher aromatics. For example, Carbide expects to get 5 to 8 times the quantity of naphthalene produced from a ton of coal by the coke ovens, 100 to 200 times as much of the higher phenolics and 300 to 500 times the amount of quinoline. What is more, it will produce some chemicals, such as aniline, which are almost completely destroyed in the 1100° Centigrade operating temperatures of the coke ovens. Carbide's process is so flexible by varying the conditions of the reaction they can vary the relative amounts of the primary products and thus produce only the products that are in demand.

The most important job of the research department is the job of finding more uses for this new supply of chemicals. They have to create new markets for such chemicals as methylnaphthalene, indan and acenaphthene for which there are very few uses. The product engineer at Carbide must then be able to take a brand new chemical and find some practical use for it whether it be in the field of medicine, plastics or solvents. This research is being done at Mellon Institute at Pittsburgh. Actually most of the new uses for chemicals have been developed by getting the chemicals into the various research laboratories of the chemical industry.

The sales department at Carbide under the title of Technical Sales Development has begun a sales program similar to that Carbide used when it first began to sell aliphatics. Under this program small amounts of new chemicals are worked up, publicized, and broadcast in small samples to industries, with technical salesmen following up to explain properties, techniques, and possible uses. Currently Carbide is beginning to ship two coal-hydrogenation chemicals, a cut of high-boiling phenols and a mixture of aromatic solvents. More finely separated chemicals will be available in sample quantities within the next few months. Larger production of scarce chemicals such as quinoline will mean that we will have more nicotinic acid, an integral part of vitamin B complex. Some other interesting products of the aromatics are: a new rot-resistant textile chemical; gamma picoline, base for the spectacular new TB drug; and a possible whole new range of phenolic plastics from higher phenols. If the aromatics ever become available in large quantities, they will enter the fields ranging from agricultural chemicals to dyes to drugs to explosives to textiles and to new fields unforseeable at this time.

It would be a stretch of our wildest imaginations to guess what the aromatics hold for our future. We can say, however, that once the aromatics are in full scale production that they will, in one way or another, definitely effect our future. The first result will be the creation of new industries for the use of aromatics. Secondly, new fields and new jobs will be created by the expansion of the chemical industry. And finally, new and better things made with aromatics will in turn help to build a greater tomorrow for all of us.

WHAT DOES MECHANICAL ENGINEERING MEAN AT M S C

By LOUIS L. OTTO
Acting Head, Department of Mechanical Engineering

The military commanders of the armies maintained by the ancient civilizations were dependent upon certain members of their armies for the construction, maintenance, and operation of devices called "engines of war," which were used in an assault upon a fortified city. These picked men, possessed of the ability to visualize in three dimensions, plus the mechanical aptitude and courage to make their visions become realities, existed in an era when "might is right" was a realistic, if incorrect, slogan, and military engineering was their primary concern. Today, with 4000 to 5000 years of experience separating these early engineers from their modern counterparts, we unfortunately find it still necessary for many of our present-day engineers to direct their efforts toward the planning, construction and utilization of the "engines" of military destruction.

During periods of comparative peace in the ancient civilizations it was possible for the engineers to devote their time to "civil" projects, and there still exist today many examples of their skill in planning and building. The Pyramids and monuments of ancient Egypt, the beautiful buildings of ancient Greece, the amphitheatres of the days of the Roman Empire, are all monuments to the combined architectural and engineering efforts of these long-forgotten men.

Until the middle ages the engineer was concerned mainly with static objects and forces. The gradual development of machines for performing many of man's more arduous tasks, and the use of water or animal power to drive them, introduced motion and the dynamic concepts which accompany it, into the field of the engineer's activities. The limited amount of power available to drive these machines retarded the rapid development of this new field of activity, but the development of the steam engine removed a large share of this power limitation, and the number, size, and complexity of machines increased steadily. Those engineers who concerned themselves primarily with the production of mechanical energy from fuels, and the utilization of that energy for the production of the needs of mankind were the early mechanical engineers.

These early mechanical engineers were continually annoyed in their efforts to make bigger and better machines by the limitations imposed upon them by their materials of construction, and a knowledge of the properties of engineering materials, and of metallurgy, became a necessary part of mechanical engineering. Similarly, the need for larger and more efficient engines of several types led to the need for a more thorough and extensive knowledge of the principles of thermodynamics.

Development of new and important fields of knowledge have led to a diversification of the activities of the mechanical engineer, resulting in engineers who are basically mechanical in training but are known by some special designation, such as tool engineers, or in an almost complete separation from the original mechanical engineer, such as the electrical engineer and the metallurgical engineer.

The practice of engineering involves the use of man's knowledge of the laws and forces of nature to produce a result immediate or eventual to mankind. The practice of mechanical engineering includes: the generation of mechanical energy from fuel; the use of mechanical energy to drive machines of all kinds, including all self-propelled vehicles; the design, development, production, operation, and maintenance of machines and objects of an infinite variety; the production and fabrication of the materials of construction used in nearly all engineering activity. In these many fields of activity the mechanical engineer often works every closely with various types of scientists, or with other engineers such as the chemical engineer, the civil engineer, the electrical engineer, and the metallurgical engineer. Most present day engineering activities have become so complex that no one person can hope to keep himself fully informed in all fields.

MECHANICAL ENGINEERING TRAINING

To be effective in his efforts to become a useful member of the engineering profession an engineering graduate must have had adequate fundamental training in the fields of oral and written communication, mathematics, physical and chemical laws and actions, and the engineering methods of combining these fields of knowledge to produce an effective attack on an engineering problem. Communication skill is needed by the engineer to be able to learn of the activities of his predecessors and contemporaries, to record and pass along to others the results of his efforts in a manner that is clear, concise, and correct, and to convince others of the value of his plans and methods. However, for the engineer, communication skill must mean more than the ability to read, write, and speak the language of the country. The engineer must be able to understand, and to create, two dimensional and three dimensional pictures of objects, assemblies, and variations of factors. The drawing, model, and graph are nearly as much a part of the communication means of an engineer as is language, and he should develop skill in the proper use of these communication methods.

Mathematics is a tool of infinite value to the engineer. His entire correlation of physical and mechanical phenomena is based upon mathematical relations, and a knowledge of the laws and operations of mathematics up to a certain minimum level, and the courage to use this knowledge, are a necessity for any aspiring engineer. A knowledge of the basic physical and chemical laws are also a necessity, since it is upon these that the successful practice of engineering is based. The effective use of these knowledge tools is made much easier by the training which comes from their coordination and use in the many courses of instruction which are peculiar to the training of an engineer.

MECHANICAL ENGINEERING TRAINING AT MSC

The Mechanical Engineering curriculum at Michigan State College represents the efforts of the faculty to offer to their students the best balance of training in communication skill, mathematics, physics, and chemistry, and engineering fundamentals which can be comfortably fitted into four school years. During his initial year the emphasis is on communication skills, with three courses in the field of written and spoken English, and three courses in Engineering Drawing. Training in mathematics is begun immediately, and continues through the first two years to produce a firm mathematical foundation upon which the engineering courses of the junior and senior years can be based. Elementary Chemistry during the freshman year, and a series of three Physics courses during the sophomore year increase the students knowledge of natural phenomena and broaden the foundation upon which his engineering training is based.

The introduction of the student to engineering during his first year is provided by a series of courses in Manufacturing Processes, Elementary Design, and Industrial Organization. In these the student is introduced to the methods used by industry to fabricate its tools and machinery, the basic design principles of fabricating tools and equipment, and the organizational patterns used in industrial enterprises.

The balance of the student's curricular activities during his first two years are devoted to collateral courses, required of all students at Michigan State College, and intended to provide all students with a minimum level of liberal education. Included in the curriculum are a series of three courses each in the three fields of Natural Science, Social Science, and Humanities. Also, since Michigan State College is a Land-Grant College, all male students are required to participate in two years of training in Physical Education, and in Military Science and Tactics.

By the time the student has reached the final quarter of his sophomore year he has attained a sufficient background in communication skills, mathematics, physics, and chemistry, to concentrate on basic engineering training. The junior year and part of the senior year are completely occupied in training in the engineering fields of: thermodynamics, properties of metals and alloys; engineering statics, dynamics, strength of materials, and fluid mechanics; elements of electrical engineering; machine theory and design; nuclear energy theory; principles of power application.

Up to this point in their training all mechanical engineering students have had the same courses. Because of the diversity of aptitudes and interests among the students, and the great variety of activities into which graduating students will go, the senior mechanical engineers are given the opportunity to choose one of several options, and to devote approximately half of their senior year to these option courses. These option courses are intended to give the student training in a certain broad area of mechanical engineering activity, and to give him training in the application of his basic engineering knowledge to the solution of typical engineering problems drawn from the engineering field selected.

At the present time, senior options are offered in the fields of Automotive Engineering, Design Engineering, Industrial Engineering, and Power Engineering. Starting with the class of 1956, there will be two additional options available: Foundry Engineering; and Heating, Ventilating and Refrigeration Engineering. During his junior year the student will select his senior option. During his senior year he will complete all of the courses required in his chosen option, and take as electives several additional courses from other options, or from the large number of technical electives available. The option courses will introduce the student to certain types of engineering problems which he might encounter if he entered after graduation into the field of mechanical engineering indicated by the option title. However, it is not the intent of the option courses to give the student all the training he needs to step into an active and responsible position in a given field of industry. Instead they utilize the greater interest of the student in a certain type of work to improve his comprehension of his terminal undergraduate training in engineering methods. The product of this training is expected to be an individual with sufficient comprehension of mathematical, physical, and engineering fundamentals to absorb, and profit from, the post-graduate training which he will get in industry.

There can be no doubt that the training received by Michigan State College engineers has been effective in preparing them for a subsequent engineering career. Michigan industry especially, and to a lesser extent, industry and government in the United States and most foreign countries, is liberally supplied with MSC Engineering graduates who have attained positions of responsibility and trust due to their engineering activities. The number of requests by industry and government for MSC Engineering graduates has grown year by year. During the present nationwide shortage of engineering school graduates these requests have risen to nearly the stage characterized by the word "clamor." Although the present shortage will not always be so acute, developments indicate that the demand for engineering school graduates will not be nearly satisfied within the forseeable future.

The fields of activity into which the Mechanical Engineering graduate can go are very numerous. They include the general fields of design, development, production, operation, maintenance, supervision, sales and research in the general areas of power generation, transportation, raw material processing, heating, ventilation, refrigeration, steel production, automobiles and trucks, aircraft, engines of all kinds, chemical process equipment, machine tools, etc.

DEPARTMENT TO COLLEGE RELATION

The Mechanical Engineering Department is only one of the many individual departments which, collectively, make up Michigan State College. The Mechanical Engineering student at MSC has every opportunity to obtain the benefits which accrue to a student at any other great university. He can study, live, and play side by side with students from other departments whose interests

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THE FOUNDRY SOCIETY AT THE CAREER CARNIVAL

By CLARIDON THOMAS, Publicity, A.F.S. Student Chapter
and BRUCE HARDING, Corresponding Secretary, A.F.S. Student Chapter

The month of November afforded Michigan State College at East Lansing a wonderful opportunity and a large attendance for its fourth annual "Career Carnival." This all-college event is staged for the purpose of introducing college students and prospective college students to industry and to help these students direct their educational programs to a desired end.

The Career Carnival at M.S.C. was originally a brainchild of the Senior Class of 1949, for the purpose of introducing the senior students to interested prospective employers. November of that same year, however, saw a slight change in this arrangement as others on campus became more interested, until today the Career Carnival at M.S.C. is an all student event.

The tabulating of companies for the program made just before their representatives started arriving totaled 88 industries, plus the Armed Forces, social services, The American Foundrymen's Society and the Foundry Educational Foundation. From these 88 representatives students could choose a career of any sort to guide them during their entire college days. A cross section of these industries showed a representative sample of all fields requiring college graduated personnel throughout the country.

It was not until this year's Career Carnival, however, that the cast metals industry was represented in any way, and it is of interest to note that it had the only display booth which represented an industry as a whole.

The Career Carnival at Michigan State College was held on the second floor of the Student Union Building. Each industry was assigned a certain area or booth with which to work. The industry was then able to move in its displays showing the products it manufactured or a description of the services and opportunities it could offer.

The Carnival lasted for two days and two evenings with an estimated ten thousand people attending. These people were not only college students, but also high school students and their teachers, vocational school instructors, and others just wandering through out of pure curiosity. One of the interesting features of the Carnival crowd was that Thursday night was Date Night and all girls on campus were allowed late permissions if a Career Carnival program was taken back to the dormitory. This produced an unusually large attendance for that evening.

Invitations were extended to 52 colleges in Michigan by Michigan State's President John Hannah two months prior to the Carnival. Many of the invitations were accepted and representatives were sent to see the Carnival. The representatives expressed favorable opinions and stated that the Carnival was an excellent method of laying groundwork and achieving a goal for all college students.

Early last spring the Michigan State College Advisory Committee of the Foundry Educational Foundation met and decided that the cast metals industry should be represented at this year's Carnival. Money for this project was contributed by the four Michigan Chapters of the American Foundrymen's Society. Members of this Committee were Paul Olson, Chairman, Eaton Manufacturing Company, Foundry Division, Vassar; Ross Schaeffer, Lackey Foundry, Muskegon; Dave Boyd, Engineering Castings Company, Marshall; Charles Esgar, Staff Assistant F.E.F.; Charles Sigerfoos, Foundry Professor at M.S.C., and Ernest Frens, President of the M.S.C. A.F.S. Student Chapter, who worked with the Committee. Several meetings followed at the M.S.C. campus where the Advisory Committee of F.E.F. and a number of the student chapter members made plans and got display projects started.

The booth was designed to depict the carnival spirit and to attract the students, and then to show them the importance, functions, and opportunities of the cast metals industry. High above the display, where it could be seen for the full length of the corridors, was shown an electric sign reading OPPORTUNITY with an arrow pointing to the booth. It was constructed by student Jim Ogilvy. Brightly colored flashing lights on a carnival wheel was the next thing to hit the eye. Ernie Frens built this to show the variety of fields of education with which one could win within the foundry industry. Ashley Sinnett prepared a large display in the corner of the booth which showed, with toy models, the areas of application in which castings play their role and are the basis for particular industries. This portrayed the idea that the Cast Metals Industry was fundamentally a basic industry and had stability. Mounted in the base of this display was a continuous film loop, taken from "This Moving World." It was very ably narrated by Edwin C. Hill, showing in color some of the basic operations of

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THE TURBO-ENCABULATOR
A BOON TO INDUSTRY?

For nearly 20 years the Industrial Bulletin of Arthur D. Little, Inc., has endeavored to interpret scientific information in terms that the layman could understand. The present contribution is, however, of such basic significance to scientific thought as well as to industrial progress, that we have thought it best to print without delay for the benefit of those specialists who can fully appreciate its precise terminology. Perhaps one of these specialists will later offer a more general interpretation.

We regret that, despite the relaxation of wartime security regulations with their attendant hazards, the authors of this paper have preferred to remain anonymous.

THE TURBO-ENCABULATOR IN INDUSTRY

For a number of years now work has been proceeding in order to bring perfection to the crudely conceived idea of a machine that would not only supply inverse reactive current for use in unilateral phase detractors, but would also be capable of automatically synchronizing cardinal grammeters. Such a machine is the "Turbo-Encabulator." Basically, the only new principle involved is that instead of power being generated by the relative motion of conductors and fluxes, it is produced by the nodial interaction of magneto-reluctance and capacitive directance.

The original machine had a base-plate of prefabricated amulite, surmounted by a malleable logarithmic casing in such a way that the two spurving bearings were in a direct line with the pentametric fan. The latter consisted simply of six hydrocoptic marzelvanes, so fitted to the ambifacient lunar vane shaft that side fumbling was effectively prevented. The main winding was of the normal lotus-o-delta type placed in panendermic semi-boloid slots in the stator, every seventh conductor being connected by a non-reversible tremie pipe to the differential girdles-spring on the "up" end of the grammeters.

Forty-one manestrically spaced grouting brushes were arranged to feed into the rotor slip-stream a mixture of high S-value phenylhydrobenzamine and five per cent reminative tetryliodohexamine. Both of these liquids have specific pericosities given by $P=2.5C$ b/n 7 where "n" is the diathetical evolute of retrograde temperature phase disposition and "C" is Cholmondeley's annular grillage coefficient. Initially "n" was measured with the aid of a metapolar refractive pilfrometer (for a description of this ingenious instrument, see L. E. Rumpelverstein in "Zeitschrift für Elektrotechnistatischs Donnerblitze" vol. VII), but up to the present date nothing has been found to equal the transcendtal hopper dadoscope. (See "Proceedings of the Peruvian Academy of Skatological Sciences" June 1914.)

Electrical engineers will appreciate the difficulty of nubbing together a reguritative purwell and a supramitive wennel sprocket. Indeed, this proved to be a stumbling block to further development until, in 1942, it was found that the use of anhydrous nangling pins enabled a krypotonastic boiling shim to be tankered.

The early attempts to construct a sufficiently robust spiral decommutator failed largely because of a lack of appreciation of the large quasi-piestic stresses in the gremlin studs; the latter were specially designed to hold the roffit bars to the spamshaft. When, however, it was discovered that wending could be prevented by a simple addition to the living sockets, almost perfect running was secured.

The operating point is maintained as near as possible to the h.f. rem peak by constantly fromaging the bitumogenous spandrels. This is a distinct advance on the standard nivelsheave in that no dramcock oil is required after the phase detractors have remissed.

Undoubtedly, the Turbo-Encabulator has now reached a very high level of technical development. It has been successfully used for operating nofer trunnions. In addition, whenever a barescent skor motion is required, it may be employed in conjunction with a drawn reciprocating dingle arm to reduce sinusoidal depleneration.

Bus Driver: "All right back there?"

Feminine Voice: "No, wait till I get my clothes on."

Then the bus driver led the stampede to the rear to watch a girl get on with a basket of laundry.

Rose Technic

★ ★ ★

Mary had a little skirt
She stood against the light.
Who gives a
For Mary's lamb
With Mary's calves in sight.

★ ★ ★

Then there was the fellow who had a hobby of collecting stones and putting them in his bathroom.

He had rocks in his head.

Rose Technic

★ ★ ★

Two little boys were standing on the corner. A little girl passed by.

Said one: "Her neck's dirty."

Said the other: "Her does?"

Duke Engineer

THE ENGINEER-HIS GROWTH

By A. C. MONTEITH

Vice-President in Charge of Engineering
Westinghouse Electric Corporation

EDITOR'S NOTE: The following is an excerpt from a talk given before the Delaware Engineer's Association, Nov. 13, 1952.

What we are talking about tonight is not how any particular experience group can be expected to grow—but rather how we as engineers can promote the growth of all phases of experience, through individual and corporate effort.

If this is our aim, it seems to me that pertinent subjects for discussion would include the character of the engineer and what he can do to promote his own growth; what the corporation can do to promote the engineer's growth, and the goals to which this growth can be expected to lead.

I do think that the place to start is to discuss the individual and his responsibilities in this great undertaking. What are some of the characteristics a young engineer should have? Well . . .

He should have his mind fixed on a definite field of endeavor, but should allow some flexibility in his thinking.

He should be loyal to the company for which he works.

He must realize early in his career that interest in his job is paramount.

He must be willing to work.

He should be encouraged to be a team player.

He should have determination.

He must expect that his mistakes will be noted.

He must be encouraged to continually analyze himself on all matters but especially to be sure he understands his objectives.

He should be encouraged to accept responsibility.

He should be encouraged to be a businessman.

These points of course, do not cover all the desirable traits but are sufficient to suggest that in general, progress will be made if a reasonable degree of common sense is mixed with initiative.

But, before we complete this reference to the responsibilities of the individual in achieving growth, there is one other point I would like to make. I have set it aside from the other, not only because it is seemingly paradoxical, but because it is a question which everyone must face at some time in his life. And, in my opinion at least, while one answer will not necessarily assure growth, the other will certainly limit it.

The question is "opportunity" or "security," and in this form it has received a good deal of consideration and a fair amount of discussion in the political field. Generalizations have a way of being misleading, and I think that this is no exception when we imply that there is a choice of either opportunity or security. As a matter of fact, security follows opportunity. If you doubt that statement, think of the automobile at the turn of the century, and General Motors today or the Chemical Industry and the DuPont organization.

So I think it is essential for the young engineer to choose opportunity if he is to make future growth possible. By this I mean, a job which is challenging and stimulating, one which will give him an opportunity to do real engineering.

But, and here comes the paradox, I would caution the young engineer to beware of impatience. And unfortunately, the engineer with the greatest potential is frequently the most impatient. In all too many cases, impatience has blinded the engineer to the very real opportunities that are all around him.

Russell Conway's story, "Acres of Diamonds," tells of an ambitious young man who set out from his native Persia to look for diamonds. After years of fruitless wanderings all over the face of the earth, he returned home, a bitter and disappointed old man. And a little while later, he found his diamond mine—in his own backyard. In other words, opportunity is often within reach simply for the reaching.

So much for the individual. Now what are some of the responsibilities of others in seeing that he develops at a satisfactory pace?

Considerable attention in recent years has been directed to this problem by the Engineers' Council for Professional Development. This group has attempted to develop a program for the individual. Although through committees the Council does much work on subjects closely allied to our topic, I think we are most interested in the Committee on Professional Training which is formulating a program to bridge the first five years after graduation. The Committee firmly believes that if healthy attitudes are established during this period, from then on the young engineer can put greater effort into his own development.

To achieve this healthy development, the Committee recommended a number of actions.

In the first place, they found it essential that engineers be given the opportunity to do engineering. Now this may seem facetious, but detailed studies show that much of the work now being done by trained engineers in industry today can be done by supporting personnel. The Committee points out that this waste of engineering talent in a time of engineering shortage is not the greatest loss a company can expect unless it rectifies this situation. We must consider also that non-engineering assignments handled protestingly by older engineers adversely affect the young engineer because the attitude of the older man is important to his youthful counterpart. Further, non-engineering assignments for the young engineer can directly discourage him, and even worse, can impair his development by failing to offer the continued challenges essential to growth.

The second step, the Committee reported, in assuring that a man grows at the maximum rate is a good training program. The transition from directed development in college to self-development in industry is not easy, and such transition becomes more difficult with every passing day. This is true because industry is becoming increasingly technical and complex. While the craftsman of former years grew up with the business, the college graduate of today steps into a strange organization at a relatively high level. He has had no opportunity to understand, through long association, the methods and operations of the concern. Industry therefore has a dual responsibility in orienting him first into the business world itself and secondly in giving the guidance and training so that he can start building on the foundation provided by his formal education.

The training course brings the engineer into contact with the best men available for training work. Such association provides an enduring beneficial influence on his behavior. He unconsciously builds fences against influences that can reduce his professional status and his individuality.

Then too, by proper training, an industry that was new to a young man a short time before employment, becomes a dynamic entity, and he feels a part of it. Consider that the young graduate has been carefully selected as potentially a key man. He reports to work determined to really wade in and build a reputation. These hopes are increased when he finds that his company is devoting the time and effort necessary to acquaint him with its policies, objectives, and procedures. He realizes that meanwhile, he is, at best, only semi-productive but the company sees fit to pay him a salary during the training period. Certainly this company must have plans for him, and he must get himself ready for the opportunities that will open to him.

The sincere employer considers high-quality training of the young engineer to be an obligation, and his professional growth a challenge. It is certainly one way to help our young engineers "do more, quicker," and to that extent, have the effect of increasing our numbers, thus offsetting our present shortage.

In addition to a good program of training, another immediate measure employers can adopt to develop the individual is to urge younger men to continue their education. Good learning habits encourage efficient performance. Morale is kept high if the employer encourages and assists the young engineer in supplementing his college training by evening classes or guided self-study. The maturing and broadening effect is obvious.

Now, of course, it is recognized that physical location and other factors may not permit all organizations to sponsor educational programs. However, encouragement and guidance from supervision will start many graduates in groups of their own in self-improvement programs. The Engineers' Council for Professional Development program is aimed at expanding this opportunity for engineers in areas where it does not now exist.

But continuing education has another very real advantage for engineering as a whole. Right now the engineering schools are under pressure from one group which wishes to increase the number of engineering courses, because of increasing specialization. Another group advocates more of the so-called academic courses on the grounds that the engineer must handle business as well as engineering problems. Unfortunately both sides are right to a degree. But the compromise offered —a five year engineering course—seems to me to place an additional drain on already overtaxed educational facilities, a further deterrent to young men who must carefully weigh the cost in time and money of even a four year college course.

Now thus far, our discussion has been limited to professional growth of the young engineer. Equally, or possibly more important, is personal growth as a responsible and congenial member of the community.

During the first few years with the Company, the young engineer is finding his place in the organization, attempting to understand himself, and shaping his professional attitude, setting his sights on a goal. Frequently, he is establishing his family and generally his salary is modest. Closing the gap between his experience on the campus and realities of earning a living is not an easy task. It is further complicated by the fact that the majority of engineers must build up a new social life at the same time, since there just aren't enough job opportunities in either home town or college towns.

It seems to me that right here is an excellent place for the local engineering councils to take a hand and welcome the newcomer to the community as well as to the profession. I have attended enough local meetings to realize the excellent jobs these societies do in furthering technical knowledge, but it has always seemed to me that social events are very limited. The compatibility of professional interest of the engineering societies forms a good nucleus for advancing a social program.

* * * *

In this era of mass production, the engineer is taking an ever-increasing position in the executive field.

During the last decade engineers have begun crowding the bankers and lawyers in the contest for high-level administrative posts. So successful have been their efforts that an independent survey shows that one-third of the largest corporations in America—50 out of 150—are headed by graduate engineers. The records also show that 40 percent of those taking an engineering education end up in management positions. These figures become even more significant when one recalls that there are ten liberal arts and teachers colleges in the country for every engineering school.

So in conclusion we see that the schools, corporations, communities, and societies have one objective: to do everything possible to help the young man rapidly attain full professional stature, provided, of course, the young man realizes that he first must accept the program with enthusiasm and devote time to it. He will get out in proportion to what he puts into the program.

The degree of success attained by a young man depends on many factors, but there is little chance of success unless the man is enthusiastic about his job. The "Parable of the Stonemasons" illustrates this point and also poses the challenging question, "What kind of engineer are you?"

It runs: "Once upon a time a man stood watching the construction of a large edifice. Scaffolding reached high and the ground was littered with huge blocks of stone. Workers were engaged in many tasks, but the most interesting of them all were three stonemasons.

"The man watched them at work and then approached each of the three in turn.

(Continued on Page 42)

The Prize Winning

Tau Beta Pi Initiation Essay

By WALTER HUSS

Chemical Engineer '53

The terms used to define the fiery apparitions that appear in the sky have often been misrepresented. As used in this article a meteor is the fireball as it appears in the sky and a meteorite is the solid heart of the meteor that is left after it strikes the earth. Furthermore, a comet shall be considered as a very large meteor, some of which, if the tail is added, have exceeded the sun in dimension.

There have been misconceptions concerning these fiery objects since man first existed. Until fairly recent times, and to a degree even today, they have been revered as an agent of God sent to earth as a reminder of His omnipotence. An outstanding example of this is the Black Stone in the heart of the holy Koaba of Mecca. Because it fell from heaven it is the most sacred of all the reliques of the Mohammedans.

Meteorites are not a rarity, even though comparatively little is heard about them. The great showers that fall come in definite cycles and seasons and from this has arisen the theory that they travel in orbits, just as the earth, sun and other planets do.

While traveling in their orbits they sometimes attain the speed of 175,000 miles per hour. This high velocity is possible because of the lack of friction which the atmosphere surrounding earth would present. Meteors in earth's region of space move approximately 95,000 miles per hour and enter the first thin layer of earth's atmosphere at a distance of about seven hundred miles. They dash against this atmosphere at a speed of 7.7 to 44.7 miles per second, depending on whether they travel with or against the direction of rotation of the earth.

It is estimated that about one million meteorites the size of the end of a thumb fall on earth every hour, but since this equals only about one to every two hundred square miles of the earth's surface it does not seem quite so strange that they are seldom found. This rate of fall adds twenty pounds to one ton of mass to the earth every day and about one-half inch to the earth's radius, dating from its estimated birth.

Meteorites vary greatly in size. About ten billion the size of a marble or golf ball enter the earth's atmosphere every day but are reduced to mere meteoric dust by the time they fall on earth. However, a considerable number of a more appreciative size have fallen.

The earth has been more fortunate than our nearest neighbor, the moon. Unlike the earth, the moon has no tough resilliant atmosphere. The atmosphere surrounding the earth is equal in mass to fifty-two inches of the toughest steel armor plate but affords more protection than that due to its composition. When a metallic meteorite reaches the earth intact it is scarred and fluted by temperatures calculated to exceed three thousand degrees Centigrade; a temperature generated by the friction between meteorite and air molecules. In addition to the heat caused by air resistance, a great pressure is exerted on the meteorite. One the size of a medium sized hand, moving twenty seven miles per second at a height of twelve miles sustains a pressure of a half million pounds. It is this pressure which often causes them to blow up and disintegrate.

If a person chances upon one of these stones from heaven he quite often values it, thinking it may be a valuable object and perhaps composed of a material non-existant on earth. Actually he would have a meteorite of little innate value, since there have never been discovered any elements in meteorites which didn't exist on earth, and usually in abundance.

Meteorites fall mainly into three groups. The siderites, or metallic type, the aerolites, or stony type that is composed of the same rock substances that are common to most areas on earth, and mixtures of the two types, siderolites. Ten to fifteen percent of the meteorites recovered are virtually solid chunks of metal and an equal number are rocks alone. Although more metallic and mixed meteorites are found, more stony meteorites fall to earth but are not found because they look much like ordinary stones and are smaller than metallic meteors.

Of the three greatest catastrophes that have been accepted as arising from the action of meteorites, the

This essay, part of the required pledge activities of all Tau Beta Pi aspirants, was chosen the best of the Fall term initiation class. The winning essay has been sent to the national Tau Beta Pi Board for competition on a nation-wide level.

most publicized one is represented by Barringer Crater, located a few miles from Winslow, Arizona. This fireball came from the north over the Idaho mountains. "Its glowing heart was a mass of nickel-iron, probably five hundred feet thick and weighing more than one million tons." It drilled through 2,400 feet of solid rock, ground millions of tons of rock into flour and raised a rim around the crater that rises 125-160 feet above the surrounding plain yet today. The crater is 4,100 feet wide and six hundred feet deep; less than one-half its original depth. Evidence of a meteorite fall was supported by the work of Dr. D. M. Barringer. He found metallic masses at 1,346 feet by drilling under and beyond the south rim of the crater, indicating that the meteor probably came at a low angle from the north, as had been surmised by earlier studies.

Science has estimated this event to have occurred twenty thousand to fifty thousand years ago and again a mystical reverence has arisen from the cataclysm; this time by the Hopi Indians of Arizona.

The greatest meteorite fall of modern times took place shortly after the turn of the century and remained comparatively unknown for nineteen years. This act of nature chose June 30, 1908 as its appointment date with earth. It fell in the wild, almost uninhabited swamp lands between the Yenisei and Lena rivers in Siberia. In 1927 Prof. L. A. Kulik and his expedition crossed the tundras to this remote section and found a shallow depression about two miles wide. "The ground had been pushed up violently sideways, as a stone dropped in thick mud, so that concentric rings were still visible. Inside this large depression were two hundred craters with diameters ranging from one to fifty yards. Every tree in the depression was destroyed and all trees in a radius of twenty to thirty miles were fallen in a fan-like fashion.

The person closest to the disaster that remained alive was a farmer fifty miles away. He saw a great light followed by utter darkness, then a wave of such intense heat he feared his clothes would catch fire. He woke up on the ground after several hours of unconsciousness only to discover that the porch on which he had been standing had been leveled with his house. A herd of fifteen hundred reindeer a few miles closer to the fall were entirely obliterated, except for a few thoroughly charred carcasses. At the same time a train on the Trans-Siberian railway four hundred miles away was stopped for fear it would be thrown off the tracks.

As tremendous as were those two meteoric falls there is yet one that almost pales them into insignificance. This flaming comet came from the northwest; over Alberta, Saskatchewan, North Dakota, and Minnesota. Over Illinois the compressed air ahead flattened forests like matchsticks. Over Kentucky, Tennessee, and the Great Smokies it came, melting rocks of the mountains. "It almost missed the continent, but struck the southeastern coastal plain in the area between Virginia and mid-Georgia." Nothing much remained alive in North Carolina, Georgia, and eastern Tennessee and severe results were probably felt as far north as Quebec and west to Kansas. Fires raged over 100,000 square miles.

"This was a swarm of meteors, thousands of feet thick, roughly spherical in shape and covered an area four hundred miles wide. Had it been a solid mass of stone and metal it would be comparable to a cannon ball one hundred miles in diameter. Evidence of this blow to earth can be seen today. In the Atlantic coastal plain there are thousands of earth scars. They are strangely regular, rounded to almost a circular shape and up to ten thousand feet in diameter. The scars exist mainly in a belt eighty miles wide, four hundred miles long, from Virginia to Georgia, parallel to the coast, but twenty to forty miles inland. However, this is only part of the entire area hit. The whole area covered is believed to have been an ellipse with its long axis running northwest-southeast; that is, at a right angle to the present belt of bays. This belt would have extended from a spot well to west of the Appalachian mountains to a point far out into the ocean off the southern Atlantic coast. The eastern part of this oval would now be obliterated by the seas that formerly extended far inland. The western hilly and mountainous part would be effaced by erosion long ago. The craters exist only in the plains where submergence under the ocean apparently wasn't long enough to destroy outlines of the craters and erosion is very slow. "Magnetometer tests prove great masses of metal exist just southeast of certain bays."

Estimates today of this meteoric fall are not too exacting and place it at anywhere from six thousand to sixty thousand years ago.

In this present age of atomic energy we are inclined to think that such catastrophes as these could only be the result of atomic energy release. This is not the case. These scars on earth are the result of inertia of motion and inertia of rest, compression of matter, and physical and chemical explosions.

From a study of these planetoidal collisions man has been able to learn more about the history of earth and the universe, expanded his knowledge in most of the scientific fields of endeavor, and has the only direct evidence that other bodies in the universe are composed of the same elements as earth. What results this almost newly acquired supply of knowledge has on the life-course of mankind can only be revealed by the passing of time.

The Future of Our Petroleum Reserves

By LARRY JACKSON
Geology '53

At the time an oil well is abandoned as much as 80 percent of the initial quantity of petroleum may yet be underground. This was the case of one of the older fields. The field had been operated until it became an unprofitable venture. Yet a greater quantity of petroleum was left underground than had been extracted.

The first flow from a well is obtained without the aid of "man directed" forces, and is known as "primary recovery." This driving force is the result of three separate pressures on the petroleum. They are:

1. Pressure caused by the weight of the overlying rock formations.
2. Gas pressure upon the petroleum.
3. The hydrostatic pressure of the water below the petroleum which is included in the reservoir.

When a well is drilled into a petroleum reservoir, it acts as a vent and the high pressures seeking an outlet move toward the well. The migration of gas and water

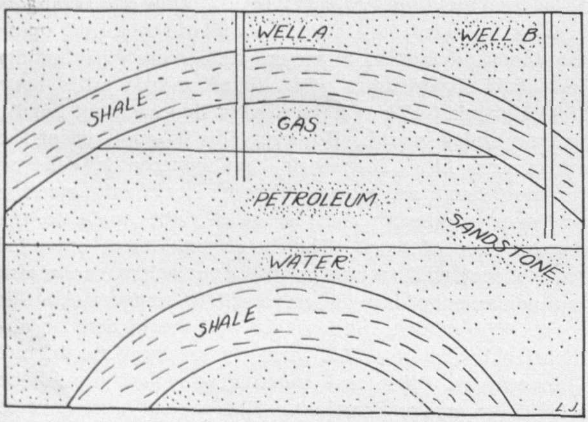


Figure 1. Cross-section of a typical petroleum reservoir which has been on production for a short period.

will drive some petroleum ahead of it. However, the greater portion of petroleum remains in the reservoir because the petroleum is more viscous and has a greater force of adhesion to the rock grains than does gas or water. The result of these conditions is a short production life for the reservoir. As the gas is removed the pressure drops, which in turn decreases the driving force on the petroleum.

All this time the water is approaching the well in tongue-like projections from the main body below the petroleum. The tongues of water by-pass a large volume of petroleum and will in time cut off the petroleum entirely, as they seek to relieve the pressure. This condition is best understood by visualizing a bicycle wheel turned on its side, with the hub representing the well, the spokes representing the water, and the air spaces representing the by-passed petroleum.

A typical production record of a well using only primary production methods would show a large quantity of petroleum produced for a short time after the well is opened. The quantity of production then drops off sharply and starts a gradual decline until water begins to show. This water presents an added problem. It must be separated from the petroleum and disposed of by some other means than the local streams. These disposal techniques are covered later under "water injection" methods. Eventually the cost of lifting the mixture and separating the petroleum from the water becomes greater than the price of the petroleum. The well is now unprofitable to operate, yet a large quantity of petroleum has been bypassed by water. The petroleum is now unrecoverable by primary methods.

The main key to the problem of low production is the natural gas found in the reservoir. If it is put back into the reservoir it will drive more petroleum to the well. As long as the pressure is maintained in the reservoir, a portion of the gas will remain in solution with the petroleum. The gas in solution causes the liquid to be less viscous, which in turn makes it more easily recovered. The process just outlined is one of the "secondary recovery" methods in use today.

"Secondary recovery" is defined as forces directed by man to obtain petroleum from a reservoir. There are many different methods used in "secondary recovery," but the two that have been proved are "gas repressuring" and "water injection" methods.

The principle of "gas repressuring" was given previously. In the application of this principle, the gas is not allowed to blow off in the form of a gusher when a new well is brought in. Instead it is capped; then petroleum and gas are taken from the well simultaneously. The gas as it comes from a well contains natural gasoline and other liquid gydrocarbons. Hence the term "wet" gas is used. This "wet" gas is processed in the field to extract the liquids. The "dry" gas is then pumped back into the reservoir to add to the pressure of the reservoir.

The use of "water injection" has produced more petroleum to date than "gas repressuring." However, the more recent fields favor "gas repressuring," due to greater ease of operation and lower cost. A complete coverage of the reservoir by water input and petroleum production wells is required when using "water injection" methods.

Although the trend today is toward "gas repressuring," there are limits to its adaptability, beyond which "water injection" is best. It is true that "water injection" is more efficient in recovering petroleum, but the expenses are also greater when using this method.

Water flooding is used in reservoirs which are composed of fine grained sands, because the water will penetrate smaller pore spaces than can the petroleum. This means that water will flush every space the petroleum can occupy and will in turn give a greater yield. Reservoirs having coarse sands or porous limestones are operated more efficiently by the gas drive method. This is true because capillary forces are reduced sufficiently to allow the gas pressure to flush the pore spaces. "Water injection" would give a greater yield, but the larger quantity of petroleum produced would not be sufficient to cover the expense of installing this system.

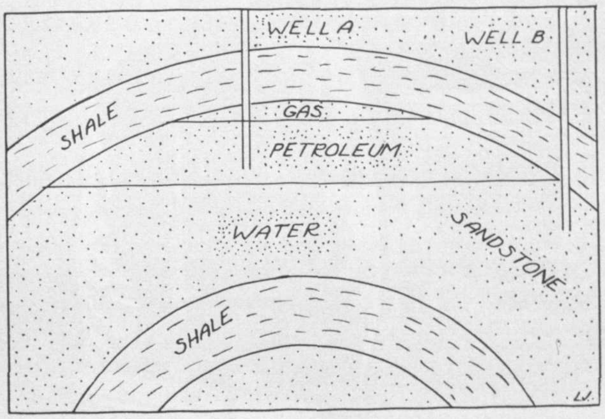


Figure 2. The same reservoir after a long period of production. Note the gas volume has decreased and the water level has raised sufficiently to cause Well B to produce only water.

Before a field is put on secondary production, a study of the reservoir must be made to determine which method should be used. If the decision is to use water injection, a pattern covering the entire reservoir with "injection" and "production" wells must be designed, which will return the greatest production with the least number of wells. The spacing of well holes is determined by the size of the drainage area around each well, which in turn is an indication of the permeability of the reservoir. A few new wells are usually required to complete the pattern of both types of wells. New "injection wells" are likely to be drilled just off the edges of the reservoir to insure that the petroleum will be forced toward the center of the reservoir.

The most common configuration in use is the "five spot" pattern, where four injection wells are arranged in a square with one production well in the center of that square, and in turn every injection well is bounded by four production wells. This is a ratio of one injection well for every one production well. Figure 3 is an example of such a pattern.

The only variation from this pattern is found at the edges of a field, where the pattern is forced to conform to the shape of the reservoir. Since the water will tend to push upward, it is best to locate "injection wells" down dip of "production wells." Figure 1 will illustrate this technique.

Well "B" contacts the reservoir rock at a greater depth than well "A," therefore well "B" is down dip from well "A." However a large field using the "five spot" pattern will have some "production wells" located down dip of "injection wells." This condition is unavoidable, but in large fields it is not too serious.

Another expense of this system is the cost of lifting the petroleum-water mixture to the surface and separating the petroleum from the water. The water extracted from the "production well" is then treated to remove corrosive agents, thus preventing pipe and pump damage. Clay is also removed which will clog the reservoir pores if it is allowed to remain in the water. After these operations are completed the water is then pumped back into an input well to aid in the further flooding of the reservoir.

Should a reservoir be fitted for "gas repressuring," only wells near the top of the structure will be converted to "injection wells." The gas cap is found at the top of the structure if any is present. The object is to add gas volume directly to the gas cap. Thus, converting a "production well" to gas injection requires only puncturing the well casing near the top of the gas cap.

The main reasons why "gas injection" costs less are: fewer injection wells are required. Only one out of five to seven wells are necessary for injection using this method instead of a one to one ratio which is required of "water injection." Also no set pattern of wells or even a complete coverage of the reservoir is required when employing "gas repressuring."

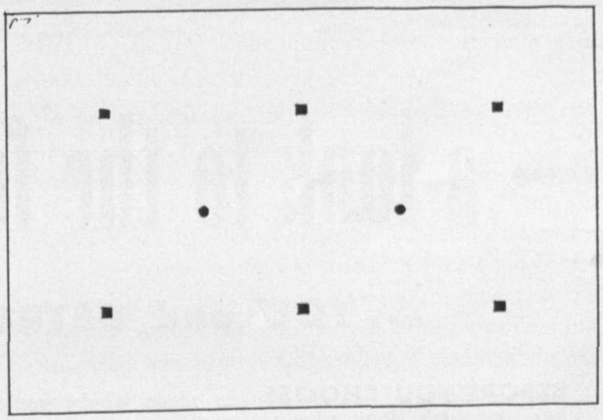


Figure 3. The "five spot pattern;" squares represent "injection wells" and circles are "production wells."

Today when a new petroleum reservoir is tapped, "secondary recovery" methods, previously outlined, are brought into early use. The production schedule is set by reservoir engineers to insure the greatest possible yield on a long term basis. This involves conserving the pressure in the reservoir, which is a "secondary" method. In the interest of greater production it is best to withdraw the petroleum slowly. A slower flow will carry fewer loose grains which may lodge in the pore spaces and cut the flow. It also aids in maintaining the pressure and gives individual droplets a chance to collect in the well rather than being by-passed and lost. A typical production record would show a yield similar to primary production, but the decrease in production is much slower using secondary methods. Old reservoirs become rejuvenated when operated by secondary methods. An increase and then a constant or very slight decrease in production is noted, once the new methods are adopted.

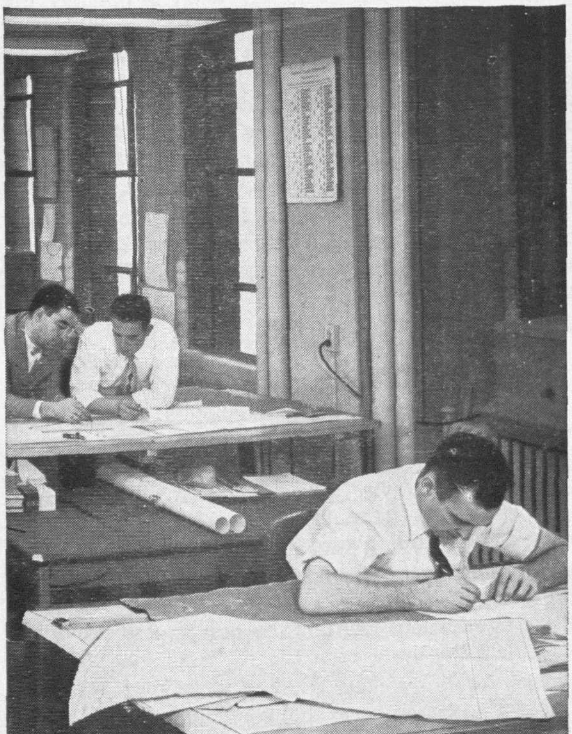
However, even the best "secondary methods" leave sufficient petroleum underground to warrant an attempt at further recovery. The term "tertiary recovery" is being used in connection with mining, detergents, and heat techniques. However these methods are unproved at this time.

Board and room to grow!

"Sure. I realize there are opportunities at General Motors. But how long will I be stuck on a drafting board before I can take advantage of them?"

This is a very familiar question to our College Representatives at their job conferences with engineering seniors.

And—in the individual case—frankly it's a hard question to answer. For often first jobs for graduates in certain phases of engineering work are at a drafting board. And the length of time the individual stays at a drafting board depends on many variables—most important being the individual's own talents and his ability to develop them.



But there is one general answer that can be made. And it's a very recent one. At a large gathering of General Motors engineers—many of them in top management—others in important divisional positions—this question was asked:

"How many of you started your GM careers on a drafting board?" The answer: practically everyone said "I did!"

So perhaps the best reply to your query about the duration of your drafting board experience is to say — "there are drafting boards and drafting boards." And a GM drafting board has this advantage—it can lead to a secure and satisfying life work in a company headed, in many cases, by engineers and with a record of supplying engineers with the equipment and the associations and the opportunities they ask to make the most of their particular training.

May we suggest you ask any such questions of our College Representative. Your College Placement Office can arrange a meeting with him on his next visit to your campus. Or drop us a line.

GM POSITIONS NOW AVAILABLE IN THESE FIELDS:

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Your Engineering Council

By PHIL SANFORD
Associate Editor

The Engineering Council . . . What is it? What does it represent, and why?

Most likely the majority of you reading this page do not know the answers to all or any of these questions, and possibly do not even care. You should, however —both care and know about the functions of this organization. For, it is an organization for you—**your** Engineering Council.

Membership in the Council is composed of representatives from each engineering organization on the Michigan State campus, and presently numbers about 35 people. Each professional society, such as the American Institute of Electrical Engineers and the American Society of Civil Engineers, is entitled to three representatives on the Council; two upperclassmen and a sophomore, elected in his second term; each honorary fraternity—such as Tau Beta Pi and Pi Tau Sigma—has one member on the Council, as do the interest societies—such as Phi Lambda Tau. In addition, the Spartan Engineer has two Council members, and there are several people on it representing organizations in fields closely allied to engineering—the Industrial Arts Society among these.

Thus far we have considered what the Engineering Council is and what it represents. The why of the Engineering Council, though, is more important and more difficult to answer than the two previous questions.

First of all, the Engineering Council may indirectly be one of the factors which influenced your decision to study at Michigan State College. On another page of this magazine there is a full description of the activities of JETS—Junior Engineering Training for Schools. The Council helps out in this function—designed to give Michigan high school students a view of what a future in engineering might mean to them.

In another, even more positive way, the Engineering Council attempts to help both high school and college students by sponsoring, in conjunction with the other campus engineering organizations, the annual Engineering Exposition. Each year the campus societies and commercial firms from in and around Michigan set up exhibits of things pertaining to engineering in Olds Hall and other buildings on campus. For two days, high school students, college students, and other interested people are free to walk through all the exhibits, talk to company representatives and engineering students, and even have available to them a free testing, counseling, and guidance service.

In addition to all this, the Engineering Council presents at the Exposition three special features: a banquet for professional engineers, a speech by an outstanding member of industry, and a show by a commercial company which highlights scientific achievements of today and dreams for tomorrow. This year Michigan State is privileged in having the services of members of three of the nation's outstanding firms, in putting on these three features. Dr. Kenneth McFarland, a consultant to General Motors, is the featured speaker, while both General Electric—through Detroit Edison Co., and Bell Telephone Laboratories of New Jersey will have shows during the Exposition. The General Electric show is their famous "House of Magic," while Bell Telephone will present its non-technical show of switching circuits.

Reigning over all these activities is the Engineering Queen, who this year will be chosen by the students of the engineering school. Her reign also includes the Holiday Ball, a dance sponsored each fall by the Council.

Now, you may ask, "Why should this concern me?" This is what we think is the answer: This function—the Engineering Exposition—offers what is possibly the best chance each year for you to meet members of industry and talk with them about job opportunities and a career in engineering; it offers the best chance for you to see what is being done by students and faculty in departments of engineering other than your own, and it offers you one of your best chances to meet and work with the engineers in the other departments.

With these facts and opinions in mind, think of the opportunities you might have to help the Engineering Council, and then act. Please—support **your** Engineering Council.

* * * *

Last fall the Spartan Engineer ran three articles concerning scholarships and graduate fellowship awards available to all undergraduate engineers. Since then, we have received no news of any additional such awards. We have, however, received further information concerning the A. F. Davis Undergraduate Welding Award. The report is that there has been a small number of entries made for this award.

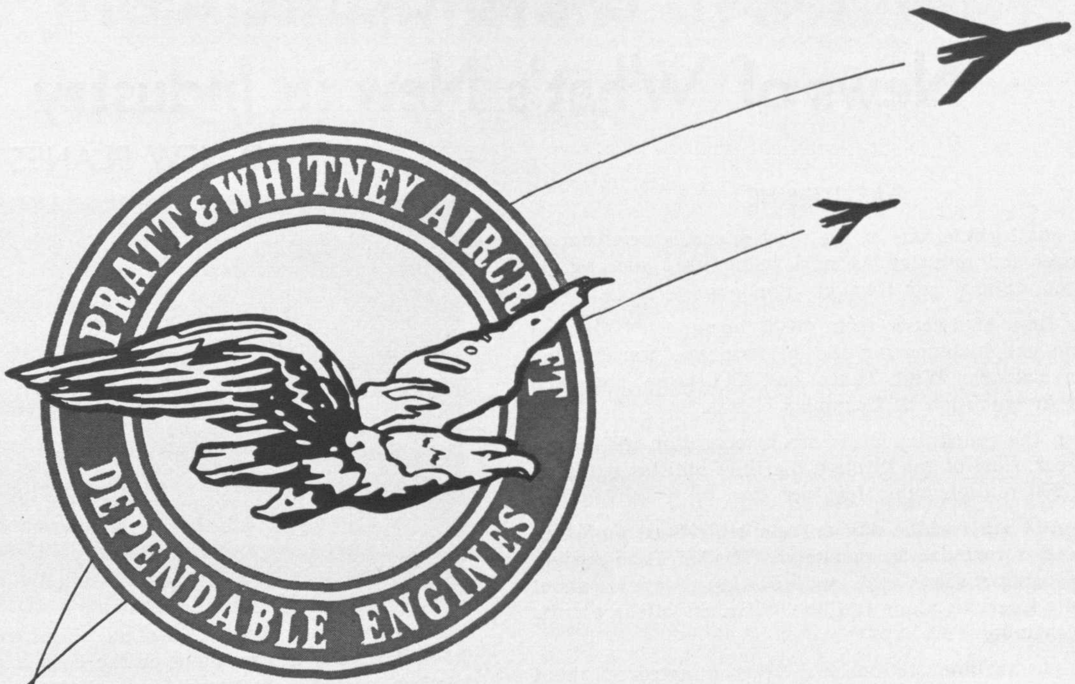
The first prize in this contest consists of $200 and second prize is $150. In addition to the individual prize, the publications printing the best papers submitted will receive a duplicate award.

Deadline for this contest is April 1, 1953. For further information about it, see the November issue of the Spartan Engineer, or contact a member of the magazine's editorial staff.

* * * *

Do you have any questions or comments concerning what has been said on this page? About anything in this magazine? Or about anything pertaining to engineering in general?

If you do, the Spartan Engineer would be glad to hear from you. Send your contributions c/o Box 468, East Lansing, Mich., or bring them to the Spartan Engineer Office, third floor, Union Building.



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New Developments
News of What's New in Industry

GAS TURBINE

The gas turbine, one of the most versatile new sources of power for industry, is now being used successfully to pump natural gas through pipelines.

The first of twenty-eight 5000 horsepower General Electric gas turbines for the El Paso gas transmission system between West Texas and California has been placed in operation at Cornudas, Texas.

When the remaining units are in operation within the next year, flow of gas through the lines will be increased about 300 million cubic feet per day.

The new gas turbine will operate centrifugal pumps to obtain this increase in capacity. The El Paso system is now using stations with reciprocating pumps at about 100-mile intervals along the line. The use of these units will continue.

The gas turbine stations are being inserted at about 30 mile intervals between existing reciprocating stations to boost the average pressure and the flow of gas.

The operating cost of the new stations is expected to be less than the cost of present reciprocating stations, principally because the new stations will require less manpower for operation and maintenance.

Sites of the new stations are in the desert where water is a precious commodity. Gas turbines are well suited to such locations because they require little water and few operating personnel.

MARINE CORPS BODY ARMOR

U.S. Marine Corps body armor—called "shrap jackets" by American fighting men—is now being produced in quantity.

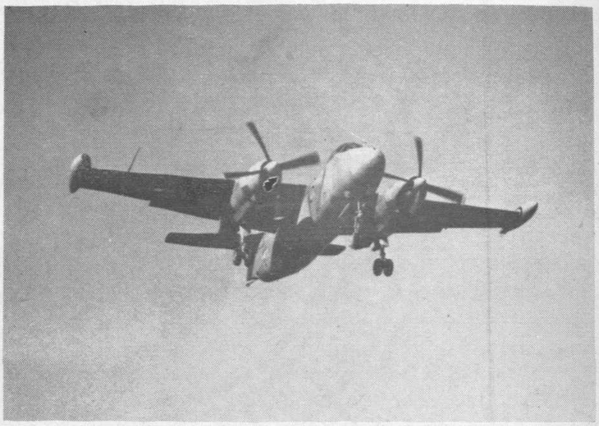
In revealing that Westinghouse is making the armoring material for the Marine Corps, Eugene Perry, Micarta Division manager said the "shrap jackets" get their life saving properties from three things: the way they're made, and their two basic ingredients, glass cloth and a synthetic resin. This combination enables the material, known as Doron, to actually stop deadly mortar and grenade fragments and similar low velocity missiles.

When a fragment or a small caliber bullet strikes the material, the layers of impregnated cloth separate as the missile attempts to smash its way through. This delamination actually sets up a cushioning effect that instantly reduces the velocity of the fragment to practically zero.

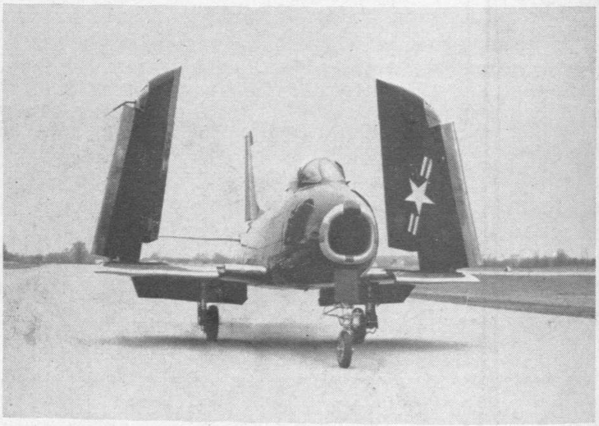
Doron is made by applying heat and pressure to layers of resin-impregnated glass cloth. While the exact details of manufacture are withheld for security reasons, it can be revealed that the layers are not pressed together tightly. If they were, the plates would lose some of their effectiveness against the missiles they are intended to stop.

The present model of the armor vest, weighing less than eight pounds, has been described as the best of its type ever developed.

TWO NEW PLANES



The new AJ-2 Savage. An advanced version of the AJ-1 Savage, this new plane is the largest carrier-based bomber in the U. S. Navy's arsenal. It weighs 26 tons, is 65 feet long, 21 feet high, and has a wing span of 75 feet. It is capable of delivering an atomic bomb from either carrier or land-based stations.



This picture is of the Navy's new FJ-2 Fury and shows how the plane's wings fold for carrier storage. This plane is a swept wing jet fighter, which carries four 20 mm. cannons and is capable of a speed of 650 miles per hour.

NEW DEVELOPMENT SHORTS

Passenger car horns manufactured by Delco-Remy division are tuned to the musical notes E flat and G, which provide a pleasing tone and carry maximum distance.

Spark plugs must operate in 1,500 degree temperature, giving up to 2,000 sparks per minute, and withstanding explosive pressures as high as 500 pounds per square inch.

A surfagage, an instrument that detects scratches as small as one millionth of an inch, has been developed. It is used in shops and factories to determine the average roughness of highly machined surfaces of such parts as pistons, and cylinder linings which call for precision fits.

Is the Human Brain Obsolete?

By LEE MAH
Electrical Engineer '54

Another Prize-Winning Tau Beta Pi
Initiation Essay

After the presidential election four months ago, it was disclosed that early in the election tabulations, UNIVAC, Remington Rand's analogue computer, a mechanical brain, had predicted the outcome of the election. This prediction turned out to be astoundingly accurate. UNIVAC predicted that Eisenhower would win 40 states and Stevenson only eight. It also predicted a considerable lead in popular vote for Eisenhower. The reason why these facts were ignored at the time was that the humans operating UNIVAC refused to believe them. They altered the information going in UNIVAC to get results which they thought were right. It turned out that UNIVAC was right and they were wrong.

Why is it that a machine such as UNIVAC is able to outthink the human brain? The reasons are, first, compared to the nerve impulses in a mechanical brain, the human impulses seem very slow and sluggish. The nerve impulses in a mechanical brain can travel at the speed of light. The human nerve impulses are hopelessly outclassed by this speed. Secondly, the mechanical brain is able to concentrate with pure logic entirely on one subject and one subject only. It has no such extraneous factors as prejudices, party loyalties, or other emotions to distract it. In other words, its conclusions are based completely on cold, cold facts. No human brain is yet capable of accomplishing this.

How did it come about that Man who claims himself to be the master of all mortals is now challenged by this mighty thinking machine? There was an old saying to the effect that "It is man's own creative ability that leads to his destruction." This seems to be true in the case of the mechanical brain.

Man first began by inventing the adding machine. A harmless little gadget that could add, or substract, 2 and 2 and produce the right answer. Obviously, to compare such a machine to a human brain is ridiculous, for this machine is extremely primitive in comparison. It does not even possess the brains of an idiot. However, as new inventions came about, the machine was able to do all types of arithmetic calculations. And then, finally, it developed into the forerunner of the modern brain. Such is the evolution of the mechanical brain. The forerunner of the modern brain is "Simple Simon." It can handle operations that consist of a relatively small amount of numbers and has a limited memory. But it can perform reasoning operations of indefinite length. It can be said to have the brains of a moron.

From this midget of a machine has come the colossal electronic brains of today. The IBM Automatic Sequence-Controlled Calculator (Mark III), for instance, takes only 0.004 second for addition and 0.01 second for multiplication of two 16 digit numbers. It can also memorize 60,000 units of information. A new electronic brain has already been developed to design aircrafts and guided missiles conforming to any set of design characteristics.

Electronic brains are now being used in situations where the nerve impulses of a human being find it impossible to respond with the swiftness that is required. For instance, in the newly developed F-94C high speed, all-weather interceptor, it was found that human reaction alone was inadequate to operate the aircraft. Therefore, electronic devises were installed for flying the craft and for firing its armament. In manufacturing and in chemical plants where high speeds and high quality production found normal human controls inadequate and inefficient, electronic brains are taking over the job.

At the present, it is believed that there are two very important shortcomings of the mechanical brain. One is that the thinking apparatus must be turned on or off by human beings. The second is that problems must be created by Man to be fed into the machine. The machine cannot create problems. As for the first shortcoming, it is conceivable that with the increasing reliability of Man on the mechanical brain to solve his problems, he must through necessity leave the machine switched on and improve it for continuous operation. The second defect seems insurmountable. However, one must realize that when man first came out with the adding machine little did he know what it might develop into later. Who can predict with certainty what the mechanical brain may develop into tomorrow?

There is no doubt in the fact that the mechanical brain today can do much quicker and more accurate calculation and reasoning than the human brain. This is shown by its increasing use in high-speed aircrafts and in industries. As such, it is an incalculable aid to mankind. However, will man who invented this monster brain continue to develop it to such a degree of perfection that it will eventually replace his own thinking device?

Junior Engineering Training for Schools

By RALPH L. PAUL

Ass't Prof., Engineering Drawing

The story of JETS, Junior Engineering Training for Schools, goes back four years to the time when the current engineering shortage first became apparent. The enrollment in the engineering schools and the prospective enrollment was not enough to furnish the required number of new engineers. In order to increase the supply, Dean L. G. Miller of the School of Engineering conceived the idea of a high school organization to acquaint students with the engineering profession. The purpose is not to sell engineering to high school boys who are trying to decide upon a vocation, but rather to give them information and experience upon which to make a decision. It is felt to be as important to have one boy decide against engineering as a profession as to have another decide to enter that profession. In other words, the purpose is to help the student make his first decision sound and lasting.

Local clubs are formed in high schools where there is interest enough to have at least five or six boys active in the organization. Some high school teacher, such as a mathematics, science, or industrial arts teacher, acts as the advisor or Jet Pilot. In each case, it is planned that a professional engineer serve as consulting engineer. The officers of the club are Captain, First Officer, Communications Officer, and Navigator who serve as President, Vice-President, Secretary, and Treasurer, respectively.

As the purpose of the club is one of activities, business and organizational matters are kept at a minimum. Activities may include projects which may be of individual or group nature. Projects can consist of experiments, investigations, model building, or anything which strikes the fancy of the individual or group. The idea is to illustrate the scientific laws or the procedures employed by an engineer when carrying out his duties. Other activities are varied. Some of these are visits to enterprises employing engineers and engineering procedures. Some may be talks or demonstrations by engineers and scientists. Many films and recordings which have interest for JETS members are available from educational institutions and industrial concerns.

At the present time, there are about 20 clubs in the state of Michigan and at least one in New York state. Inquiries come from many different areas. General Electric is encouraging similar clubs in the areas surrounding some of their large plants. They have also been very helpful in supplying material of interest to JETS.

In Michigan, the activities of the year are culminated at the Engineering Exposition held at Michigan State College early in May. At this time, projects may be exhibited and prizes, which may include scholarships, are awarded for outstanding entries.

Staff members in the School of Engineering aid the JETS program as an extra-curricular activity. They write projects, make visits, and serve as consulting engineers.

The college assists a JETS Club in several ways. In addition to visits of faculty members, many materials are available. Lists of literature, films, recordings, and projects are compiled and revised and made available to the clubs. These materials in some cases are available directly from the college and in other cases addresses are given where they may be obtained. Starting kits are available which consist of the Jet Pilot Handbook, suggestions, projects, and lists of additional materials and aids which will be furnished upon request. Periodically, a newsletter called "JETS-O-Gram" is sent to the clubs with information of interest to them.

Recently, one of the honorary organizations at Michigan State College required each of its initiates to write a project. The results were very satisfying. Probably one of the reasons is that these men have been out of high school for only a few years and can place themselves at the high school level more easily than an older person. These projects will be edited and combined in cases of similar subjects and be made available to club members. Other honorary organizations are contemplating following the practice for initiation use.

It is difficult to evaluate the results of such a program. The JETS organization has been in operation long enough so that we now have some former JETS members in the Engineering School at Michigan State. One of these recently won a slide rule for the highest scholastic average during his first term at college. This prize is awarded each year by the Michigan State College chapter of Tau Beta Pi, all engineering honorary. A student who came to an early Engineering Exposition will, in 1953, serve as Chairman of the Exposition. Those connected with the program are happy to see these students succeeding in this manner.

Students now at Michigan State who have not belonged to a JETS Club often express their interest in such an organization realizing that it would have been of immense value and help to them in planning a college career. Some of these students in their visits to their home towns contact a member of the public school system to interest them in the JETS program. Others express interest in being able to assist in this work upon their graduation and entrance into industry. The JETS program is growing and no one pretends to know how far it can go. Both high school teachers and students express a great deal of interest in the organization and need more help than is now available to them. The program is worthy of whatever assistance any engineers, whether professional or student, may be able to give.


10TH REUNION
CLASS OF '53
53

Clubs and Societies

EDITOR'S NOTE: The Spartan Engineer welcomes contributions to "Clubs and Societies" from any engineering organization on campus. This can be an effective way of reviewing past activities and outlining future plans for all interested persons.

Bring contributions to the Spartan Engineer office, third floor, Union Building; or send them c/o Box 468, East Lansing, Mich.

A. S. A. E.

The American Society of Agricultural Engineers finished up the fall term with five members attending the winter session of the A. S. A. E. convention at the Edgewater Beach Hotel in Chicago Dec. 15-17. The program consisted of lectures and the reading of reports on recent research projects. Of special interest to the graduating members was an hour each day set aside for job interviews.

The winter term started out with members assisting the agricultural engineering department as guides during Farmers' Week to those farmers visiting the department.

At the Agricultural Honors banquet February 11, Carl Granthen received the annual award as the club's outstanding member. The prize is a six-inch slide rule, awarded on the basis of club and campus activities.

On February 15, the student chapter attended a joint meeting with the parent society. Highlight of the trip was a tour of the Conners Creek power plant.

Plans are now being made for the Engineering Exposition and the Jolly Trolley.

TAU BETA PI

On November 19, 1952, the Michigan Alpha Chapter of Tau Beta Pi held their annual fall term initiation. Those initiated into the fraternity were seniors Thomas Burke, Stanley Dudek, James Gusack, Walter Huss, Louis LeBay, Robert Morton, Clifford Mosher, John Mysing, Lawrence Scholten, and juniors William Crampton, Leo Jedynak, and Lee Mah.

Tau Beta Pi's outstanding freshman engineering student award for 1951-52 was given to John Rood, East Lansing sophomore.

The winter term initiation was held on March 4, 1953. At this time, Mr. Jack F. Wolfram, General Manager of the Oldsmobile Division of General Motors, was initiated into the Chapter along with 29 undergraduates.

At the banquet held immediately after the ceremonies, Dean Lorin G. Miller was presented with a gift by Chapter President Elvin E. Tuttle. Mr. E. V. Sayles of the Consumers Power Company was the main speaker of the evening. Dr. R. J. Jeffries of the Electrical Engineering Department was toastmaster.

The new members who came in at this time were seniors William Cronkrite, Eliguiz Galesewski, William H. Friday, Charles A. Partlow, William R. Rood, and juniors William Busch, Jacquith Butler, Stuart Byam, Clayton Callihan, John Clark, David Cummins, Wayne Erickson, John Giddings, Bruce Harding, Delbert Elliott, William Kannawin, Richard McClaughry, Gerald Massa, Fred McFadden, Joseph Meyers, Allan Moore, Howard Newcomb, George Pence, Richard Sedlak, Laurence Smith, James Stang, John Walker, Rolland Wheaton, and Leslie Wolsey.

AIEE-IRE

At their first joint meeting of the winter term, AIEE-IRE members heard a talk on "A Long Range Problem For Engineers" by Mr. Frank Sanford, Assistant Chief Engineer of Commonwealth Associates at Jackson, Mich.

The members are now working on projects for the Engineering Exposition.

ETA KAPPA NU

Eta Kappa Nu, Electrical Engineering Honorary, is holding an initiation for new members. Members are working on projects for the Engineering Exposition in co-operation with AIEE and IRE.

A. S. C. E.

The next meeting of the American Society of Civil Engineers will be open to all engineers on the Michigan State College campus and to any interested professional engineers. Feature of the evening will be a film on the building of the new Wayne County Building in Detroit, and will be shown by Mr. H. Warren Reise of Harley, Ellington, and Day. Time of the meeting is Thursday, April 9, at 7:30, and will be in Room 111, Olds Hall.

Recent activities of the Society have included preparation of its annual report to the parent society, and a trip to Detroit February 19. Included in the trip were visits to the Detroit Sewage plant, the Wyandotte water works, the United States Steel company, and the Portland Cement Association.

Work on the Engineering Exposition is proceeding rapidly, with probable exhibits to be in surveying, soil mechanics, hydraulics, and the concrete lab. Ray Filipchuck and Carl Siefert are co-chairmen of exhibits for the Exposition.

THE FIFTH ANNUAL

ENGINEERING EXPOSITION

IS COMING

MAY 1 and 2

Using an electron tube developed by RCA, automotive engineers have perfected an instrument which automatically controls automobile headlights.

Out of the stars – a cure for headlight glare!

When RCA scientists developed an electron tube so sensitive that it could respond to flickering starlight, astronomers promptly put it to work in their studies of the Universe.

Called a *multiplier phototube,* RCA's invention now "takes to the road" in an instrument which will add to your safety when driving at night. The multiplier phototube is now being used in an *automatic control for automobile headlights.*

Here's how it works. RCA's tube, in a new system, sits behind your windshield where it can "see" approaching headlights. A car comes, and the multiplier phototube activates a system which shifts your headlights to low beam—returns them to high when the other car has passed. It's simple. It's completely automatic. And what's most important, it lets you keep your undivided attention where it belongs . . . *on driving your car.*

Development of the multiplier phototube is another example of how RCA research benefits you. RCA research assures you finer performance from any product or service of RCA and RCA Victor.

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See the latest in radio, television, and electronics at RCA Exhibition Hall, 36 West 49th Street, N. Y. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York 20, N. Y.

CONTINUE YOUR EDUCATION WITH PAY—AT RCA

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- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
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- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to College Relations Division, RCA Victor, Camden, New Jersey. **Also many opportunities for Mechanical and Chemical Engineers and Physicists.**

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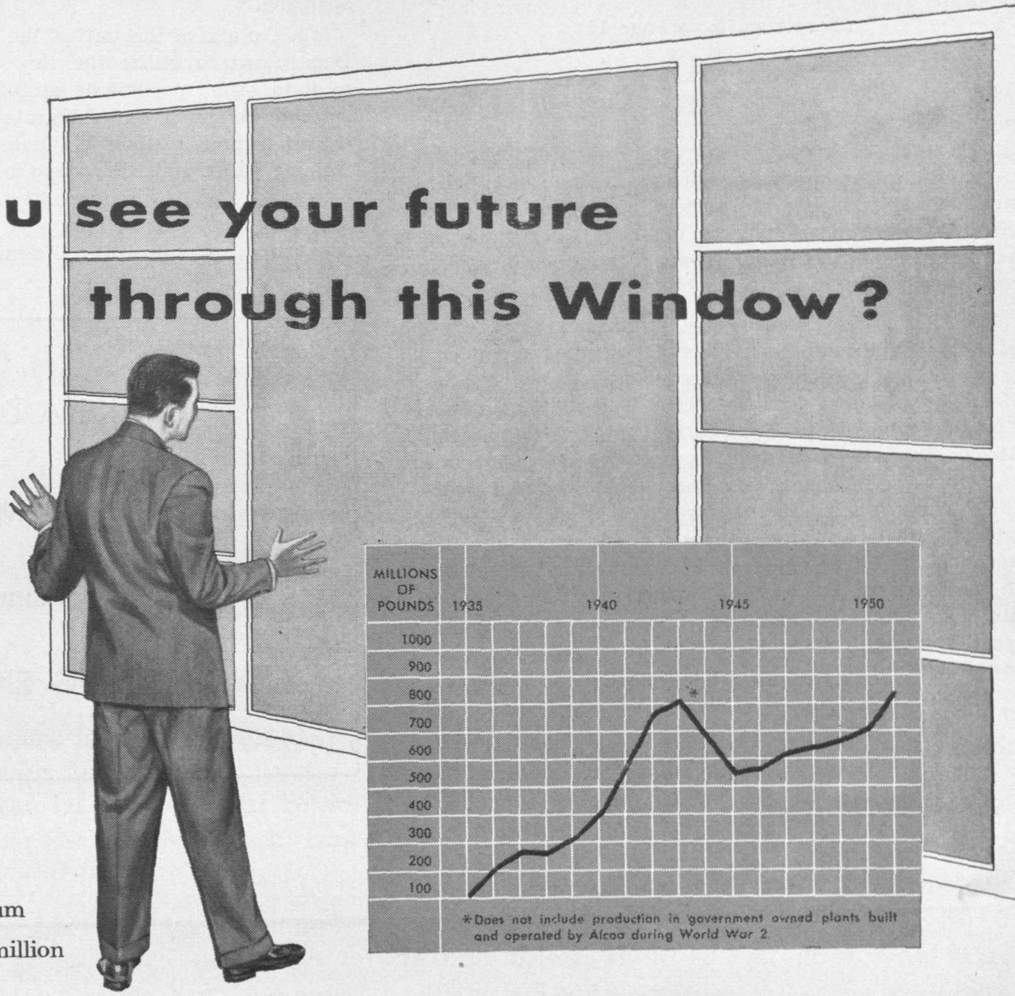


This is an aluminum window, one of four million that will go into buildings in 1953. Twenty years ago, it was just an idea in the mind of an Alcoa development engineer. Ten years ago, only a few thousand were made annually. Now, production *is increasing* at the rate of over half a million a year. This is just one of a torrent of new uses for aluminum which means that Alcoa must continue to expand. Consider the opportunities for you if you choose to grow with us.

What can this mean as a career for you?

This is a production chart . . . shows the millions of pounds of aluminum produced by Alcoa each year between 1935 and 1951. Good men did good work to create this record. You can work with these same men, learn from them and qualify yourself for continually developing opportunities. And that production curve—is still rising, we're still expanding, and opportunities for young men joining us now are almost limitless.

Ever-expanding Alcoa needs engineers, metallurgists, and technically minded "laymen" for production, research and sales positions. If you graduate soon, if you want to be with a dynamic company that's "going places", get in touch with us. Benefits are many, stability is a matter of proud record, *opportunities are unlimited.*

For more facts, consult your Placement Director.

The best things in aluminum come first in **ALCOA ALUMINUM**

By ALUMINUM COMPANY OF AMERICA • Pittsburgh, Pennsylvania

Mechanical Engineering

(Continued from Page 15)

will lie in areas distinctly different from his own, and his outlook on life cannot help but be broadened by this contact. The college can offer many opportunities in entertainment, sports participation, and cultural activities. Courses in a wide variety of subject fields are given by recognized experts in those fields, and are available for all students having the necessary prerequisites.

The Mechanical Engineering Department makes use of the availability of those experts by sending its students to other departments for courses in Mathematics, Physics, Chemistry, Natural Science, Social Science, Humanities, Communication Skills, Engineering Drawing, Engineering Mechanics, and Electrical Engineering Fundamentals. In return the Mechanical Engineering Department maintains extensive laboratory facilities in its own fields, and uses these to offer courses for students from other departments in the College. Well equipped laboratories in the fields of Automotive Engineering, Industrial Engineering, Foundry Engineering, Forging and Welding, Heat Treatment, Sheet Metal Fabrication, Pattern Making and Woodworking, Power Generation, Refrigeration, Machine Tools, and Experimental Stress Analysis, are all part of the equipment of the Mechanical Engineering Department, and are used to good advantage by its staff members to illustrate and augment their classroom instruction.

It is the aim of the staff of the Mechanical Engineering Department to utilize the time and facilities available to it to offer to students at Michigan State College a carefully planned and integrated series of courses intended to provide their graduates with the fundamental training which will allow them to become better members of society, and to become effective members of an engineering profession which will provide them with an interesting and rewarding lifetime career.

MAKE A DATE

MAY 1 — MAY 2

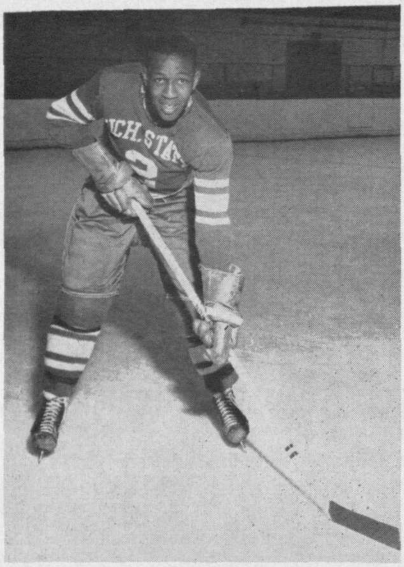
Fifth Annual

ENGINEERING EXPOSITION

ATHLETICS and ENGINEERING

By RICHARD LORD

Chemical Engineer '53



DICK LORD

Dick is co-captain of the Michigan State Varsity hockey squad. Rated as one of Coach Amo Bessone's finest and most spirited players, Dick started his college hockey-playing as both a forward and defenseman, then at defense only, and now in his final year is strictly a forward.

Dick, in addition to being a hockey stalwart for four years, has successfully combined an education in chemical engineering with his sports activities.

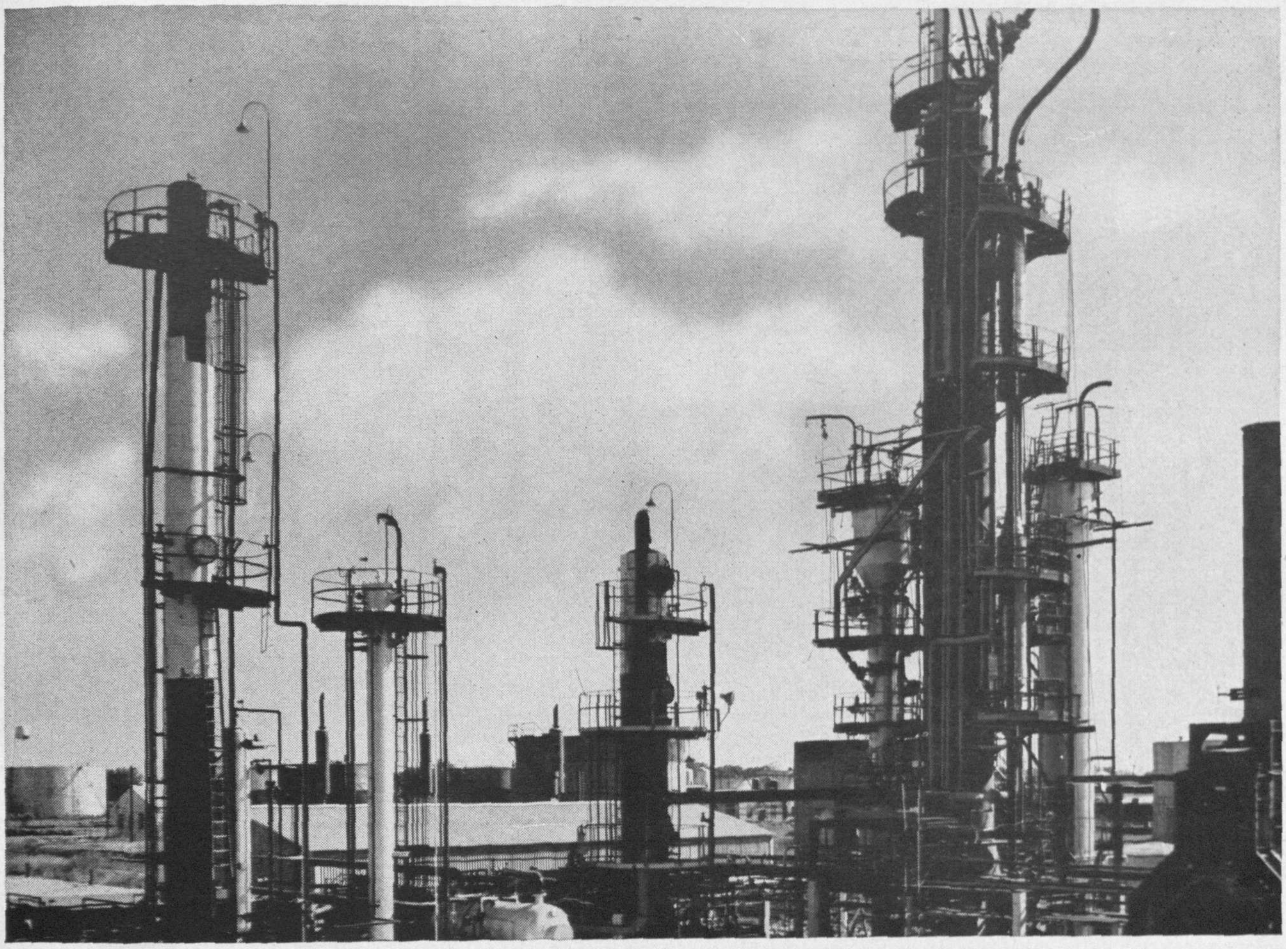
One of the best examples of academic work and sports in harmony is the combination of engineering and athletics. Engineering is the art of constructing and designing useful works. Besides receiving a sound training in this essential field the student gains a physical program necessary for mental alertness. In recent years, many athletes of note have graduated from the school of Engineering, among them Jim Davies, boxer; Dick Rieger, tennis; and Bill Finneran, hockey.

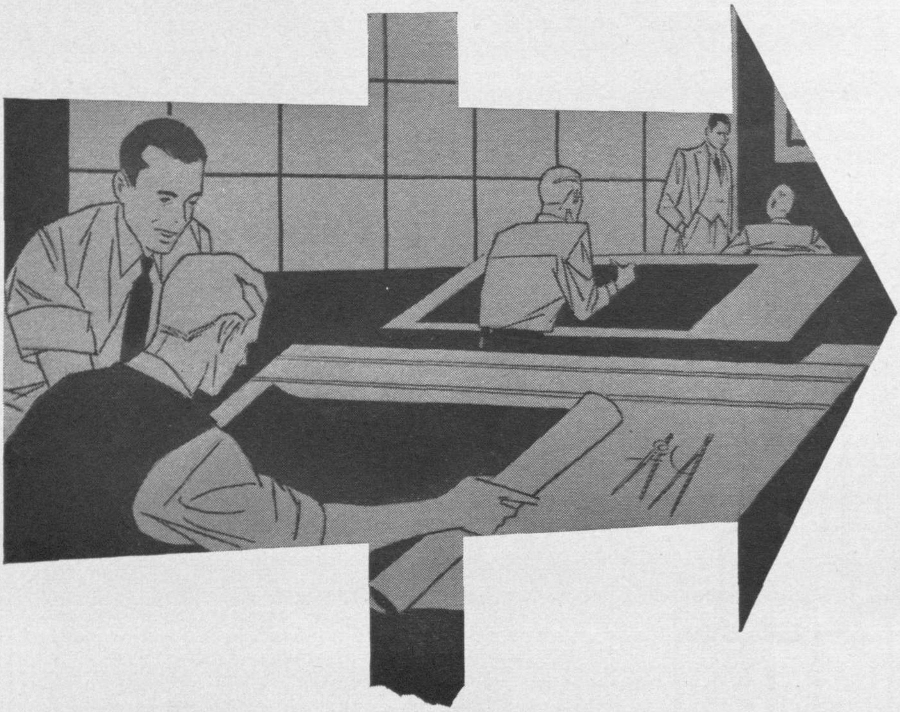
Going back through Michigan State College's pages of time one comes across great engineering students who excelled in this field: T. Fred Burris who graduated from Chemical Engineering in 1924, was a member of the Varsity hockey, track and football teams, and is now a chief engineer with the Chesapeake and Ohio Railway Company; Vincent Vanderburg, a brilliant star on the football team for three years, and colonel in the Reserve Officers Training Corps, graduated from Chemical Engineering in 1937 and is now owner of the Vanderburg Construction Company with headquarters in East Lansing; Frank Gaines, graduate of Chemical Engineering in 1938, who played football and participated in boxing as well as being a member of the Society of Automotive Engineers, is now stationed in Caracas, Venezuela as Chief Engineer for the Creole Petroleum Corporation. These are only a few of the many who proved that engineering and athletics can come to harmony for success.

In engineering, the freshman is given an opportunity to obtain a high standard in both aspects of college life. Professor Robert Sweet of the Metallurgical Engineering Department is the Adviser to Athletes in Engineering and serves as an intermediatary between the Athletic Department, the student and the Engineering Enrollment officers. He is available to help the athlete with extra courses or with any personal problem that may arise. This is an entirely new venture of the School of Engineering which was organized by the "never-say-die," Miss Agnes McCann, Assistant to the Dean.

Dean Miller who played five sports to receive his letters, firmly believes that an engineering student can take an active part in athletics without too much loss of academic time. He suggests that the student take a lighter schedule and a few more quarters to graduate. In this way, both phases would receive the attention that they deserve, for both are equally important. In addition to the rigorous training required for effective play, the engineering student must have a good foundation in Basics, a deep knowledge of mathematics, and a complete understanding of all phases of mechanics as well as other engineering courses.

Beyond a doubt, athletics teach the engineering student a characteristic that will stand him in good stead in his future profession, the ability to work in harmony with his fellow-man.





Design — one of the best routes to an engineering career!

A recent survey found that 40 per cent of the top jobs in industry are now held by men with broad engineering training. In General Motors, the chairman of the board, president and 19 vice-presidents are engineers of wide experience and training.

Yes, there's a great future in store for young engineers with well rounded training in the dynamic automobile industry which has shown continual growth.

And while the industry itself has shown this steady growth, Pontiac has grown even more spectacularly. Today Pontiac holds an enviable position. Its reputation for quality and its public acceptance are unsurpassed.

There is, indeed, a future with Pontiac. But even more important to you is the fact that one of the most practical ways to this great future is by way of designing. Did you know that the majority of all leading positions in automobile engineering are held by men who have had experience in designing? There's no better route for the young man who wants a well rounded engineering career based on opportunity, future advancement and liberal General Motors compensation and employment benefits.

Pontiac's huge new engineering building is the industry's most modern with every conceivable facility for designing better and better Pontiacs.

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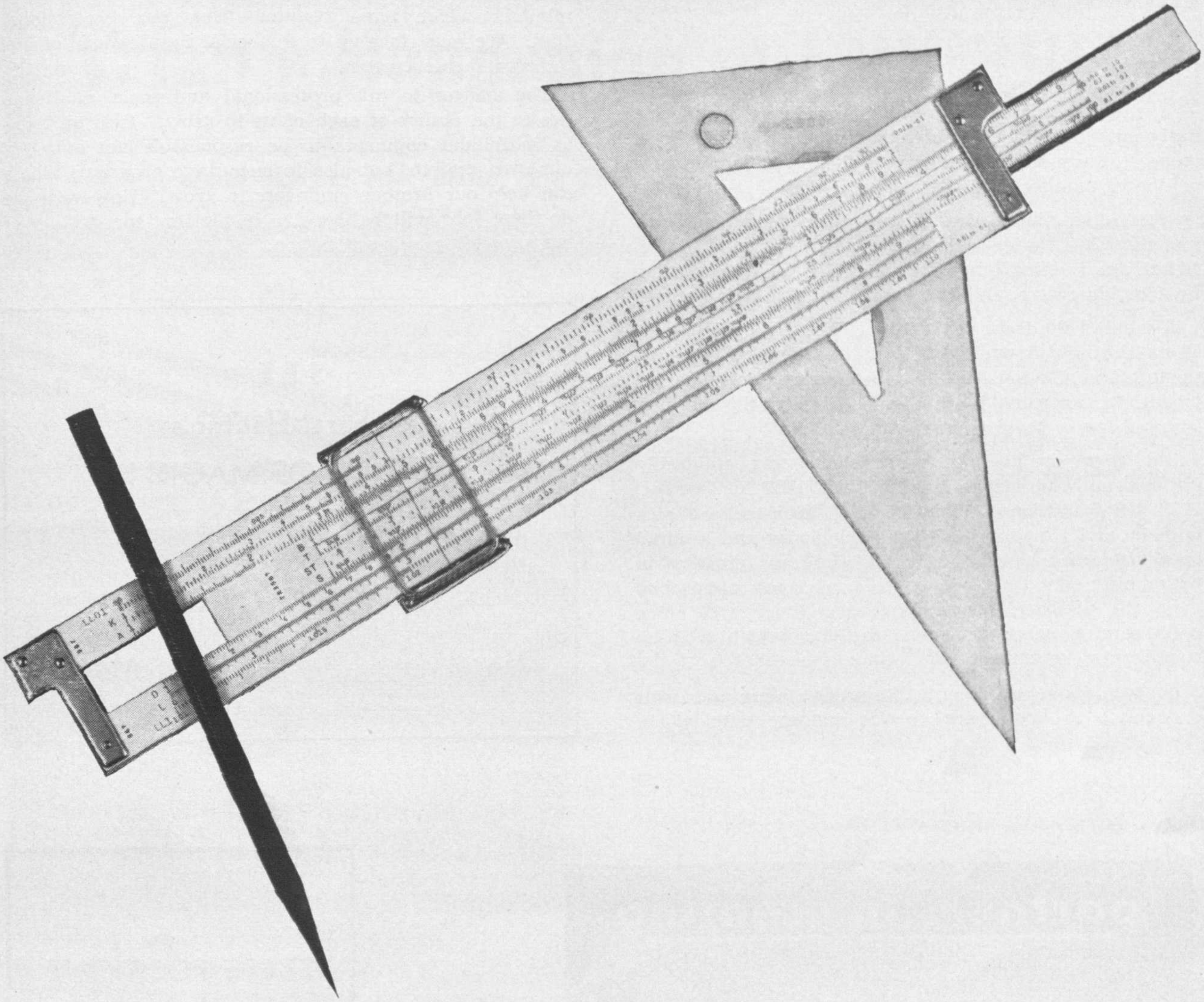

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If that's the kind of engineering prestige you'd like to enjoy, look into Boeing opportunities. This company has been growing steadily for 35 years. It provides the finest research facilities in the industry. It offers you work on such exciting projects as guided missiles and the fastest known bomber in the world: the B-47 six-jet medium bomber, as well as the still-classified B-52 eight-jet heavy bomber.

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Plan *now* to build your career as a member of Boeing's distinguished Engineering personnel after graduation. Boeing has present and future openings for experienced and junior engineers in aircraft

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- **RESEARCH**
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For further information, consult your Placement Office, or write:

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Company, Seattle 14, Washington

BOEING

The Engineer — His Growth

(Continued from Page 19)

"He asked the first stonemason, 'What are you doing?' The tired workman wiped his perspiring brow and dully answered, 'My job is to move these huge blocks of stone . . . my superior tells me where to put one stone on top of another, and that's what I do.'

"He asked the second stonemason, 'What are you doing?' The man looked up from his work puzzled, 'What am I doing?' he echoed. 'Why, they're putting up a building here, and I've got a good job laying stone.'

"He asked the third stonemason, 'What are you doing?' The artisan put down his tools and stood erect. Looking up to where the towering structure seemed to touch the clouds, he answered with simple dignity, 'I,' he said, 'am helping to build a great cathedral'."

But there is another goal, which was admirably summed up in an article in DUN'S REVIEW for October, 1952, titled, "Science, Wait for Us." This serious plea is made and I quote: "Will the engineering and kindred specialists who have made some wondrous progress in triumphing over time, space, force, microbes, atoms and even the weather, please lend us a hand with some pressing problems in the social world on which progress hasn't quite kept pace with your advances?"

As we, above all people, know, we dare not wait if we are to keep pace in this country with world competition. And we cannot in all fairness refuse to join in the common battle to understand the inventive miracles which have resulted from our professional skill. We must face up to the social implications of our technical achievements.

The answer to this professional and social challenge lies in the ability of each of us to grow. It is up to us as individual engineers to be responsible not only for our own growth, but also to encourage programs which can help our brother engineers to grow. How well we do these jobs will be decisive in plotting the destiny of our profession and our nation.

SEE

General Electric's

"HOUSE OF MAGIC"

Bell Telephone's

"SWITCHING CIRCUITS"

May 1 May 2

★

STAFF POSITIONS

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ENGINEER

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SOPHOMORES

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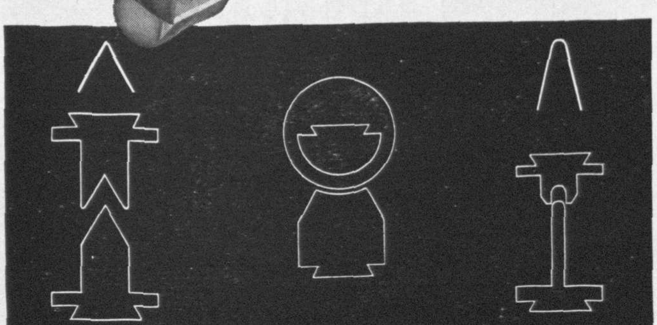
What's Happening at CRUCIBLE

about scoring and cutting rule steel

Lengths of cutting rule steel after edging

Shaped to cut wallet section (note bends, and form-holding method)



Some examples of the many shapes of bends needed

Scoring and cutting rule steel is a cold-rolled specialty steel for use in preparing dies for cutting paper, leather, rubber and other materials.

It is a pre-tempered product manufactured by skilled workmen, using precision rolling and hardening equipment, to close limits for chemistry, grain size and hardness. This product must also be capable of meeting intricate bend requirements in the hardened and tempered condition.

This specialty is furnished with round edges and in coil form to the rule manufacturer who grinds the edges — the one edge square and the other to a knife edge as well as cutting the material into desired lengths. This is sold to a die-maker who bends the rule to the required shape. This is then the nucleus of a pre-hardened die, which when properly brazed and supported is used to cut out material for display cards — aircraft parts — pocketbooks — wallets — gloves — gaskets — washers.

engineering service available

Since there is a great diversity of cold-rolled products, our staff of field metallurgists can help you apply what you require. Take full advantage of Crucible's more than 50 years experience as the first name in special purpose steels. Crucible Steel Company of America, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

52 *years of* *Fine* *steelmaking*

Midland Works, Midland, Pa. • Spaulding Works, Harrison, N. J. • Park Works, Pittsburgh, Pa. • Spring Works, Pittsburgh, Pa. National Drawn Works, East Liverpool, Ohio • Sanderson-Halcomb Works, Syracuse, N. Y. • Trent Tube Company, East Troy, Wisconsin

Foundry Society

(Continued from Page 16)

foundry work to prove to the public that the foundry as an occupation is not necessarily an undesirable one. The movie was contributed by Albion Malleable Iron Company. A map made by Louis Bachinski showed the concentrations of the cast metals industry by showing the number of foundries in each state and by areas. Louis was also responsible for a poster depicting the foundry as a tree, showing the different branches labeled "gray iron," "steel," etc. Claridon Thomas made a large poster which showed why "Your Chances Are Better in the Cast Metals Industry," and another illustrating advancement opportunities beginning with the trainee as a graduate and finally achieving the successive steps to management status. Each of the different displays was colorful and well done. The complete display easily held its own with the more expensive and professional ones around it.

Chuck Esgar and Paul Olson were in the booth most of the time and succeeded in snaring a number of unsuspecting students who happened to pass too close or stopped for a second look. They were aided in this capacity at various times by Russell Brandt, Engineering Castings Company; James McDonald, Central Foundry Division, GMC; Russell Peters, Eaton Manufacturing Company; Kenneth Priestley, Electro-Alloys, Vassar; Professor Sigerfoos; and students Ernest Frens, Ash Sinnett, Robert Grace, Bruce Harding, Louis Bachinski, and Claridon Thomas. Everything went smoothly in the booth, although Paul was on the spot at one time when he was approached by a coed who asked, "What could I do, I am interested in social services and cultural backgrounds." Chuck Esgar also had a close call with a horticulture major.

Students stopping to give the display and the men a few minutes of their time were given publications from the Foundry Educational Foundation. These publications described engineering education for the foundry industry, training of the foundryman, Foundry Educational Foundation activities and a few case histories of actual experience of students entering the cast metals industry. The Student Chapter gave each person a mimeographed sheet telling of its coming activities for the remainder of the term.

A good number of students visiting the booth were interested in finding out just what the Foundry Industry could offer them and how its opportunities compared with those of the other organizations. Many of them were also impressed by the fact that the booth represented an industry as a whole, illustrating the cooperative spirit and the desire for advancement existing in the cast metals industry.

Looking back now, it is felt that those connected with the booth accomplished their mission of bringing the cast metals industry, its opportunities, and its good will to the students of Michigan State College. It is believed that those students who are potential foundrymen or users of castings were deeply impressed with the size and importance of the cast metals field. It is hoped that the American Foundrymen's Society and the Foundry Educational Foundation will henceforth be a perennial member of MSC's Career Carnival.

"I needed to 'Find' Myself— that's why I picked Allis-Chalmers,"

says A. J. MESTIER

Massachusetts Institute of Technology Sc. B.—1943
and now Manager, Syracuse District Office

"I WAS LOOKING for an engineering job, but I wasn't very sure just what phase of this broad field would interest me most. I didn't know whether I wanted straight engineering, sales engineering, production or some other branch of industrial engineering.

"Allis-Chalmers Graduate Training Course gave me a means of working at various jobs—seeing what I liked best—and at the same time obtaining a tremendous amount of information about many industries in a very short time."

Experience Typical

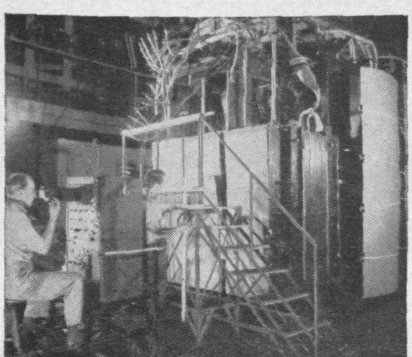
"My experience is typical in many ways. I started the Graduate Training Course in 1946, after three years in the Army. My first request was to go to the *Texrope* V-belt drive department. From there I went to the Blower and Compressor department; then the Steam Turbine department. By the time the course was completed in 1948, my mind was made up and I knew I wanted sales work. I was then assigned to the New York District Office and in 1950 was made manager of the Syracuse District. The important thing to note is that all Allis-Chalmers GTC's follow this same program of picking the departments in which they want to work.

"Best of all, students have a wide choice, for A-C builds machines for every basic industry, such as: steam and hydraulic turbine generators, transformers, pumps, motors and other equipment for electric power; rotary kilns, crushers, grinders, coolers, screens and other machinery for mining, ore processing, cement and rock processing. Then there is flour milling machinery, electronic equipment and many others."

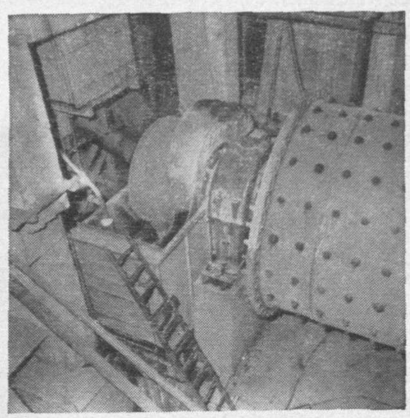
A Growing Company

"In addition, new developments and the continuing growth of the company offer almost endless opportunities for young engineers.

"From my experience on the Graduate Training Course, I believe it is one of the best conducted in the industry and permits a young engineer to become familiar with a tremendous variety of equipment—both electrical and mechanical—which will serve him in good stead in his future profession."



Taking surge voltage distribution tests on power transformer in A-C shops with miniature surge generator and cathode-ray oscilloscope.



Ball Mill grinds ore for large copper producer. Same type of equipment from Allis-Chalmers pulverizes much of nation's cement.

Texrope is an Allis-Chalmers trademark.

ALLIS-CHALMERS

For information call the Allis-Chalmers District Office in your locality or write to Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

The Engineer and the Physicist

(Continued from Page 11)

work of the Metallurgical Laboratory that arose from the war time situation and the fact that first steps were being taken in the use of atomic (nuclear) energy. But the problems faced by the creative engineer would require the same kind of fundamental scientific knowledge in virtually every new kind of industrial and construction development.

In the engineering utilizations of nuclear energy that are being striven for today there certainly is no easy path that allows the engineer to use old and proven techniques. The transfer of heat from a pile, for example, is being studied with the intention of not merely keeping the pile cool but of actually obtaining enough heat to operate a power plant. The heat transfer agent in such a case probably can more suitably be a liquid metal instead of water; such a pile must be operated at very high temperatures, and hence, many problems concerning the behavior of matter at these temperatures must be faced and solved. The possible adaptation of nuclear reactors into mobile power units, as for ships or airplanes, must involve new complications at almost every point in the design of such units.

Nuclear physics is an obvious example of the engineer's making use of new physical knowledge in his work, but with a few exceptions knowledge that is obtained in other branches of physics is likewise rapidly used in engineering. Spectroscopy now provides scores of techniques for the examination of materials; the same may be said for X-ray and electron diffraction studies. So called "solid state physics" has given birth to the transistor, which engineers may soon be utilizing almost everywhere in place of electron tubes. The engineer's concern is with the application of science; hence it seems that the scientist is his indispensable helpmate, and a knowledge of science is the first element of his professional education.

Engineers have certainly been required for as long as there have been societies which built with and transformed nature's materials. It seems to be significant that the engineer, the architect of practical accomplishment, has found himself joined in activity with the physicist and other scientists. The idea, by itself so evanescent from the point of view of daily practice, does in the end come to have strength and endurance. We see, as Francis Bacon said at an early day in our era, that "knowledge is power."

With the aid of the physical scientists' ideas the engineers have brought us a world that seems to grow ever richer in comfort and interest. This has been possible only because of the stage of accuracy and definiteness to which the physical scientists have brought their ideas. The engineer who likes to think of better worlds cannot but realize, however, that some aspects of the world he makes today are not too pretty. We can speculate that perhaps someday biology, psychology, and the social sciences will guide the engineer in making the whole world better for all kinds of men, as does physics today for a partial world.

"They must have a girls softball team in the harem."

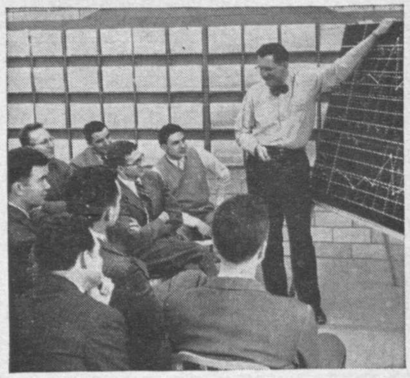
"What makes you think so?"

"I just heard one of the girls ask the Sultan if she was in tomorrow's line-up."

Duke Engineer


USAF
USAF
USAF

THE DU PONT DIGEST



William Chelgren, *B.S. in M.E., Armour Institute of Technology '38, explains quality control methods to a group of Du Pont production supervisors.*

THE TECHNICAL MAN IN

Production Supervision

Scientists who know both people and processes are needed to keep Du Pont's 71 plants humming

H. D. Tallman, *B. S. in Industrial Administration, Yale '37, checks on product loading methods in Du Pont's Belle, West Va., synthetic urea plant.*

Keeping production rolling in a modern industrial plant is a job that appeals to men trained in many branches of science and engineering. If you are looking for opportunities in this field, you won't have to look far at Du Pont, where nearly half the entire technical force is assigned to production supervision.

To qualify, a man must have the ability to understand both the mechanical and chemical phases of production. In addition, he should be a good planner and, above all, have a knack for handling people.

The production supervisor—there are several levels at Du Pont—has three important areas of responsibility. The first is to the men working for him. He must be able to appraise them skillfully and assign duties accordingly. He must train them not only in the efficient operation of equipment but in safe working practices as well.

A second responsibility is to the customer. He must get the product out on time and provide uniformly high quality at the lowest possible cost. When demand for a product is subject to rapid fluctuations, he must be prepared to make quick readjustments in the scheduling of both manpower and materials.

The supervisor's third responsibility is to the higher management. Here, again, quality and cost are important factors. He is expected to prepare forecasts, to justify unusual expenditures, and to suggest process improvements leading to greater yield and better quality at lower costs.

One of the toughest nuts a production supervisor has to crack is the scheduling of preventive maintenance for minimum interference with production. In some companies where products are turned out in small-unit operations, a program of breakdown maintenance suffices. At Du Pont, however, where large-unit operations are the rule, unscheduled downtime is costly and something to be avoided whenever possible.

Since it makes over 1200 products and product lines, Du Pont can offer to men interested in production supervision opportunities in many types of operations. In the next issue of the *Digest*, we will describe a specific production operation in one of our 71 plants.

36-PAGE BOOK, "The Du Pont Company and the College Graduate," describes opportunities for men and women with many types of scientific training. For copy, write: 2521 Nemours Building, Wilmington, Delaware.

DU PONT

REG. U. S. PAT. OFF.

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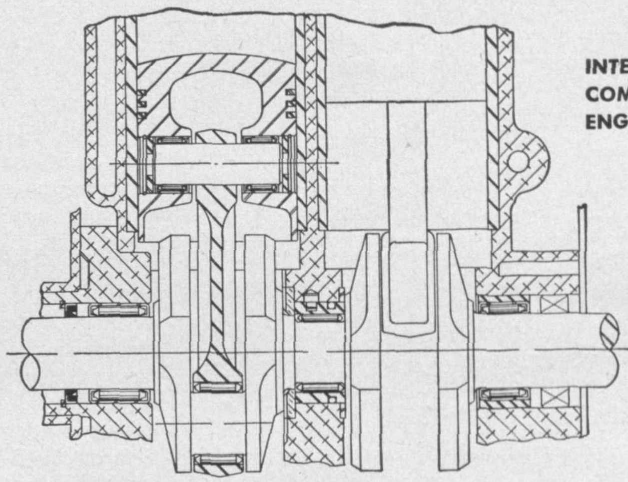
The Torrington Needle Bearing...

for designs where light weight is important

Reducing weight without sacrificing performance is one of the major considerations in many modern products. Designs are streamlined to pare off excess weight. New and lighter materials are being used. Components which save even a few ounces frequently contribute greatly to product success.



INTERNAL COMBUSTION ENGINE

Needle Bearings reduce weight and size while providing high radial load capacity.

Light Weight Plus High Capacity

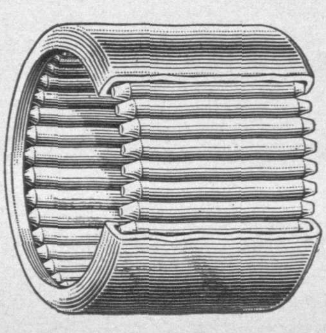
The unique design of the Torrington Needle Bearing makes it ideal for a wide variety of product uses. It consists of two components — a thin, hardened outer shell and a full complement of small diameter rollers. Its many lines of contact give the Needle Bearing a greater rated radial load capacity than any other type of anti-friction bearing for its size and weight. Conversely, for a given load capacity, a Needle Bearing is the lightest, most compact bearing available.

Weight Savings In Related Assemblies

In addition to the light weight of the Needle Bearing, its design permits sizable reductions in the size and weight of the related assemblies. Its small outside diameter allows the use of smaller housings. And, since a press fit in a simple straight housing bore is adequate to locate the bearing, no complex shoulders or housing modifications are required. The hardened shaft usually serves as the inner race, saving additional space and weight.

These advantages, plus its high radial capacity, have made the Torrington Needle Bearing particularly attractive to the designers of aircraft, portable power tools, small gasoline engines and many other products where weight and space are important factors.

In future advertisements of this series, other features of Torrington Needle Bearings will be discussed. The new Needle Bearing catalog will be sent on request.



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TORRINGTON *NEEDLE* BEARINGS

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • STRAIGHT ROLLER • BALL • NEEDLE ROLLERS

Girl Engineers

(Continued from Page 9)

ject. At least, she said, it is when it's over.

And a note to other engineers—the girls don't like the "Basics" either.

Here, the similarity between the girls somewhat dissolves—although both say they are proud of Michigan State athletics. While Alice was graduated in a high school class of 350 seniors, Virginia said this number was about the size of her whole high school. Alice's school was Lansing Eastern, and Virginia's, North Muskegon High.

Virginia said the transition from such a small school to one the size of Michigan State wasn't too hard; she had come to all of the Spartan's home football games in 1951, and had spent two summers here in the annual music clinic. And—sorry to disappoint you engineers—she added, "Then my fella from high school came here, too."

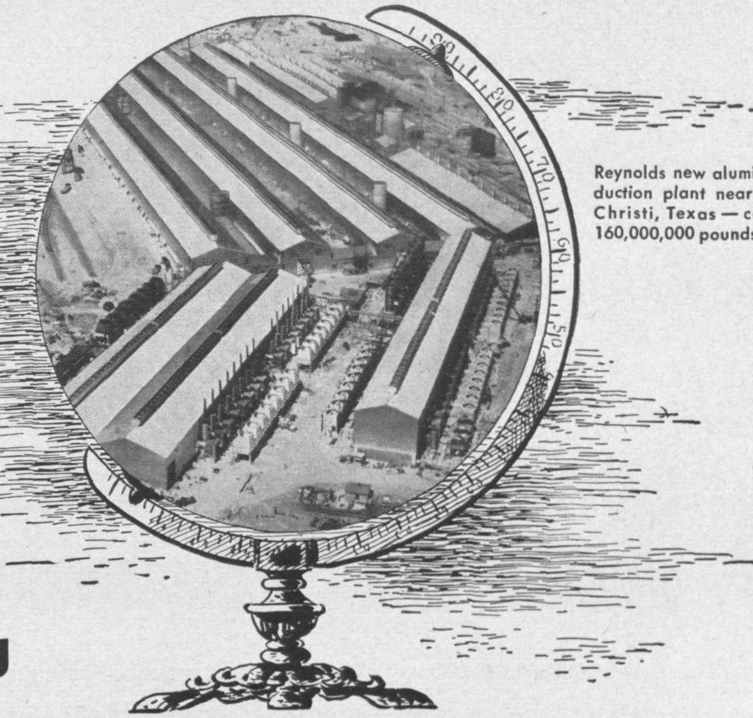
For an extra-curricular activity, Virginia plays the clarinet in the MSC Varsity band. She also plays the piano. Asked why so many engineers seem to like music, she explained that, "If you like math, you like music," and that's probably because "there's lots of math in music."

Virginia has always lived in Michigan, and now in North Muskegon. Her father is an electrical engineer with a motor company in Muskegon.

Alice, too, has always been a Michigander, having lived in Battle Creek until she was nine years old, since then in Lansing. While at Lansing Eastern High School, she worked on the school's yearbook staff.

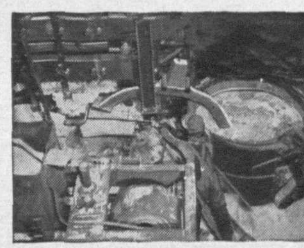
Alice particularly is proud of Michigan State athletics. She likes all sports, except wrestling and boxing—that is, she said, except when Michigan State' Chuck Davey is the boxer. Then, she said, she's all for boxing. The same is true in that she likes to see an underdog in any sport break another team's long string of victories—except when Michigan State is the other team.

These two girls, Alice Jacobson and Virginia Kueny, form a team that is embarking on garnering themselves an education in what is recognized as one of the hardest of all courses. This article has been written as a tribute to them, and in the hopes that perhaps other girls will follow their example and help to alleviate the critical shortage of engineers that now confronts the country. Our hats are off and our hearts go out to you—Alice Jacobson and Virginia Kueny.

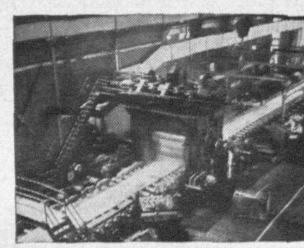


Reynolds new aluminum reduction plant near Corpus Christi, Texas — capacity 160,000,000 pounds a year.

A World of Expanding Opportunity!



Tapping one of huge battery of electrolytic cells



Sheet rolling—reverse hot mill in operation

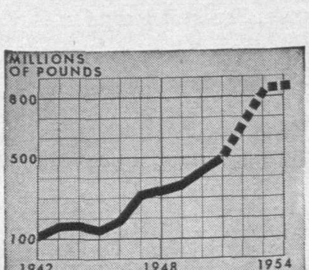
In a land noted for rapid expansion of free industrial enterprise, few companies have matched the swift and continuing growth of the Reynolds Metals Company. Now operating 27 plants in 13 states, and still expanding, Reynolds offers the ambitious engineering graduate a world of opportunity.

Reynolds operations include bauxite mining in domestic and foreign locations...chemical and electrolytic processing to produce aluminum pig ...sheet rolling...drawing and extrusion of mill and structural shapes ...foil rolling and printing...powder and paste production...finished parts and products fabrication. In these and in the allied sales and marketing operations promising careers exist for graduates in virtually any phase of engineering.

On-the-job training is the Reynolds policy—after preliminary orientation which may include basic experience in production plants for sales personnel, and sales office work for technical trainees. Liberal insurance, hospitalization and retirement programs are maintained.

For important background information on "your future in Aluminum," *mail the coupon.* If you are definitely interested now, write direct to General Employment Manager, Reynolds Metals Company, 3rd and Grace Streets, Richmond 19, Va.

REYNOLDS ALUMINUM



Reynolds expanding production — historic chapter in 33 years of continuing growth.

Reynolds Metals Company, Employment Dept.
Richmond 19, Virginia

Please send me, **FREE,** your 96-page booklet, "The ABC's of Aluminum"; also the 44-page book, "Reynolds Aluminum . . . and the Company that makes it."

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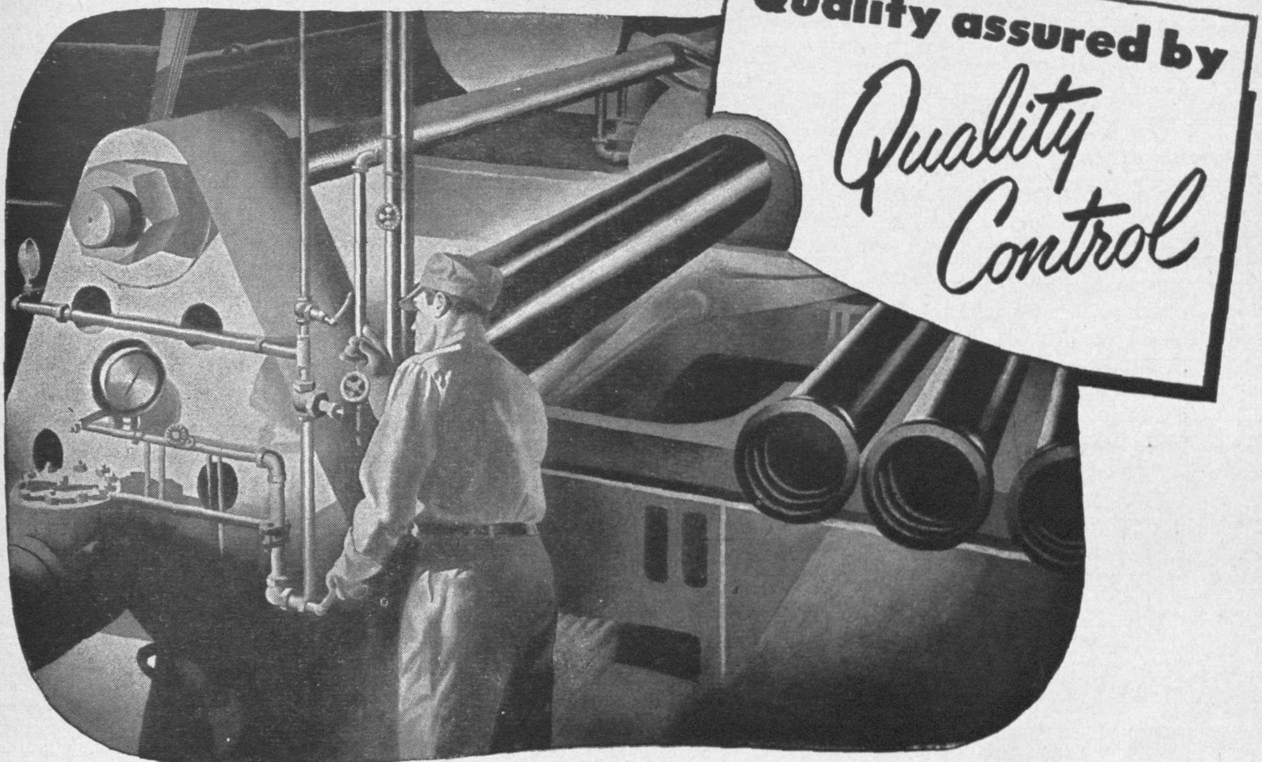
Quality assured by Quality Control



THE HYDROSTATIC TEST

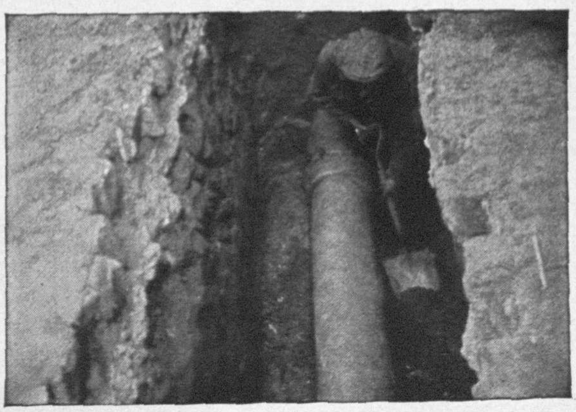
Nobody can buy a length of cast iron pipe unless it has passed the Hydrostatic Test at the foundry. Every full length of cast iron pipe is subjected to this test under water pressures considerably higher than rated working pressures. It must pass the test or go to the scrap pile.

The Hydrostatic Test is the final one of a series of routine tests made by pipe manufacturers to assure that the quality of the pipe meets or exceeds the requirements of standard specifications for cast iron pressure pipe.

Few engineers realize the extent of the inspections, analyses and tests involved in the quality-control of cast iron pipe. Production controls start almost literally from the ground up with the inspection, analysis and checking of raw materials—continue with constant control of cupola operation and analysis of the melt—and end with inspections and a series of acceptance and routine tests of the finished product.

Members of the Cast Iron Pipe Research Association have established and attained scientific standards resulting in a superior product. These standards, as well as the physical and metallurgical controls by which they are maintained, provide assurance that cast iron pipe installed today will live up to or exceed service records such as that of the 130-year-old pipe shown.

Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction. Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3, Illinois.



Section of 130-year-old cast iron water main still in service in Philadelphia, Pa.

CAST IRON PIPE SERVES FOR CENTURIES

SIDE TRACKED

Bus Driver: "You're only six? When will you be seven?"
Small Passenger: "As soon as I get off the bus."

★ ★ ★

The nice old lady stopped and dropped a two-dollar bill in the beggar's cup.

"Lady," he said, "two-dollar bills are bad luck. Ain't you got two ones?"

"My goodness, how did you know it was a two-dollar bill if you're blind?"

"I ain't blind. It's my partner that's blind. This is his day off and he's at the movies. Me, I'm deaf and dumb."

★ ★ ★

His wife lay on her death bed. She pleaded: "John, I want you to promise me that you'll ride in the same car with my mother at the funeral."

He sighed: "O.K., but it's going to ruin my whole day."

★ ★ ★

Sign in a New Orleans optometrist's window: "Eyes examined while you wait."

Auburn Plainsman

★ ★ ★

He: "I'm going to kiss you when we get to the next corner."

She: "Don't you think that is going too far?"

Missouri Ram-Buller

★ ★ ★

Before she was married she played the banjo, but now she just picks on her husband.

Patuxent River Tester

★ ★ ★

Man to pilot: "How are we doing?"
Pilot to man: "We're lost, but we're making good time."

Lincoln U. Clarion

★ ★ ★

Husband to wife reading contest rules: "I'll give you a prize myself, if you can finish any sentence in 25 words or less."

J. Monahan in *The Saturday Evening Post*

★ ★ ★

A Columbia professor's appraisal of a high-flying colleague: "Such time as he can spare from the adornment of his person he devotes to the neglect of his profession."

Donald Clark, quoted by Bennett Cerf in *The Saturday Review of Literature*

★ ★ ★

E.E.: "I like mathematics when it isn't over my head."
C.E.: "That's the way I feel about sea gulls."

Purdue Engineer

★ ★ ★

Sunday School Teacher: "Lot was warned to take his wife and flee out of the city, and she was turned into a pillar of salt."

Little Boy: "Please, teacher, what happened to the flea?"

California Pelican

Bert went into his barn and saw his kid Mert shaking a rabbit and yelling: "Come on now, how much is five and five?"

Bert: "Mert, what's the idea of shaking the bunny and asking him how much is five and five?"

Mert: "My teacher told me that rabbits multiply rapidly and this dumb bunny can't even add."

Penn State Engineer

★ ★ ★

When you put on your cute rayon scanties
Do they crackle electrical chanties?
Don't worry, my dear.
The reason is clear.
It's just you have amps in your panties.

Duke Engineer

★ ★ ★

A couple checked into the hotel and after cleaning up, forgot to turn off the faucets in the tub. A short time later the guest in the room directly below them opened his window and stuck out his head, "What's the matter?" he asked. "What is ailing you?"

"Stop your cursing," the upper returned. "I've got a lady up here."

"And what do you think I have down here—a duck?"

Duke Engineer

★ ★ ★

Teacher: "How much is seven times six?"
Boy: "Forty-two."
Teacher: "Pretty good."
Boy: "Pretty good — it's perfect."

★ ★ ★

An optimist is a man who thinks his wife has stopped smoking cigarettes when he finds cigar ashes around the house.

Rose Technic

★ ★ ★

A freshman reports that a plane owned by a neighbor of his stuck in mid-air when its shadow started wallowing in the mire of a country road.

Tarkio Torch

★ ★ ★

The naked hills lie wanton to the breeze,
The fields are nude, the groves unfrocked,
Bare are the limbs of the trees,
No wonder the corn is shocked!

Montana Engineer

★ ★ ★

They laughed when I came with shorts on, but when I sat down they split.

Rose Technic

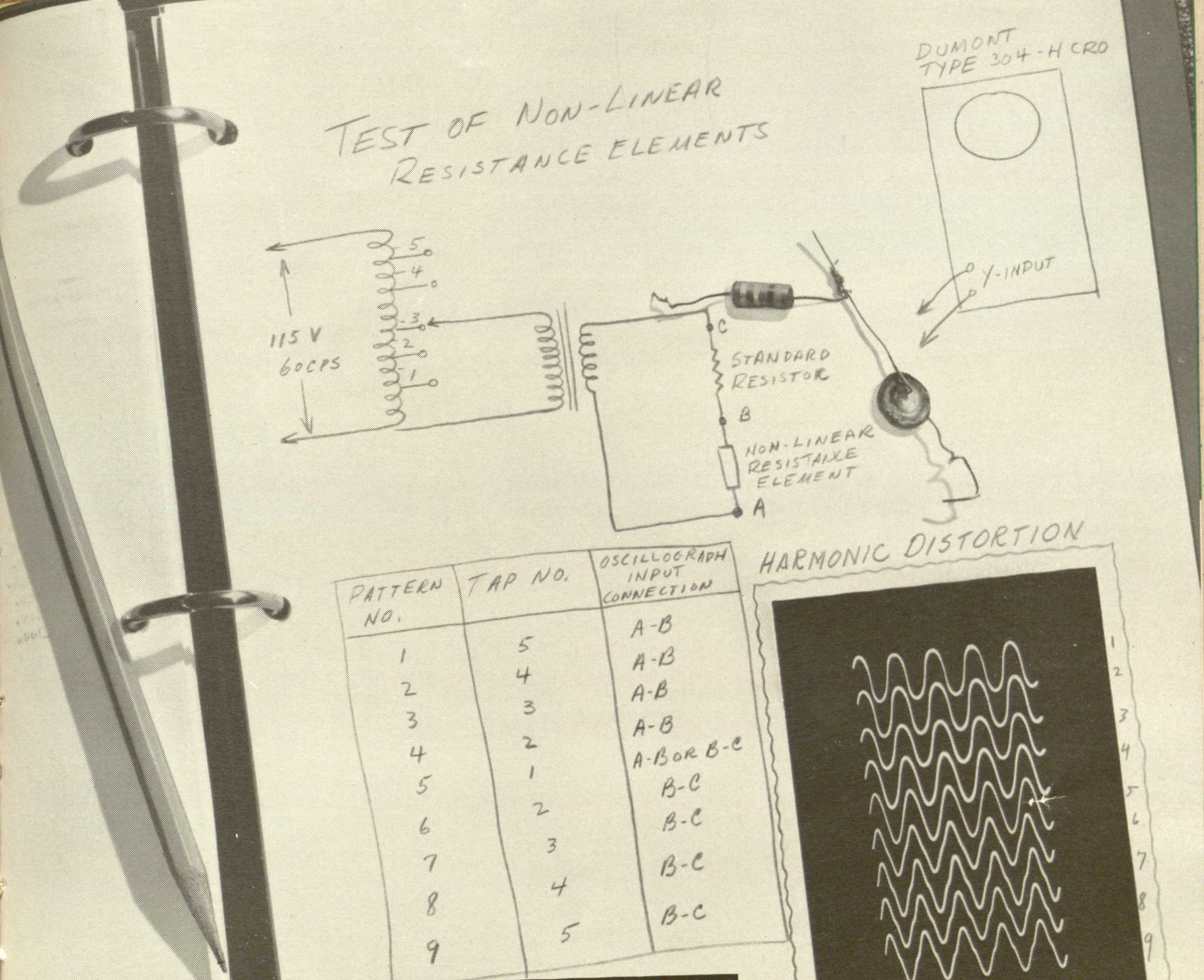
★ ★ ★

"Well, Sally, what did you learn at Sunday School today?"

"Oh, about a cross-eyed bear."

"Now, Sally, are you sure that's what the lesson was about?"

"Yes, and his name was Gladly. We even sang a song about him—"Gladly, the Cross I'd Bear.""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DUMONT TYPE 304-H CRO
Y-INPUT
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NON-LINEAR RESISTANCE ELEMENT
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7 | 3 | B-C
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HARMONIC DISTORTION
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MY QUESTION TO THE G-E STUDENT INFORMATION PANEL:

"What qualities do I need for a successful career with a company like General Electric?"

. . . HARRY K. LEADER, Lafayette College, 1954

Two answers to this question, given at a student information meeting held in July, 1952, between G-E personnel and representative college students, are printed below. If you have a question you would like answered, or seek further information about General Electric, mail your request to College Editor, Dept. 221-6, General Electric Co., Schenectady, N. Y.

G. C. HOUSTON, *Manufacturing Services Division . . .* While this is a rather broad question, I am sure it is one of real importance to any young man starting out in industry and looking forward to a position of responsibility in any of our successful industrial enterprises.

The mere asking of this question indicates that the individual has a definite goal or objective. This is important since progress can be made only if we attempt to reach a well-defined objective—even though it may be modified to some extent in the light of later experience. In G.E. we are looking for young men who have not only determined their objective but who are ready to work for it—who accept responsibility and have ability to get things done—who work well with others—to be a part of the team.

This calls for other qualities essential to long range success. We look for the enthusiastic individual, one not easily discouraged, and who can inspire the confidence of his co-workers. We desire individuals who show imagination and good judgment—particularly the ability to look ahead and maintain perspective beyond the immediate situation. Finally, we cannot overlook the qualities of loyalty and dependability since these are important in steering the individual through periods of discouragement which occur in every career.

When you decide on your business affiliation, make sure you associate yourself with a company that is soundly managed, that has a good business future, and that is the kind of company you would like to be a part of for the long pull.

E. S. WILLIS, *Corporate Services Division* . . . A successful career with a company like General Electric is built on the same qualities that contribute to success in any endeavor. However, in G.E., there is additional opportunity to develop these qualities because of the wide variety of training sources and openings which are available.

Basic qualities needed for any successful career include an open mind, willingness to accept responsibility, persistence, adaptability, co-operativeness, and common sense intelligence. Others such as physical well-being, ability of expression, and sound inquisitiveness also go to make up a truly qualified individual.

Most important is the fact that General Electric offers a wealth of opportunity to develop special capabilities and talents. The broad selection of training courses, in any chosen field, gives you a chance to sharpen your basic training and abilities. By decentralizing operations into about 70 different businesses, there is opportunity to see—in comprehendable dimensions—the full operation of the business. It means, too, that senior managers and young employees are more closely associated—a real advantage for the young man on his way up.

Also, our business requires specialists as well as managers. Thus, there are equal chances for success for those who concentrate in particular fields such as research, design, accounting, and planning.

So set your cap for a goal. And capitalize on your native qualities, which fortunately are different with each of us.

You can put your confidence in—

GENERAL ELECTRIC