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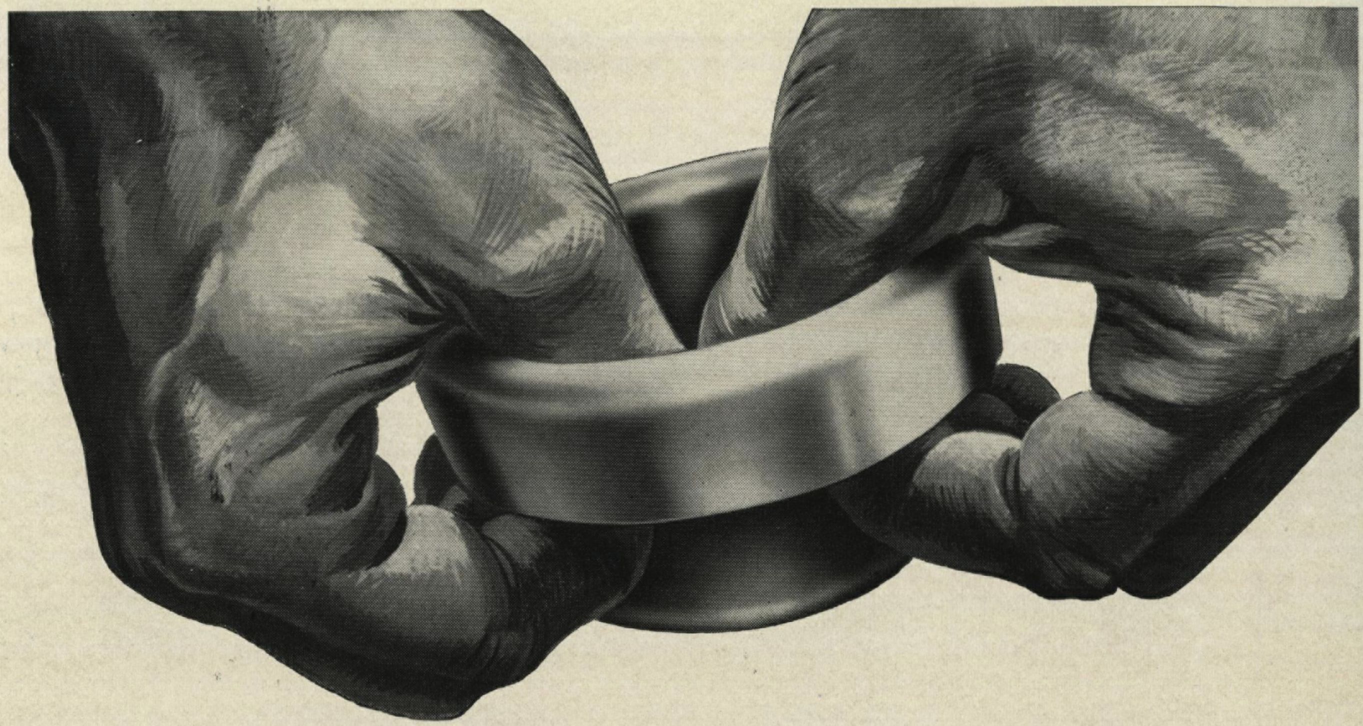
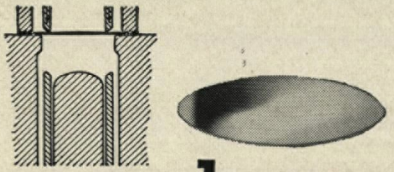


How to turn a high strength steel cup <u>inside out</u>, <u>cold</u>



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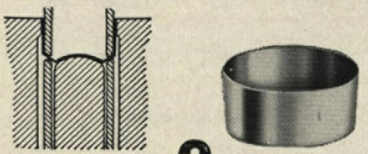

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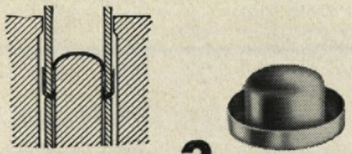

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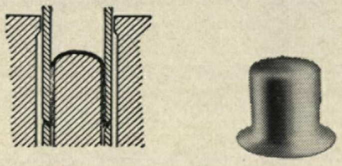

4

OFFHAND, anyone familiar with high strength steels would say it couldn't be done. But one of our customers does it every day.

Employing a unique reverse-drawing method and using a U·S·S High Strength Steel especially adapted for this process, they turn out cylindrical containers of various kinds that are not only stronger than those made from carbon steel but weigh substantially less.

To accomplish this, the steel has to meet two entirely opposite requirements. It has to be so strong that it can be used in thinner gages to reduce weight, and yet must have enough ductility to satisfy the drastic fabrication method that would be considered severe even for carbon steel.

This method is used to draw cups for large, low-pressure cylinders. These cups, 14½ in. in diameter and 24½ in. deep, are drawn cold, from 12-gage steel blanks in one continuous stroke in a reverse draw press. The diagrams at left show how it is done.

Starting with a 38 in. diameter steel blank (Fig. 1) the press first draws the steel into a shallow cup (Fig. 2). As the stroke continues, the cup is literally *turned inside out* (Fig. 3) to form the finished cup (Fig. 4) which has very uniform wall thickness. Two of these cups are then welded together to make a cylinder.

Made with high strength steel, cylinders weigh about 20 lbs. less. The maker gets 26% more cylinders from each ton of steel used. Lighter weight makes cylinders easier to handle, and also pays off in lower freight costs—both on the steel from our mills and on cylinders shipped. (A customer 500 miles away saves as much as $100 per carload.)

Developing special steels for special customer needs is an important job of United States Steel metallurgists and engineers. With their tremendous background of practical experience, they are ready to work on any problem that involves the more efficient use of steel. United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

USS TRADE MARK

UNITED STATES STEEL

Rose Technic

VOLUME LXIV, NO. 6 MARCH, 1953

In This Issue

The Cover

An arrangement of accessories used by the field geologist in his search for likely spots to drill for oil. The background is part of the western section of a surface geologic map of the United States made by the U. S. Geologic Survey. Colors show type and age of exposed rocks. Placed on the map are a surveying compass, geologist's pick, hand lens, and a fossilized ammonite, a nautilus-like sea creature of the Mesozic era, millions of years ago. Courtesy of STANDARD OIL COMPANY'S *California Bulletin.*

The Frontispiece

Assembling huge tubines is a major task. Under watchful eyes, an overhead crane carefully lowers a section of a General Electric tubine shell into position. Courtesy of GENERAL ELECTRIC.

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HIGH SCHOOL GRADUATES OF 1953

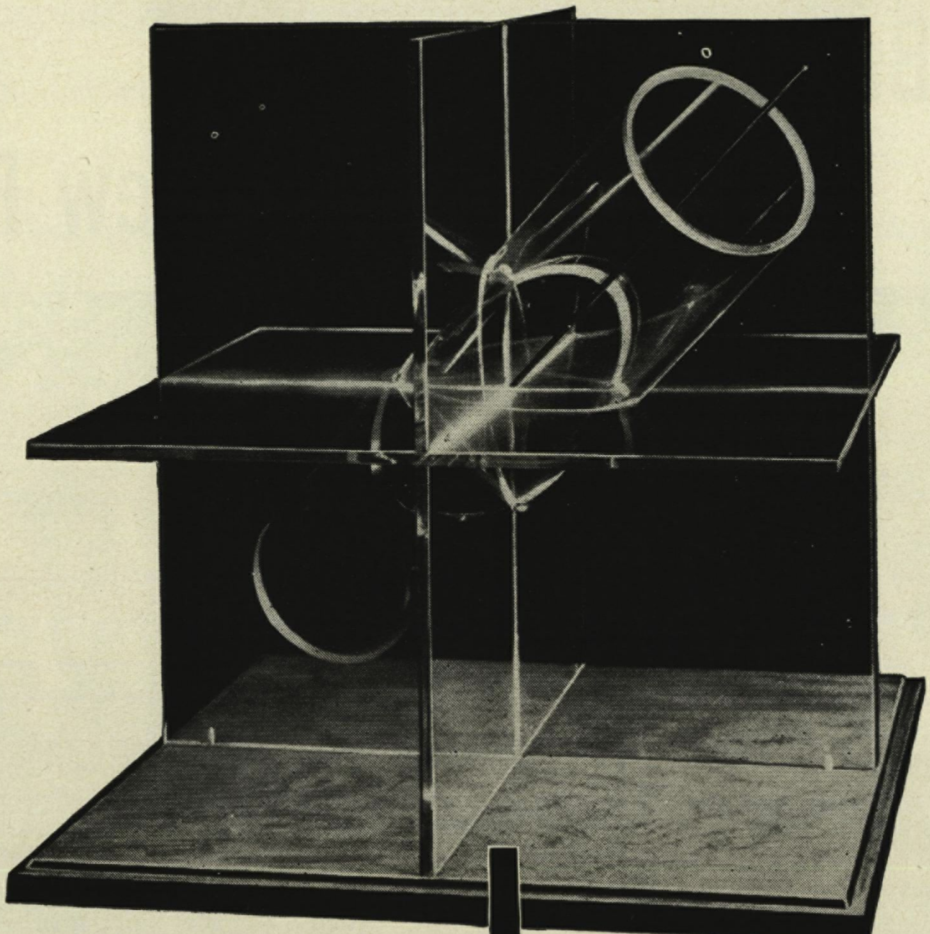
You are cordially invited to visit Rose Polytechnic Institute during the present school year to learn more about your college entrance and the engineering courses available to you at Rose. The next freshman class will be admitted September 8, 1953.

NOBLE C. BLAIR

Admissions Counselor

ROSE POLYTECHNIC INSTITUTE

TERRE HAUTE, INDIANA



A Bearing Theory with a bearing on your job future

The futuristic-looking object in the picture above is a demonstration model of Maxwell's distortion energy theory concerning the yielding of ductile materials.

And it's used by our General Motors research engineers in their study of "bearing fatigue."

From this study they have succeeded in discovering new facts about the "thick and thin" of bearing surface metals—and thus added to wearing qualities of journal and engine bearings.

We publish it here to point up a fact that should not be overlooked by the engineering student with a bent for research.

That fact is the wealth of opportunity for the research-minded engineer to function creatively at General Motors.

Yet research engineering is only one of the opportunities at General Motors for the graduate engineer.

For GM is not only a leading producer of motor-cars and trucks. It also manufactures many other types of civilian goods from heating and air conditioning systems to refrigerators, from fractional h.p. motors to Diesel locomotives.

And, as a top defense contractor, GM builds everything from rockets and range finders to jet and Turbo-Prop airplane engines.

So there's plenty to work on at GM. And plenty of engineering brains to work with.

Our many graduate engineers in top management prove that the engineer with the ability to make real use of what GM has to offer can build himself a very satisfying future in the GM family.

So why not ask your College Placement Office to arrange an interview for you with the GM College Representative the next time he visits your campus? Or drop us a line.

GM Positions now available in these fields:

MECHANICAL ENGINEERING • ELECTRICAL ENGINEERING
METALLURGICAL ENGINEERING • INDUSTRIAL ENGINEERING
CHEMICAL ENGINEERING

GENERAL MOTORS

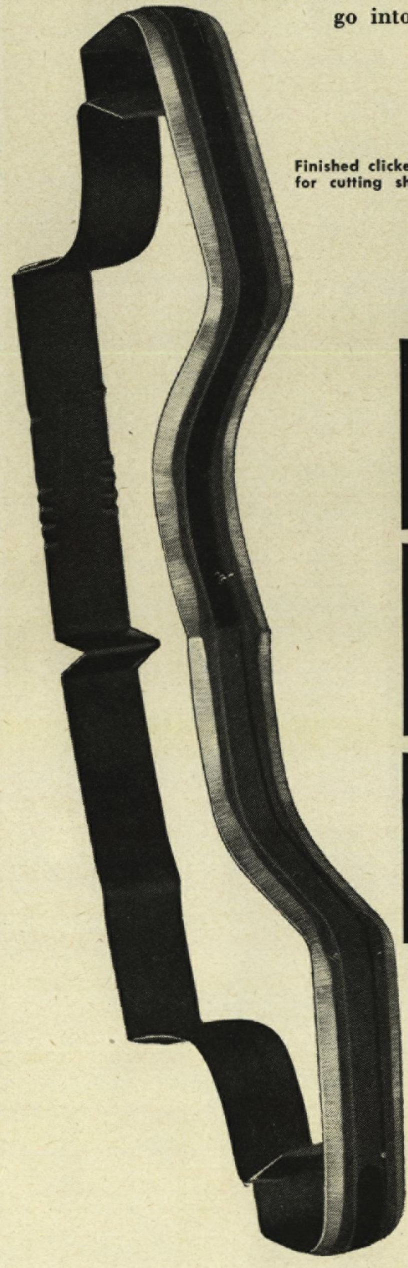
Personnel Staff,
Detroit 2, Michigan

What's Happening at CRUCIBLE

about clicker die steel

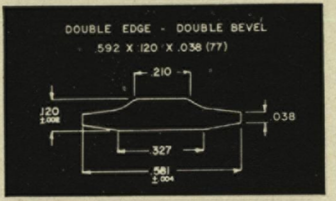
what it is

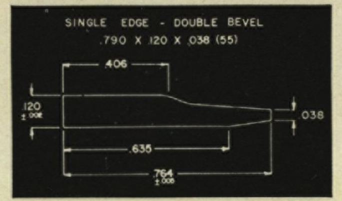
Clicker die steel is a special cold rolled alloy steel. It is used in making clicker dies for cutting leather, rubber, plastic, felt and fabrics of other compositions that go into the making of shoes and similar products.

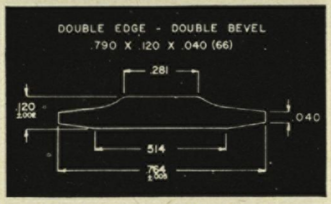


Finished clicker die ready for cutting shoe leather.

Some of the clicker die steel standard shapes.







Wider shapes are used when dies are sized by surface grinding after forming and welding. Standard widths are provided when the dies are not to be surface ground.

how it is used

Clicker die steel is furnished to the die maker in either single or double edged form in one of several standard shapes. The die maker first shapes the die by bending the die steel to a pattern that provides the desired configuration, and then welds the two ends at a corner. He finishes the die by grinding a bevel on the outside of the cutting edge and filing the inside edge. Before the finished die is hardened and tempered, the die maker forms identification marks — combinations of circles and squares — in the cutting edge so that the material cut from it may be easily identified as to its size and style.

In the cutting operation, the leather or other material is placed on an oak block in the bed of the clicker machine. Then the die is placed by hand on the material which is cut as the aluminum faced head of the machine presses the die through it. The clicking sound which the head makes as it strikes the die is where the term "clicker machine" derived its name.

what it is composed of

Clicker die steel as produced by the Crucible Steel Company of America is a controlled electric steel in which the combination of carbon and alloy is designed for maximum toughness and proper hardness after heat treatment.

Experience has proved that cold finished clicker die steel is superior to hot rolled material for sizes approximately $\frac{3}{4}$ inch and narrower because of its lower degree of surface decarburization which permits the use of slightly thinner sections. Cold finished material also has a better surface finish with closer width and thickness tolerances and thinner edges that require less grinding and filing to complete the die.

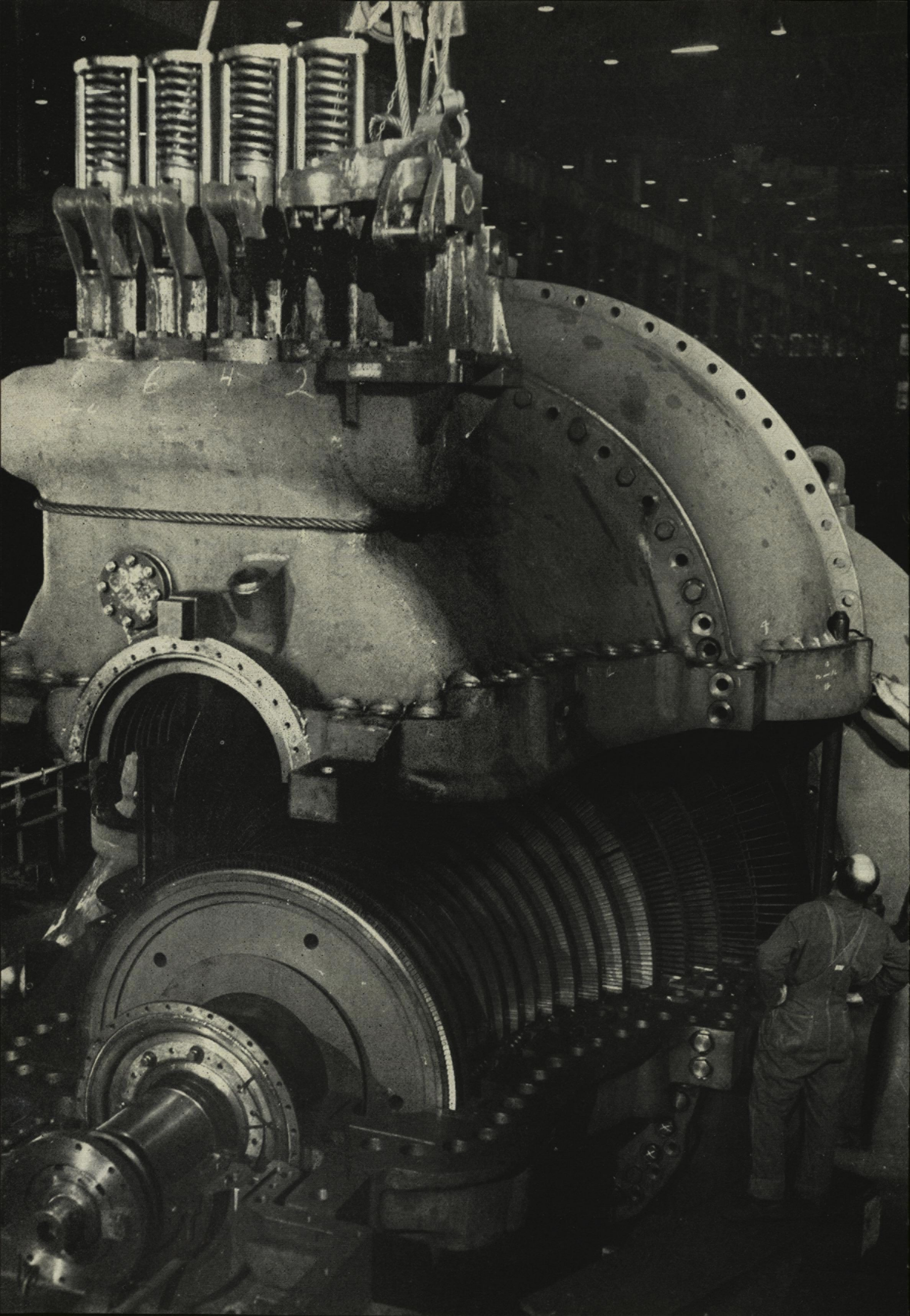
CRUCIBLE'S engineering service

As with clicker die steel, the Crucible Steel Company of America is the leading producer of special purpose steels. If you have a problem in specialty steels, our staff of field metallurgists with over 50 years experience in fine steel making is available to help you solve it. Crucible Steel Company of America, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

53 *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



Our Engineering Profession

Since this issue of the Technic is our special Engineers's Day edition, I thought it appropriate that our editorial be one of interest to those contemplating engineering as their career. However, inasmuch as my knowledge of the profession is limited to the study of a few engineering textbooks, I turn to one of the most renowned engineers of our time for his enlightening comments on his profession. The following is a portion of an address delivered by Herbert Hoover at the Northwest Engineering Centennial at Portland, Oregon, on August 9, 1952:

Within a little more than my lifetime, the training of engineers has risen from apprenticeship to a trade or secondary technical schools to the dignity of a University-trained profession.

As indicative of the distance the engineers have risen in public repute, I might recall that some years ago while crossing the Atlantic, I took my meals at the same table with a cultivated English lady. As we came into New York Harbor, at breakfast she said: "I hope you will forgive my dreadful curiosity, but I should like awfully to know what is your profession." I said that I was an engineer. Her involuntary exclamation was: "Why, I thought you were a gentleman."

The engineer has a high privilege among professions. He has the fascination of watching a figment of his imagination emerge with the aid of science to a plan on paper. Then it moves to realization in cement, metal or energy. Then it adds to the security and comfort of homes.

Engineering training by our Universities has other great values to the country than its industrial consequences. It instills character in those who would join its ranks, for high ethical standards are the essential of all professions. Technology without intellectual honesty does not work. Construction without conscientiousness soon crumbles. Here is the invocation of veracity in a world sodden with intellectual dishonesty. These are the reasons you have seen no engineers before the Kefauver Committee. Nor in the headlines which these days pour forth from Grand Juries and District Attorneys' offices. The engineers' main appearance in public is only to sit on juries and committees for reform.

From the work of the engineers comes the lifting of men's minds beyond the depressing incidents of the day. And here is the rejuvenation of spirit and confidence in the future of our country.

In any event you will agree that the engineer is an antidote to evil and the bearer of blessings. Even including his antidote to inflation.

In closing, let me repeat a statement from a good engineer of just exactly four hundred years ago. He referred to the mining engineers but his general tolerance is warranty for its application to all engineers. "Inasmuch as the chief callings are those of the moneylender, the soldier, the merchant, the farmer, and miner, I say, inasmuch as usury is odious, while the spoil cruelly captured from the possessions of the people innocent of wrong is wicked in the sight of God and man and inasmuch as the calling of the miner excels in honor and dignity that of the merchant trading for lucre, while it is not less noble though far more profitable than agriculture, who can fail to realize that it is a calling of peculiar dignity?"

P.C.E.

Ergs from

From the time of the first nuclear reactor, December 1942, until the present, physicists and engineers have looked toward the time when the latent power of the atom could be harnessed and utilized for the benefit of humanity. The political situation of the world, however, has not allowed a rapid development of peacetime uses for atomic energy, since government regulation and the concentration of research for military purposes has stifled almost all private research. This situation is improving, however, and with the entry into the research field of teams from power and chemical companies it has become apparent that central station nuclear power awaits only the accumulation of the capital necessary to construct the reactor. Let us discuss some of the possible paths to be followed in achieving this goal.

Although the theory and science of nuclear physics is beyond the scope of this article, it might be well to outline briefly the mechanism of the atomic pile. Essentially atomic nuclei are made up of neutrons and protons. These two particles are approximately equal in mass and together comprise very nearly the weight of the atom. Protons have one positive charge each and their number determines the number of negatively charged electrons in planetary orbits around the nucleus, thus giving the atom a zero charge. Neutrons are uncharged particles present in varying numbers in the nucleus. Atoms of the same element having a different number of neutrons in the nucleus are called isotopes.

Elements of very high atomic numbers, such as uranium, thorium, radium, and actinium, have certain isotopes which are unstable. These isotopes attempt to attain stability by the emission of alpha or beta particles. If an alpha particle is emitted, an element of atomic number lower by two than the original element is formed. The emission of a beta particle results in an atom of an element one higher on the atomic series. This phenomena is known as radioactivity.

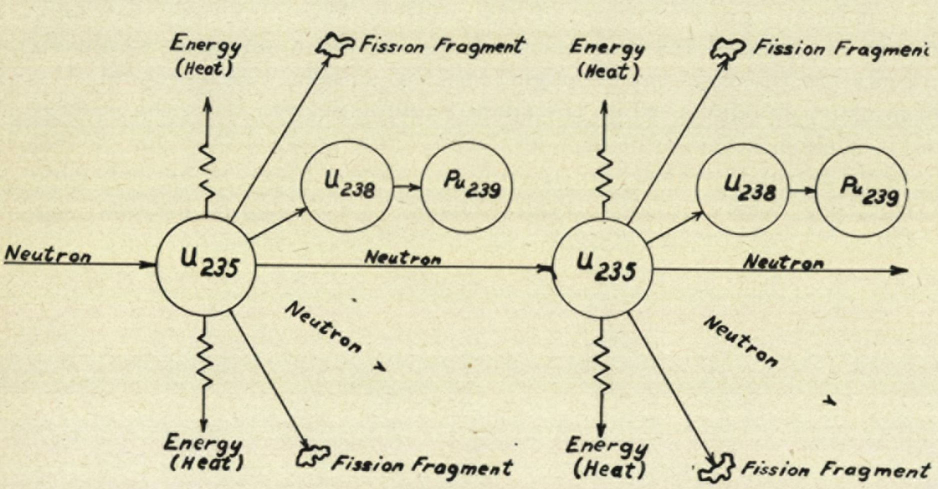
Speculation concerning the possibility of obtaining power from the atom started as early as 1905, when Einstein stated that mass and energy were equivalent. He postulated that the amount of energy, E, equivalent to a mass, m, was given by the equation

$$E = mc^2$$

where c is the velocity of light. Although no experimental evidence was offered, Einstein suggested that proof of his postulation might be found by the study of radioactive substances.

The ten year period prior to World War II saw the first experimental proof of the Einstein equation. In particular, Niels Bohr, Enrico Fermi, and others, reasoned and then proved experimentally that, if the uranium atom is bombarded by a neutron stream, the uranium nucleus would absorb a neutron, causing it to split into approximately equal parts releasing enormous quantities of energy. Fermi also thought that the fission resulted in the emission of neutrons. This rendered the chain reaction possible.

The nuclear reactor is simply a machine designed to control the chain reaction illustrated above.



Nuclear Reaction

Methods Of Application

Basic Method and Problems

Before we look at the specific methods of obtaining electrical energy from the nuclear reactor, let us look briefly at the general means likely to be used. In connection with this it should be realized that, "—Nuclear power is not a new kind of power but is only a new fuel. As such, it will be used in processes that have been under development ever since the steam engines of Newcomen and Watt." Once this fact is fully realized the problem of obtaining usable industrial power from an atomic pile is greatly simplified. This problem then consists only of finding a means whereby existing turbo-generators can be operated by the enormous quantities of heat

Atoms

By Donald Wood, Ch.E., Soph.

generated by a nuclear reaction. There are several technical problems, however, that complicate the picture. These are due to the fact that the engineers and physicists will be working more or less blindly, that is, they will be pioneering a new field. What are the principal problems confronting the reactor designer? They are four in number:

Choice of heat-transfer systems. This includes the choice of a coolant to carry the heat generated by the fission in the reactor to the turbo-generator. Some of the coolants under consideration are gases, water, and liquid metals.

Materials for construction. Many conventional construction materials are unsuitable for use in reactors under the intense irradiation encountered. New substances, not affected by radioactive materials, must be found and developed.

Chemical processing of fuels and fission by-products. Cheap and efficient processes must be developed for chemical separation of radioactive materials. This is necessary both for recovery of valuable fission by-products and for the separation of usable fissionable fuel.

Choice of plant location. At the present stage of development, safety requirements call for the location of nuclear reactors on large reservations of uninhabited land. Whereas present coal-burning generating plants are constructed on a maximum of one hundred acres, an atomic fueled generating plant must have a minimum of one hundred thousand acres. This requirement alone is a deterrent to private construction. More adequate shielding and safety precautions are a definite necessity before nuclear power can become a reality.

The above problems, while by no means insurmountable, must be solved prior to the construction of a power plant using fissionable material as a fuel.

Proposed Types of Reactors

While it has been said that, "There never has been, nor is there now, any dearth of designs of reactors which technically are feasible as producers of electrical power", a closer study shows that all of these designs can be grouped under three main types.

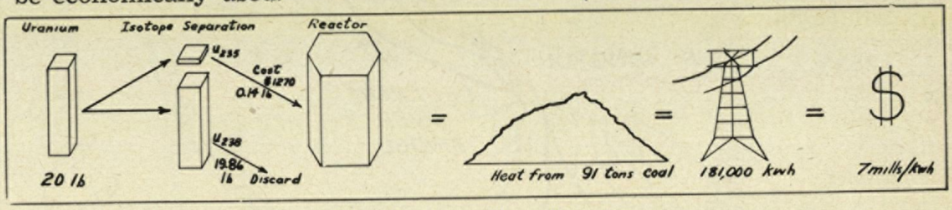
Nonregenerative thermal reactor. Reactors of this type operate by consuming fissionable material and producing heat energy alone. They are extremely wasteful since only the fissionable isotope of uranium, U_{235}, which comprises only 0.7% of the available supply of uranium, can be used. Due to the necessity for maintaining "critical size" in the reactor, accumulation of fission by-products, and changes in the U_{235} itself while undergoing fission, only one-half of this 0.7% or 0.35% can be economically used.

Regenerative reactor. Nuclear reactors such as the Hanford plant produce fissionable material in addition to heat. As shown in the diagram, when the U_{235} atom is split, one to three neutrons (average 2.5 neutrons) are emitted. One of these goes to maintain the chain reaction. In the nonregenerative reactor the remaining 1.5 neutrons are lost. In the regenerative type, however, they are not all lost. If U_{238} is present one of the remaining neutrons will be captured by the U_{238} nucleus. The U_{238} then undergoes transmutation to the fissionable plutonium atom, Pu_{239}.

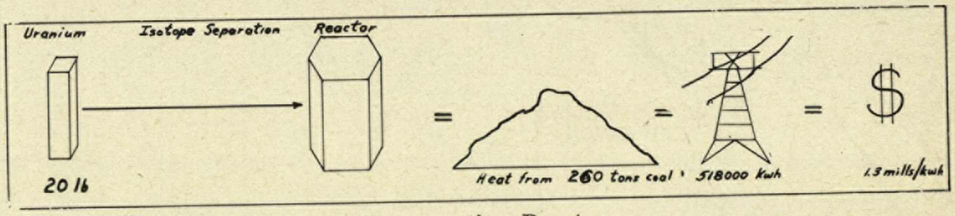
An experimental reactor of this design is operating as a research tool at Argonne National Laboratory, Palos Park, Chicago, Illinois. For each atom of U_{235} consumed, 0.8 of a Pu_{239} atom was formed.

This increases greatly the amount of power that can be generated by the initial amount of U_{235}. After the original amount of U_{235} has been

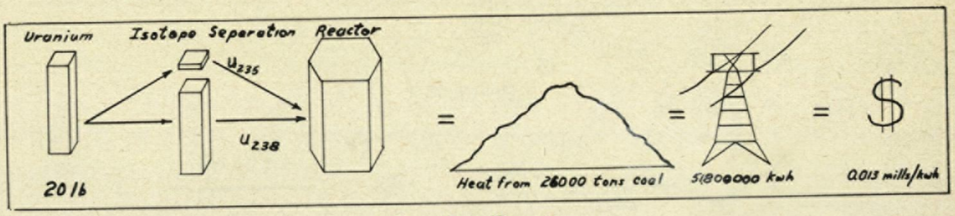
(*Continued on page 26*)



Non-Regenerative Reactor



Regenerative Reactor



Breeder Reactor

Bridging

The Chesapeake Bay was spanned for the first time in July, 1952, by a four mile long, $44-million bridge located about twenty-five miles south of Baltimore. This bridge, linking the Del-Mar-Va Peninsula to the mainland of Maryland, is a segment of an express highway which enables traffic along the Atlantic Coast to bypass every big city from New York to Richmond.

Prior to the erection of the bridge it had been necessary for motor vehicles to be entirely dependent upon water communications and consequently there was an urgent need for a highway connection from Baltimore, Washington and Annapolis to the eastern shore. The lack of an adequate crossing not only interfered with the rapid movement of vehicles but was also a handicap to the development of the land in the bay area. However, the long-felt need is now fulfilled, and the completion of the Chesapeake Bay Bridge opens up the formerly isolated Eastern Shore area to commercial exploitation, increasing considerably the size of the Baltimore-Washington retail trading area. Also the crossing time of one-half hour by ferry boat has been cut to less than 10 minutes, and a 130 mile drive around the Bay has been eliminated.

Features Of The Bridge:

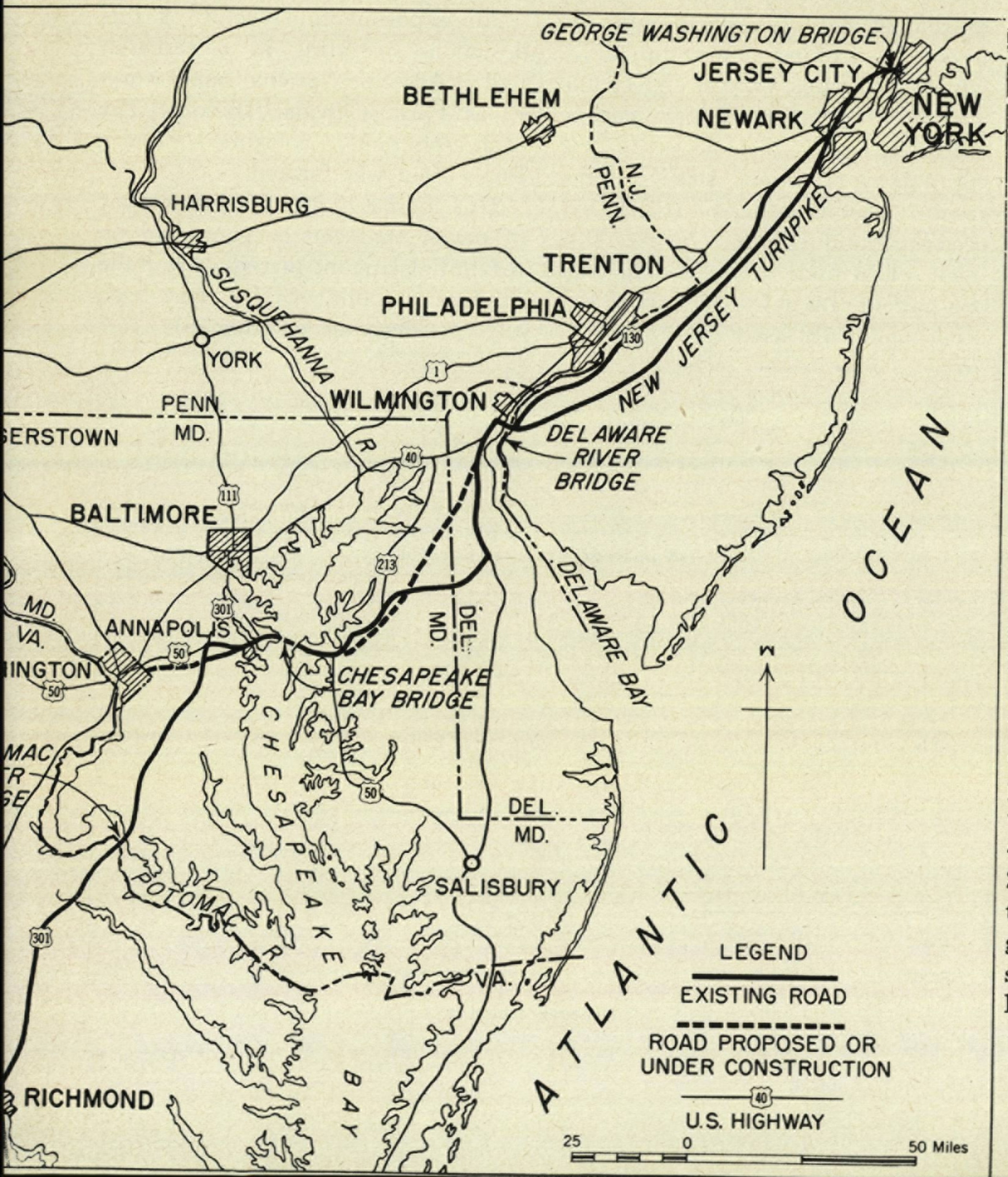
The Chesapeake Bay Bridge wa designed by the J. E. Greiner Co Baltimore engineers. The super structure was erected by the Bethlehem Steel Company, and the sub structure was constructed by a tota of six contractors.

The time required to build this the third longest bridge in the world was almost three years. A total o 33,500 tons of steel, 118,000 cubic yards of concrete and 4,130 piles were used. The crossing is 22,990 feet from shore line to shore line (4.35 miles), 21,286 and one-half feet (4.03 miles) of it spanned by the bridge and approximately 0.32 miles traversed by a causeway. The approach roadways on the western shore of 1.1 miles and on the eastern shore of 2.28 miles comprise a total project length of 7.73 miles which connects with U.S. Highway Route 50 on both sides.

Over the length of 21,286 feet are many bridges in one. Included is a 1600-ft span suspension bridge with a verticle clearance of 193.5 feet and side anchor spans of 661 feet each. There is a 780-ft. span through-cantilever bridge, a dozen deck cantilevers of 450 to 600 ft. spans, six deck truss spans of 305 feet and four of 255 feet, plus 95 deck girder and beam spans. The roadway width provided is twenty-eight feet between curbs for two lanes. This width will permit a disabled vehicle to park on the bridge with sufficient roadway remaining open to accommodate two lanes of traffic at controlled speeds.

One of the most interesting features is the curve in the bridge. Alignment of the bridge is on a tangent to a point approximately 3200 feet off the western shore, where a one degree 40 minute curve with a length of 2,870 feet joins the main portion of the bridge which continues on a tangent almost due east to the eastern shore. According to F. H. Frankland, consulting engineer in con-

Map of Chesapeake Bay Area



Chesapeake Bay

By John Simpson, C.E., Sr.

struction of the bridge, the structure is curved because, if the bridge were built straight across, it would be at sharp angles with the line of travel of the main channel. By building the bridge in a curve, the expansion part (the highest section above the water) is at a right angle with the channel traffic. In addition, a naval airport is located near one end of the bridge. The curve puts the suspension towers (354 feet high) as far out of the path of planes landing at the base as possible.

Survey Work:

The survey work necessitated precise triangulation for horizontal control and precise level work for vertical control. Individual pier locations were established from pile dolphins located offside each pier of the long span portions of the bridge. The survey dolphins were on an offset line 200 feet parallel to the bridge centerline. The location work was further complicated by the curve at the west end of the bridge. To aid in establishing exact pier locations in the curve, a survey dolphin was established at the point of intersection of the two tangents. All long-span bridge measurements were checked by direct measurements using calibrated piano wires, corrected for temperature change and having identical pull to that of calibrations. The wires were calibrated on a shore base line before and after each measurement, the wires being fully suspended for each calibration and measurement.

Sub-Structure:

Foundation cost has, as much as any one thing, deterred the building of a bridge across Chesapeake Bay. However, the Greiner engineers came up with a design that brought this cost down to the minimum possible. This design is of the type developed for the Potomac River Bridge and was used for the twenty-eight heavily-loaded, deep-water piers in the center of the bridge with the exception of the suspension span anchorages. The basic element of the design is a permanent steel form of four bellbottom legs joined by double steel diaphragms. Familiarly called a "can", it is lowered onto a laminated timber platform supported at the bay bottom on timber or pipe piles and through which project steel H-piles driven as much as 203 feet below water level to firm sand capable of supporting 130 tons per pile. The cans are filled with concrete to form the piers. This is done with tremie concrete up to El.-8 after which the cans are pumped out and the piers completed in the dry.

While the timber platforms provide support for the steel forms, they are also essential as a template to guide the driving of the steel H-piles. The most careful setting of these piles was required, and a gyro-compass was used to set the driver leads to the exact inclination for each batter pile. To drive these piles until their tops were as much as sixty feet under water required some of the heaviest pile hammers in existence. One of these was the S-14, a sixteen ton giant with a seven ton ram.

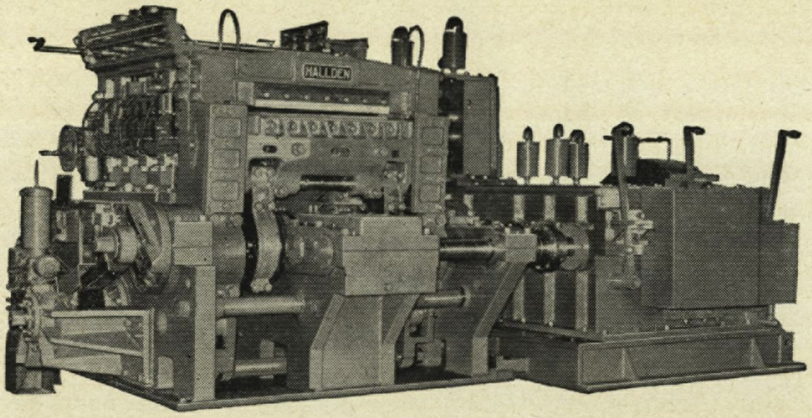
The steel H-pile and "can" design offers a practicable solution for locations where the depth to firm bearing is so great as to make the cost of cofferdams prohibitive. However, since the suspension bridge anchorages are in the form of huge monolithic blocks of concrete for which the "cans" are not suitable, cofferdams were required. The steel H-piles were also required under the anchorages, as at all of the 124 foun-

(*Concluded on page* 28)

Setting 'Cans'

East Girder Span

Another page for **YOUR BEARING NOTEBOOK**

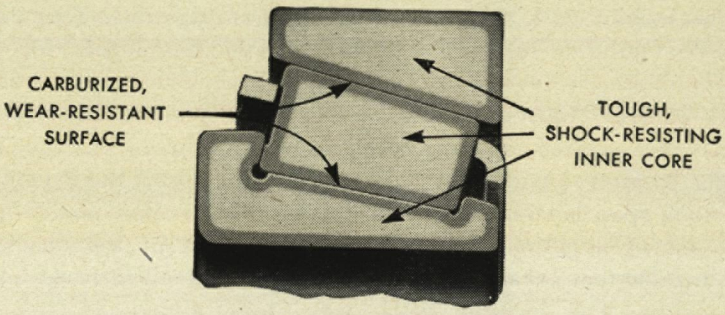


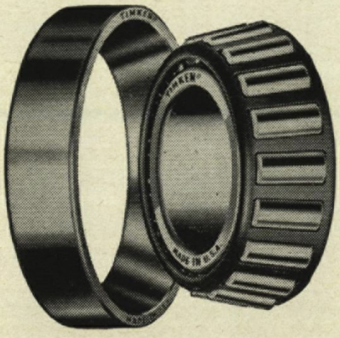
Guillotine shear cuts cost of cutting steel

To carry the terrific shock loads imposed on pinions and gears in this flying shear, engineers mount them on Timken® tapered roller bearings. Maintenance and repair costs are cut, costly breakdowns prevented, accuracy insured. Because of their tapered construction, Timken bearings take radial and thrust loads in any combination. They minimize friction, reduce wear — normally last the life of the machine.

Why TIMKEN® bearings can take the toughest loads

In Timken bearings, the load is carried on a line of contact between the rollers and races instead of being concentrated at a single point. Made of Timken fine alloy steel, the rolls and races are case-carburized to give a hard, wear-resistant surface with a tough core to withstand shock.





TIMKEN

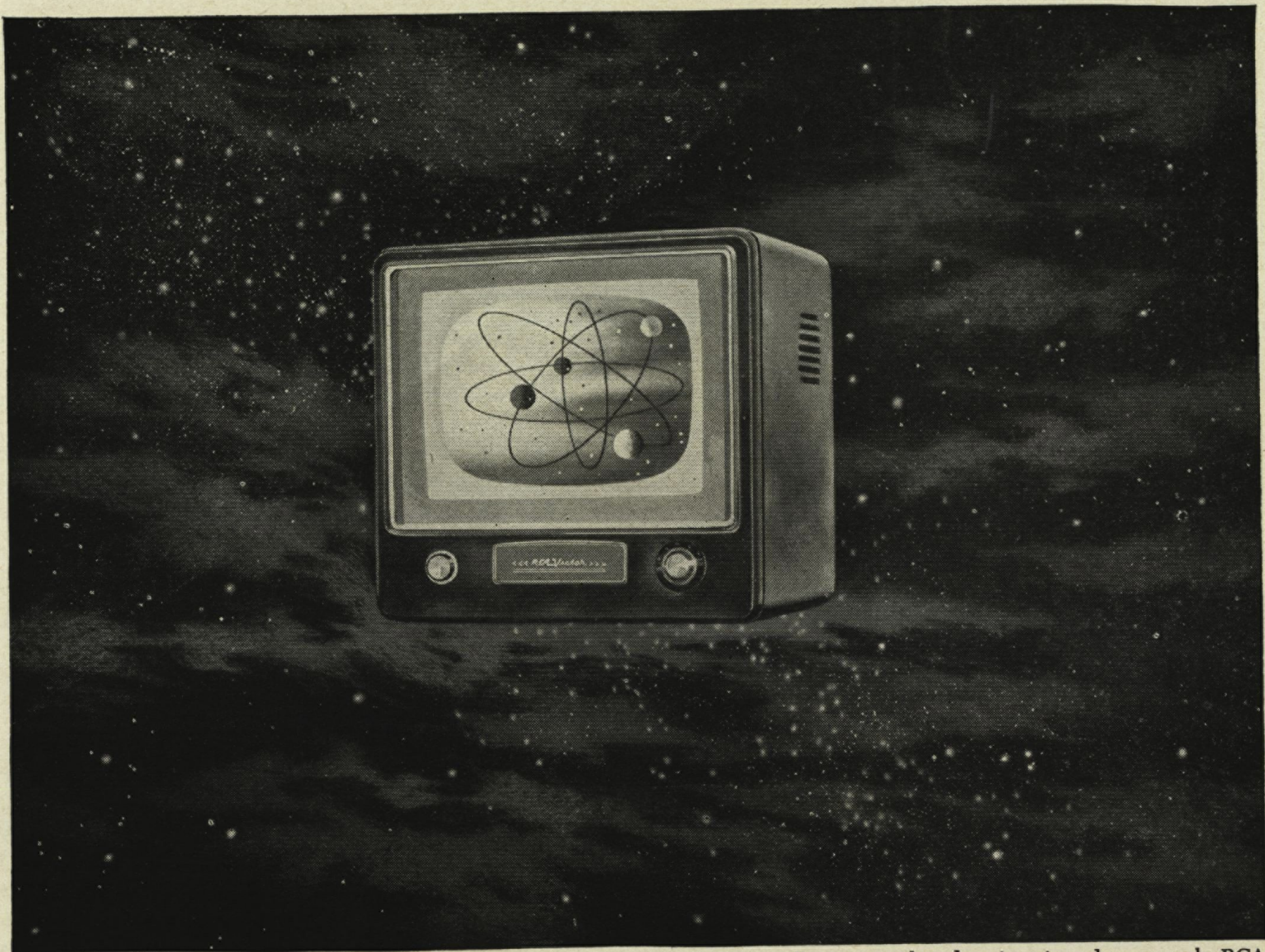
TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Want to learn more about bearings?

Some of the engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'll be glad to help. Clip this page for future reference, and for a free copy of the 270-page General Information Manual on Timken bearings, write today to The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION



Basic research and engineering advances make RCA Victor's 1953 TV receivers the finest you can buy.

First with the major advances— since Television began!

Families living in television areas have seen from the beginning why more people buy RCA Victor television sets than any other brand. As television spreads to new communities, millions more learn the same.

Enthusiastic reception of the 1953 RCA Victor sets proves that advanced research and engineering means finer TV. You see it in the new "Magic Monitor" circuit system which *automatically* screens out interference, steps up power, tunes the best sound to the clearest picture.

Further proof of this leadership is the new RCA "Deep Image" picture tube with its micro-sharp electron beam and superfine phosphor screen which ensures the finest picture quality. It is also seen in reception at a distance—as well as in *automatic* tuning of all channels, both VHF and UHF.

Today's RCA Victor receivers result from the same research and engineering leadership that perfected the *kinescope* picture tube, the *image orthicon* TV cameras, reflection-free metal-shell picture tubes — and which opened UHF to television service.

* * *

RCA research assures you better value—more for each dollar you invest—in any product or service of RCA and RCA Victor.

CONTINUE YOUR EDUCATION WITH PAY—AT RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short-wave and FM circuits, television, and phonograph combinations).
- 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.
- Development and design of new recording and producing methods.
- 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.**

RCA® *RADIO CORPORATION OF AMERICA*

World leader in radio—first in television

Napier's Bones

By William Toeppe, E.E., Senior

John Napier was born at Merchiston, near Edinburg, Scotland, in 1550. He is best known as the "author and inventor" of logarithms, which were introduced in his *Mirifici Logarithmorum Canonis Descriptio* (Description of the Admirable Canon of Logarithms) published in 1614. He has also been credited with the introduction of the decimal point in Rabdologia (The Study of the Rods) published in 1617. Previous to this a number of 123.456 would have been written $123^0 4^1 5^2 6^3$. Napier in the *Rabdologia* writes the quotient of 861094 divided by 432 as 1993.273 in the work and as $1993,2'7''3'''$ in the text. In his *Mirifici Logarithmorum Canonis Constructio* (Construction of the Admirable Canon of Logarithms) published in 1619, the decimal point is used freely without the primes or other aids. In this book appear also decimal numbers less than one as .4999712 and .0004950, showing Napier understood all the advantages of this notation.

This article is about an invention of Napier's which was the subject in *Rabdologia* and which is now forgotten: "Napier's Bones" or Rods. The bones were invented to facilitate multiplication and were really a flexible multiplication table. The bones were rectangular strips of wood or other material divided into ten squares lengthwise. The top square contained one of the ten digits. The descending squares contained the multiples of this digit. To make addition easier, the squares were divided by a diagonal, the tens digit was written to the left and the units to the right. Each rod was therefore the multiplication table for a single integer. A complete set of bones is shown in figure one. (Usually an extra bone, marked (a), was added so that the needed multiplying row could easily be found.)

To show how the bones work, let us use the multiplicand as set up in figure two, 1765479. Suppose we want to multiply this by 6. We run down guide bone to 6 and move across this line of squares. We add together the numbers in the triangles which form the oblique parallelograms from right to left as in modern multiplication and placing each sum down (try it in margin) 4, 2 + 5 or 7, 4 + 4 or 8, 0 + 2 or 2, 6 + 3 or 9, 2 + 3 or 5, 4; which makes the product 4592874. (See figure three.) Where the multiplier is greater than nine, it is only necessary to place down upon paper the individual integer product of the multiplicand, displacing one column to the left each time as in modern computation.

	1	7	6	5	4	7	9
6	4/2	3/6	3/0	2/4	4/2	5/4	

4 ,2 +3,6 +3, 0 +2,4 +4,2 +5, 4

4 5 9 2 8 7 4

Figure 3

For example: 765479 x 138 (This is left as an exercise for the reader.) In the event that the sum of the two integers in the triangles is greater than nine, then the units integer is written down and the tens integer is carried on to the parallelogram to the left. For example: 765479 x 9. (See figure three again.) The sums are 1; 8 + 3 or 11, write 1, carry the 10 as 1 into next column; 1 + 6 + 6 or 13, write 3, carry 1; 1 + 3 + 5 or 9; 4 + 4 or 8; 3 + 5 or 8; and 6. The product is 6889311.

Figure five shows the original form of Napier's bones. It can be seen that if a number were to have a repeated integer, it would be necessary to have a like number of similar bones. Therefore a useful set of bones would have several bones of each integer. However, if the bones were made of lengths of material having a square cross section with a different integer on each face, then the number of bones in a complete set would be decreased by a factor of four. Later the rods were made cylindrical with the integers from zero to nine on each cylinder so that it was only necessary to have

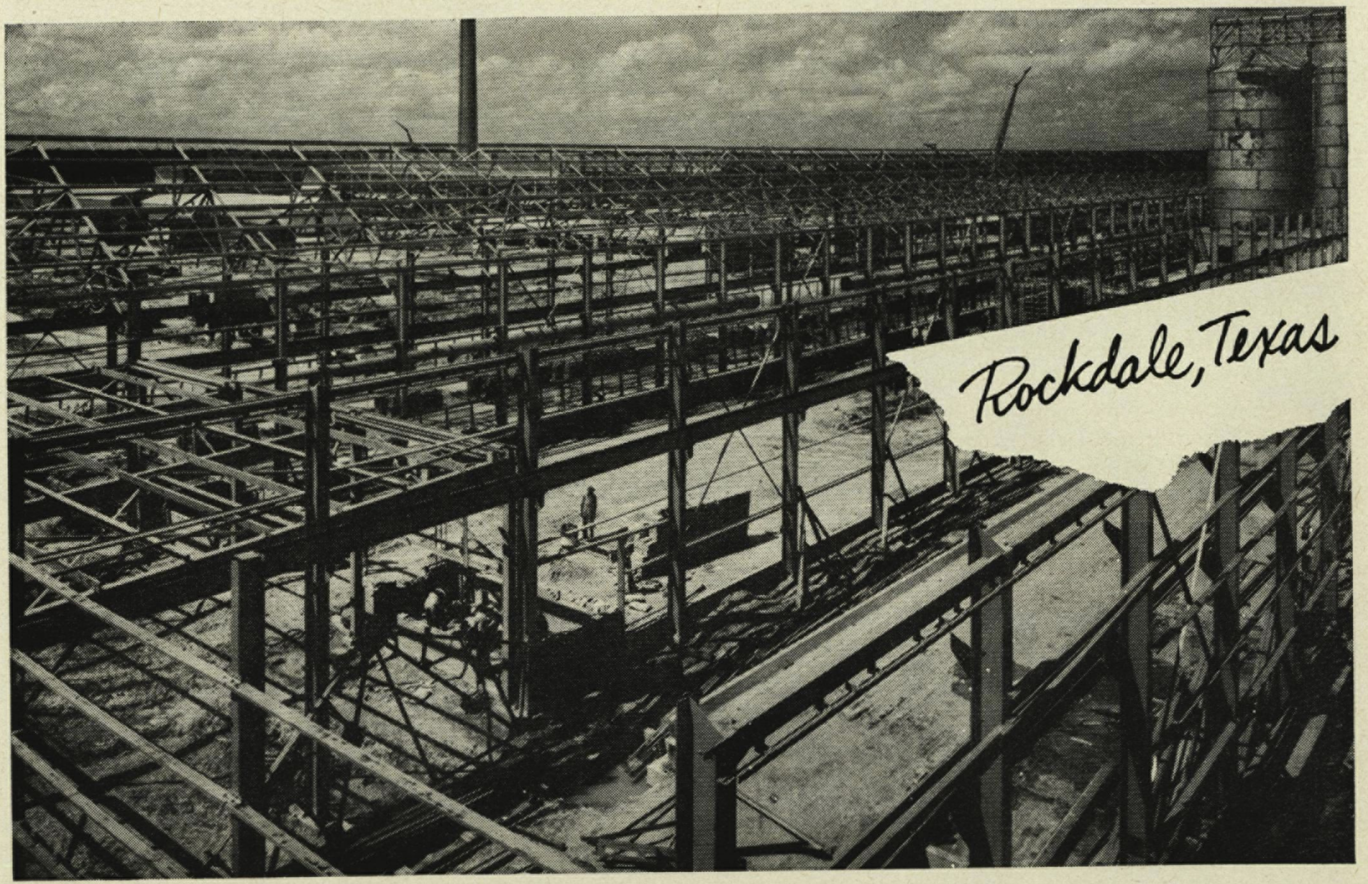
(*Concluded on page* 38)

1	0	1	2	3	4	5	6	7	8	9
2	0/0	0/2	0/4	0/6	0/8	1/0	1/2	1/4	1/6	1/8
3	0/0	0/3	0/6	0/9	1/2	1/5	1/8	2/1	2/4	2/7
4	0/0	0/4	0/8	1/2	1/6	2/0	2/4	2/8	3/2	3/6
5	0/0	0/5	1/0	1/5	2/0	2/5	3/0	3/5	4/0	4/5
6	0/0	0/6	1/2	1/8	2/4	3/0	3/6	4/2	4/8	5/4
7	0/0	0/7	1/4	2/1	2/8	3/5	4/2	4/9	5/6	6/3
8	0/0	0/8	1/6	2/4	3/2	4/0	4/8	5/6	6/4	7/2
9	0/0	0/9	1/8	2/7	3/6	4/5	5/4	6/3	7/2	8/1

Figure 1

5	9	7	8
1/0	1/8	1/4	1/6
1/5	2/4	2/1	2/4
2/0	3/2	2/8	3/2
2/5	4/0	3/5	4/0
3/0	4/8	4/2	4/8
3/5	5/6	4/9	5/6
4/0	6/4	4/8	6/4
4/5	7/2	6/3	7/2

Figure 2

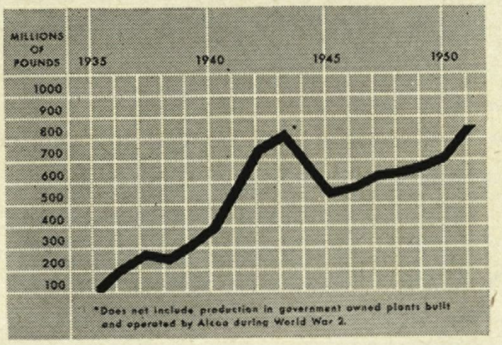


Is part of your future being built here?

Here you see the beginning of another addition to Alcoa's expanding facilities. This plant, at Rockdale, Texas, will be the first in the world to use power generated from lignite fuel and will produce 170 million pounds of aluminum a year. This and other new plants bring Alcoa's production capacity to a billion pounds of aluminum a year, four times as much as we produced in 1939. And still the demand for aluminum products continues to grow. 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.

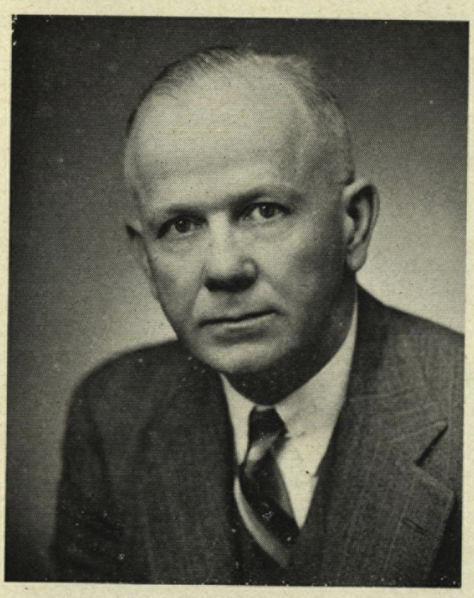
Alcoa Aluminum

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Alumni News

By Lawrence Ogborn, E.E., Jr.



Walker H. Henry

'03 Harry W. Palmer, E. E., died in October, 1952. Mr. Palmer was formerly a structural designer for the Colorado State Highway Dept.

'05 Brenton C. Cook, E. E., Vice President and Manager of Advertising and Export for Elwell-Parker Electrical Company, is retiring after 39 years. Mr. Cook was president of the National Electric Industrial Truck Association in 1951, of the Cleveland Export Corporation for 3 years, and president of the World Trade Association last year. Mr. Cook's first job was with Allis Chalmers.

'11 Ross L. Wyeth, M. E., died January 15, 1953. Mr. Wyeth was retired. He was formerly assistant instructor in the Engineering Department of the University of Houston.

'14 Walker H. Henry, of Terre Haute, Ind., has been named manager of the General Electric Motor and Generator Division's newly-organized Marketing Department at Schenectady, N. Y.

Henry, who received his B.S. degree in electrical engineering from Rose Polytechnic Institute in 1914, joined G.E. in 1919 and served as fractional horsepower motor sales engineer in Chicago, Kansas City, New York and Boston.

In 1928 he was named assistant manager of fractional horsepower motor sales at Fort Wayne, Ind. He became manager of sales in 1930.

In 1934 he transferred to the Motor Division in Schenectady and was made division manager in 1942. Three years later he became assistant manager of the Industrial Divisions. From 1947 until his recent appointment, Mr. Henry served as general manager of the Small and Medium Motor Department.

'28 Lt. Col. George J. Mason, C. E., has completed a tour of duty on Okinawa and has been transferred to Ft. Leonard Wood, Missouri.

'31 Ernest G. Hurst, E. E. and '42 Charles S. Meurer, C. E., were among four engineers who received national notice recently for their invention of an intricate machine for spraying a plastic coating on concrete blocks and other concrete products. The machine, known as the Krete-Koater, employs a new spraying process to apply a Sherman-Williams plastic product, newly introduced as Kem-Krete. The machine was perfected after over tw years of research and tests.

'33 Col. John C. Dalrymple, E. E. is serving as Assistant Deputy Chief of Staff for Operations, U. S Army, Europe. He served in the European Theater of Operations during World War II and holds the Silver Star, the Legion of Merit and the Bronze Star Medal with Oak Leaf Cluster. Col. Dalrymple received his M. S. Degree from Iowa State College, Ames, Iowa, in 1948.

'39 Major Robert N. Ladson, Ch. E., is an executive officer in the Chemical Replacement Center at Ft. McClellan, Alabama. Major Ladson was formerly manager of the Ladson Quality Bakeries in Terre Haute, Indiana.

Dec. '47 Lt. Francis A. Heinz, M. E., is in Hq. Wright Air Development Center, Directorate of Flight and All Weather Tests. He is a test pilot for cargo type aircraft. Lt. Heinz was formerly a jet pilot in Korea.

Nov. '49 John D. Winters, M. E., is a jet pilot, 25th Fighter Interceptor Squadron, U. S. Air Force.

Nov. '49 William Orbaugh, Ch. E., is now with Eli Lilly and Company. He is in Production Planning Studies (experimental). Mr. Orbaugh was formerly in the United States Navy.

Aug. '50 Paul Haas, Ch. E., has recently been released from service with the U. S. Army. He has returned to the Monsanto Chemical Company.

Campus Survey

By Jack Farell, Ch.E., Jr.; Jack Freely, C.E., Jr.; and Herb Smith, E.E., Soph.

Love Efficiency

Are you enjoying your love life as much as you might? A method by which the student body may test themselves has been introduced.

The only apparatus necessary is a rubber band. It would be best if it were clean. Now hold the rubber band horizontally in front of you. Touch it to your lips. Then suddenly stretch the rubber band and touch it to your lips again. Did you notice any difference in the feel of the rubber band in the two times it touched your lips. If you didn't, cat, you are dead!

Actually there should be a temperature difference. The work that was done in stretching the rubber band was turned into heat. The change in temperature is small, but sensitive lips can notice this difference.

By the way, if your girl doesn't seem too responsive, you might try the test on her. This might cause you to change your strategy.

A Really Successful Basketball Season

On February 19, the basketball team ended its season with a terrific win over Greenville college. The Engineers trounced a good, smooth working opponent 95 to 72. Big Joe Buscher was high point man with 21 points. Harry Badger, playing his last game for Rose, was close behind with 20 points.

This win gives the team a season record of 15 wins and 4 losses. This is one of the best seasons a Rose team has had in a long time. Coach Jim Carr has done a swell job with some fine material. The team this year had Harry Zorman and Harry Badger as co-captains.

Things are pointing to an even better season next year. Harry Badger is the only graduating senior. He will be missed because he was one of the teams leading scorers and definitely one of the main-stays of the team.

Here are congratulations to the basketball team for a job well done and a wish for as fine a season next year.

St. Pat's Day

As St. Patrick's Day approaches the members of the Freshman class prepare to prove themselves worthy of legally removing their greencaps and being recognized as human beings. The Freshmen have been working industriously toward this high goal anl have already demonstrated their budding engineering ability by constructing the bonfire for Homecoming. In order that the occasion will not be mistaken as merely a good chance for a brawl a little of the background and history of the festivities should be known.

St. Patrick is honored as the engineer's patron saint because of his work in expelling the snakes from Ireland, considered to be one of the great engineering accomplishments of history. March 17 is the anniversary of his death in the year 493.

The observance of St. Patrick's Day at Rose is highlighted by a series of competitions between the members of the Freshman and Sophomore classes to determine whether or not the Freshmen must continue to wear their green beanies. For many years the contests consisted of a series of athletic events under the supervision of Athletic Director Phil Brown. After World War II the supervision of the games was assigned to the Blue Key.

The games at present consist of a mud pole fight in which the Fresh-

(*Concluded on page 36*)

1953 Basketball Squad

Preview of Things to Come

Promise of a golden future

Yellow uranium ore from the Colorado Plateau

is helping to bring atomic wonders to you

Long ago, Indian braves made their war paint from the colorful sandstones of the Colorado Plateau.

THEY USED URANIUM—Their brilliant yellows came from carnotite, the important uranium-bearing mineral. Early in this century, this ore supplied radium for the famous scientists, Marie and Pierre Curie, and later vanadium for special alloys and steels.

Today, this Plateau—stretching over parts of Colorado, Utah, New Mexico, and Arizona—is our chief domestic source of uranium. Here, new communities thrive; jeeps and airplanes replace the burro; Geiger counters supplant the divining rod and miner's hunch.

From hundreds of mines that are often just small tunnels in the hills, carnotite is hauled to processing mills. After the vanadium is extracted, the uranium, concentrated in the form of "yellow-cake," is shipped to atomic energy plants.

A NEW ERA BECKONS—What does atomic energy promise for you? Already radioactive isotopes are working wonders in medicine, industry, and agriculture. In atomic energy, scientists also see a vision of unknown power—which someday may heat and light your home, and propel submarines, ships, and aircraft. The Indian's war paint is on the march again—toward a golden future.

UCC TAKES AN IMPORTANT PART—The people of Union Carbide locate, mine, and refine uranium ore. They also operate for the Government the huge atomic materials plants at Oak Ridge, Tenn., and Paducah, Ky., and the Oak Ridge National Laboratory, where radioisotopes are made.

STUDENTS and STUDENT ADVISERS: *Learn more about the many fields in which Union Carbide offers career opportunities. Write for the free illustrated booklet "Products and Processes" which describes the various activities of UCC in the fields of ALLOYS, CARBONS, CHEMICALS, GASES, and Plastics. Ask for booklet B-2.*

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ACHESON Electrodes • PYROFAX Gas • PRESTONE and TREK Anti-Freezes • PREST-O-LITE Acetylene
BAKELITE, KRENE, and VINYLITE Plastics • DYNEL TEXTILE FIBERS • LINDE Oxygen • SYNTHETIC ORGANIC CHEMICALS

Research and Development

Edited by John Sawyers, M.E., Jr., and William Cade, Fr.

Making Transients Stand Still

One of the problems in studying an electrical transient wave is just that—it is transient. However, by means of a device known as a Synchronograph, a transient simulating a lightning wave is repeated so rapidly that it looks like a steady-state phenomenon and hence can be studied at leisure.

This new system is being used to study surge-voltage distribution and attenuation in connection with lightning and arrester application problems. A repetitive surge generator supplies the simulated lightning wave to the system being measured. The resulting wave form is measured at the desired point in the system. By using a high repetition rate (60 times a second) the wave form appears as a steady-state trace on the oscillograph. The system is synchronized from a common 60-cycle system.

The Synchronograph has been very useful in studying surge protection and arrester application problems on systems where there is no corona or where corona effects can be neglected, such as short lengths of transmission line, power cables, generators, transformers, substations and line traps.

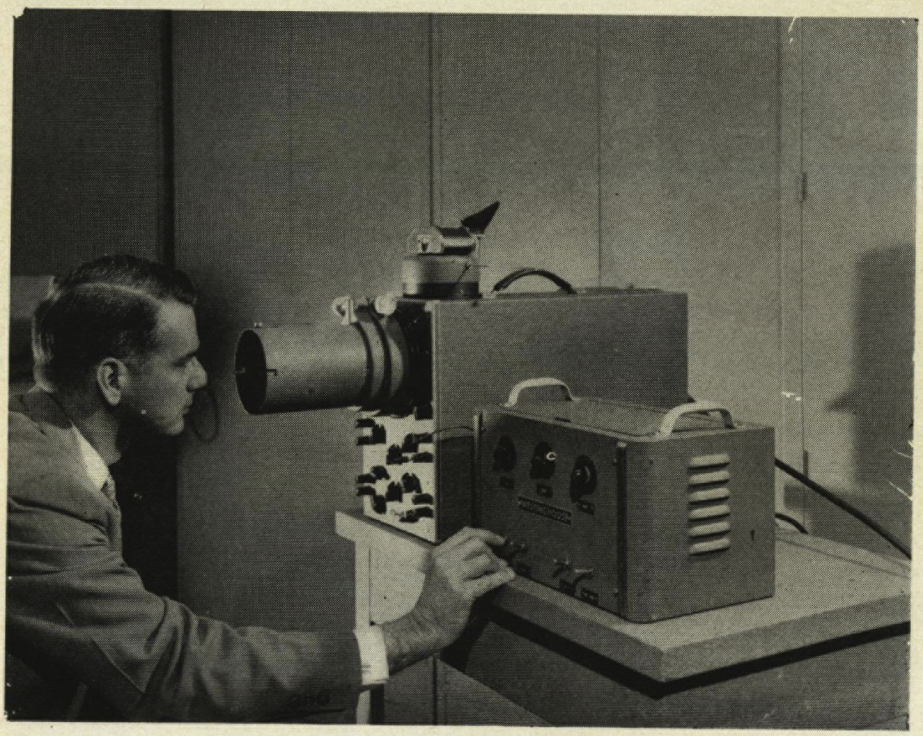
A Lamp That Gets Around

How much acceleration a man can survive without injury has been the object of many investigations. These tests deal with "g's" in the neighborhood of 10 or 12. But one Westinghouse incandescent lamp for an unusual application must get along nicely with angular accelerations of 200 g's. The job: lighting the tips of helicopter blades.

These blades swing in a 48-foot circle at 270 rpm meaning a tip speed of nearly 8 miles per minute. Sort of a perpetual crack-the-whip. That a lamp can be built to take it is made the more surprising when it is real-

Helicopter Lamp

ized that the tungsten filament is operating not far below the softening point. The filament developed for this not-so-merry-go round service is in three sections that form three sides of a rectangle, with each corner rigidly braced.



Synchonograph In Use

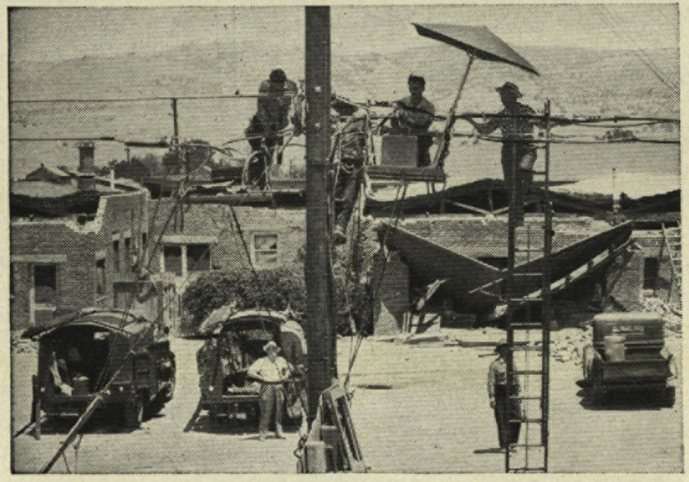
Aluminum in Reactors and Transformers

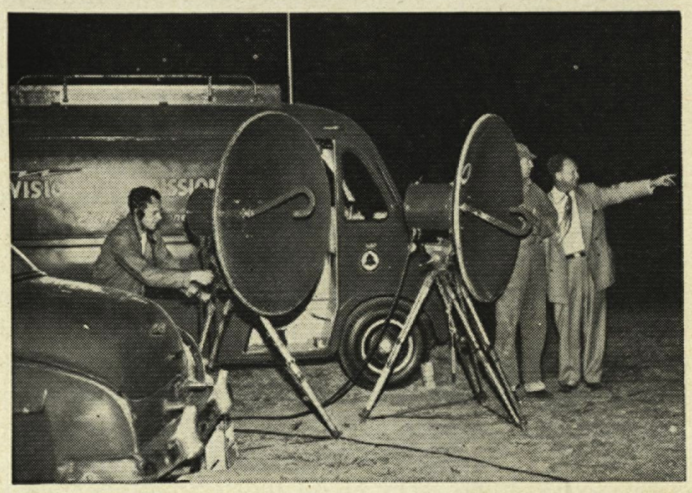
The current-limiting reactor is one device where the switch from copper to aluminum has engineering benefits beyond the saving of copper. And that saving is considerable. Even the dry-type reactor of average size contains about 800 pounds of copper; a large one has about 4000 pounds. A large oil-immersed reactor may require nearly five tons of copper.

An aluminum-wound reactor weighs about one-fourth less than its copper counterpart. Also, in this apparatus a normally undesirable property of aluminum can be turned to advantage. This is the fact that aluminum oxidizes instantly on contact with the air — a characteristic

(*Concluded on page 24*)

earthquake!





Precisely at 4:50 A. M. in the predawn darkness of last July 21, the most severe California earthquake since 1906 struck the small town of Tehachapi.

Walls were collapsing, buildings were folding. The town's telephone office shook to its foundation and the lights went out. But the night operator remained at her switchboard until it went dead. Main cables to the telephone office were pulled to the ground when a nearby wall caved in.

This was at 4:50 A. M.

At 8:30 A. M., less than 4 hours later, telephone men had reestablished 3 circuits on the edge of town (top picture). Outdoor offices were set up for Red Cross and other emergency workers.

Repairs to the damaged main cable and other equipment were rushed (center picture). By late afternoon the central office switchboard was working. Tehachapi residents were able to make calls to friends and relatives concerned about their safety.

By 9 P. M., two TV stations were sending live telecasts of the damage to Southern California viewers (bottom picture). Telephone men had established a 4-jump radio-relay station in less than 12 hours.

It was a typical disaster—brutal and unannounced. But telephone men were prepared. They quickly restored communication when it was needed most. In so doing, they demonstrated the resourcefulness and technical skill which telephone companies ask of their engineers.

For qualified engineering graduates of this caliber, there are opportunities in the telephone companies. Your college placement officer can give you details. Or write to American Telephone & Telegraph Company, College Relations Section, 195 Broadway, New York 7, N. Y., for the booklet, "Looking Ahead."

BELL TELEPHONE SYSTEM

Research and Development

(Concluded from page 22)

that is usually a headache. Aluminum oxide is a fair electrical insulator. Thus in aluminum-wound reactors where only separation is needed, it is unnecessary to apply insulation between strands to cut down eddy-current losses. In copper-cable reactors alternate layers of strands have been enameled.

The lesser strength of aluminum, however, and the somewhat greater thermal expansion of aluminum by comparison with copper, does have to be considered in the design. More supporting columns and bracing are required.

Experience with aluminum conductors is also being obtained in the ASL dry-type power transformers. The electrical performances of aluminum and copper transformers are identical. In dry-type transformers the aluminum windings weigh about half as much as copper. The overall weight is from 2 to 5 percent less.

The building of dry-type transformers with aluminum coils involves no particular manufacturing difficulties. Aluminum strap conductors are covered with fiber glass using the same process as for copper. All joints in winding, leads, and bus bars are either welded or bolted. Welded joints are all made using the inert-gas arc welding process. Bolted joints, which are kept to a minimum, are silver plated and bolted with cadmium-plated steel bolts. To maintain high contact pressure, and distribute the stress in the aluminum, spring washers are used on the bolts. All joints are varnish covered, which, with the indoor application, adequately protects them from moisture.

World's Largest Rotating Machine

The largest rotating machine ever built is being put together by the Westinghouse Electric Corporation. It consists of the five compressors and drive for the transonic and supersonic wind tunnels being built for the U. S. Air Force at Tullahoma, Tennessee.

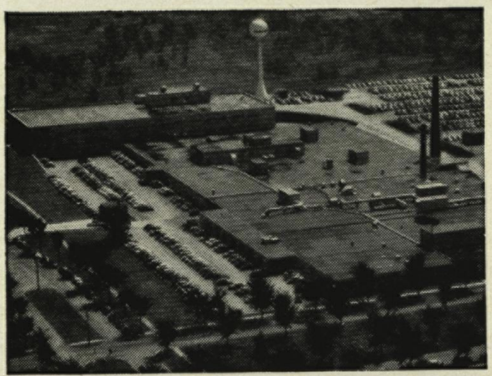
Four motors with a combined power of 216,000 horsepower are required to drive the compressors. Two of these are synchronous motors, each being nearly one third larger in horsepower than the 65,000-hp pump motors recently installed at Grand Coulee Dam.

The supersonic compressor for the wind tunnel will consist of four compressors in series, while the transonic compressor will be a single unit. Statistics on the inlet-stage blades of the transonic compressor suggest the scale of this super wind maker. Each blade is more than two feet across the face, six feet long, weighs almost two thirds of a ton, and rotates at 600 rpm on a spindle 18 feet in diameter. The top speed for this great mass is 650 miles per hour and the centrifugal force tending to pull each blade from its roots is 900 tons. The blades are solid forgings and are rooted to discs that are the largest that can be forged anywhere in the world.

The two liquid rheostats for motor speed control are also the world's largest. These will be used for secondary control of the two wound-rotor machines during starting, load transfer, etc., and each is capable of a peak dissipation of about 25,000 kw. The nickel-clad steel electrodes are three feet in diameter. Although the machine represents the highest stored energy of any rotating mass ever built it can be brought to a halt in about three minutes by using the wound-rotor motors as brakes, dumping energy into the liquid rheostats.

The problem is not only to get energy into the air stream but also to get it out again. The air stream would become enormously hot without the large cooling system provided by Stacy Brothers. Even with 100,000 gallons of water per minute flowing through coolers the air discharge temperature is above 600 degrees F. The air in the test chamber, on the other hand, will be down to about 100° F below zero.

There's great new opportunity for Engineers in Honeywell's growing Aeronautical Division



The delicately balanced glass of water below clings to its perch, despite the plane's sharp banking turn.

That's because a Honeywell electronic autopilot is in command . . . the human pilot nowhere near the controls.

So precisely are the control surfaces coordinated, that all displacing forces are instantly equalized.

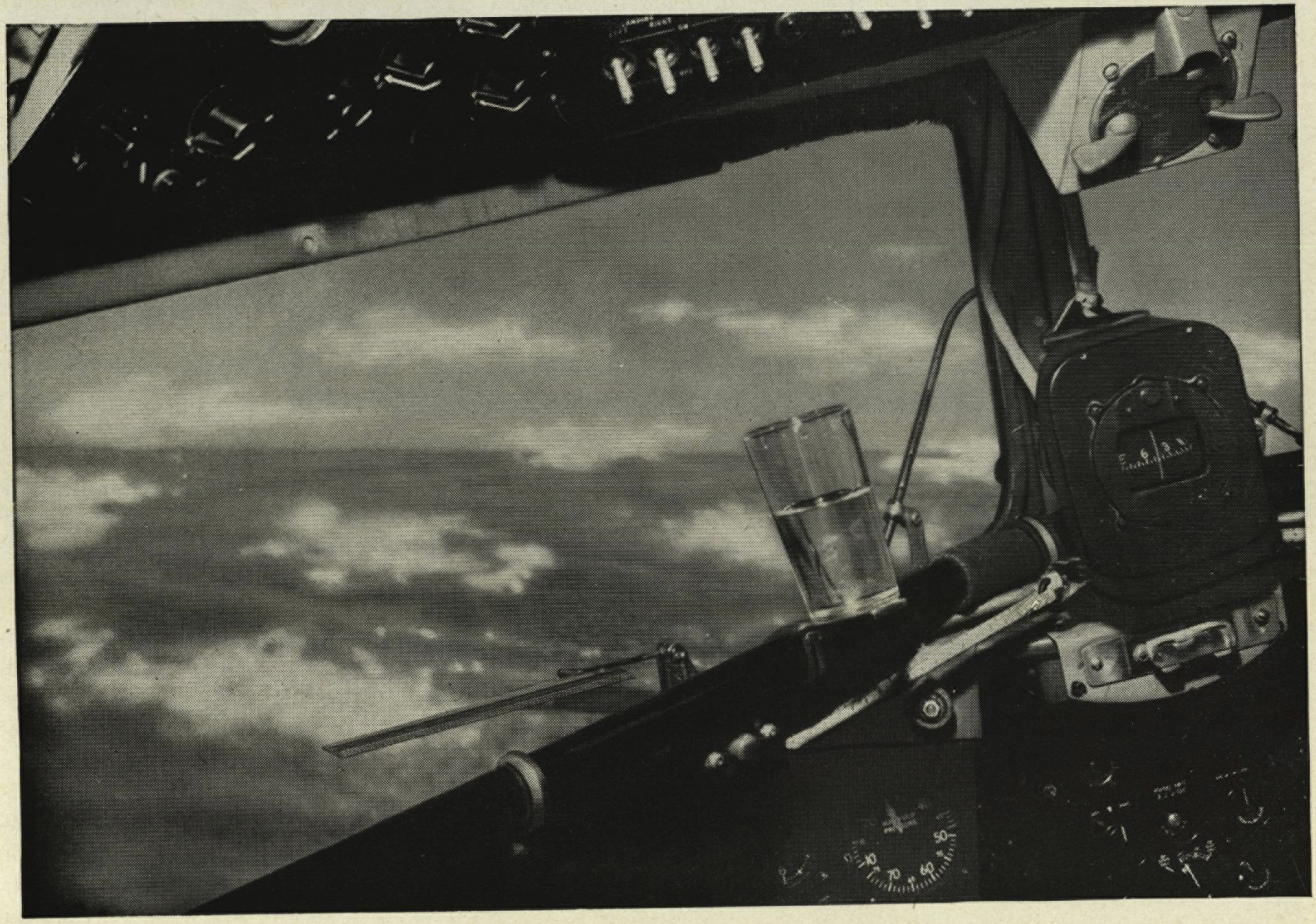
There simply can't be any skidding or side-slipping to upset the glass.

This is typical of aircraft performance made possible by controls produced in Minneapolis by Honeywell's expanding Aeronautical Division.

Besides autopilots, Honeywell's list of current aero products includes electronic fuel measurement systems, dozens of different kinds of gyros, actuators and many other controls.

Today, with aircraft and rockets flying even higher and faster, demands for new controls are being met in the new Honeywell aero plant pictured at left. In developing these new controls, the men in our expanding engineering and research sections often must work in the realm of pure science.

There's real opportunity for engineers at Honeywell—for this is the age of Automatic Control. And Honeywell has been the *leader* in controls for more than 60 years!



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Ergs from Atoms

(*Continued from page* 11)

consumed, 80% as much Pu_{239} will have been formed. By the time all of this Pu_{239} has been used, an additional amount of Pu_{239} is created, and so on. Starting with a unit quantity of U_{235} the total amount of fuel used is:

$$1 + 0.8 + (0.8 \times 0.8) + \ldots = 5$$

Thus the original U_{235} is stretched to five times the quantity. There is a possibility of using the equivalent of 3.5% of the natural Uranium instead of the 0.7% possible with the nonregenerative reactor.

This rosy prospect is complicated, however, by an increase in cost from the chemical separation necessary to prepare the Pu_{239} for use as a fuel. Also the various limiting factors listed under the nonregenerative reactor will apply here. If we arbitrarily assume that increased cost and other factors enable us to utilize only 1% instead of the 3.5% postulated, the power obtained from this reactor will be increased by a factor of three over the previous reactor.

Breeder reactors. By means of the regenerative reactor it is possible to convert 80% of the starting quantity of fissionable material to plutonium. There is a possibility, however, of converting 100% of the starting quantity and of producing more fissionable material than could be consumed. This requires that all of the neutrons released by fission be used in the reactor. This presents considerable difficulties; however, if these can be overcome the possibilities are exceptional.

"It is only through breeding that presently estimated resources of nuclear fuels can make a really significant addition to the world's energy resources. - - - the process from the nuclear standpoint works also for the fissionable U_{233} and thorium, so that for this reactor the world's thorium supply can be included as an energy resource."

Economic Feasibility

A comparison of the costs for fuel used in the nuclear-powered generating plant, shows some interesting conclusions.

The costs of fuel for each of the three reactors described will be compared with the cost of coal for conventional generating plant which averages 3.5 mills per kwh. The comparison in each case will be made using 20 lb. of natural uranium as fuel.

Nonregenerative reactor. This reactor, as stated previously, uses U_{235} alone as a fuel charge. The 20 lb. of natural uranium contains 0.7% U_{235} or .14 lb. Of this, only .07 lb. can be used, for reasons explained under the description of the reactor. This fuel charge will furnish heat equivalent to that obtained by burning 91 tons of coal giving 181,000 kwh of electricity. The cost of the U_{235} (mining natural uranium and chemical purification) has been estimated to be in the neighborhood of $20 per gram. Using this figure the cost of .07 lb. of U_{235} will be $1260. A comparison with the cost of coal shows that U_{235} will generate electricity at a fuel cost of 7 mills per kwh.

Regenerative reactor. Again using a 20 lb. charge of natural uranium for comparison, it is seen that the entire amount is used in the regenerative reactor. If it is assumed, as in the description given above, that only 1% is actually consumed, heat equivalent to 260 tons of coal will be realized. This will result in the generation of 518,000 kwh of electricity. The cost of the uranium is a matter of conjecture; however, it is known that the Atomic Energy Commission pays $3.50 per pound for uranium oxide in the ore. If this is arbitrarily multiplied by 10, the cost of the uranium would be $700 for the 20 lb. fuel charge. These values give us a cost for fuel in this reactor of 1.3 mills per kwh.

Breeder reactors. In the breeder reactor the entire 20 lb. of natural uranium is consumed, heat equal to that from 26,000 tons of coal is generated, which produces 51,800,000

(*Concluded on page* 32)

Do you own everything you would like?

If not, perhaps the problem of worker lay-offs could be solved

EVERY MAN, woman and child in America knows of many things he would buy if he could afford them—that is, if the price were low enough. Cutting prices to the point retailers and manufacturers lose money and go bankrupt is no answer. Cutting *costs* is.

Suppose every producer (mine, farm, factory) equipped itself with the most modern productive equipment—and fair tax laws let them save enough to pay for that equipment. Then let every worker use that equipment at maximum efficiency.

Costs would tumble.

Then let business pass those savings on to the public.

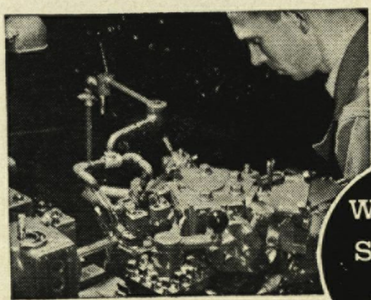
Prices would tumble.

Finally, suppose the consumer did his part, and bought. There would be such business as the world never dreamed of. More store clerks would be needed to handle the demand, more transportation workers to haul the goods, more workers to produce them. The more demand and production, the lower the costs and prices; the lower the costs and prices, the more the demand and production. And everyone would have more and more of the things he wants.

Why isn't it done? Greed, fear, misunderstanding.

Honesty, hard work, unselfishness would do it, for the principle has been proven a thousand times. We've tried laws, contracts, strikes, slowdowns—and all we've got is hatreds, shortages, and periodic lay-offs. Is there a leader great enough to rally all America to put this *positive* approach to work? The approach that every honest man knows in his heart is *right.*

There are employment opportunities at Warner & Swasey for young men of ability and character who believe as firmly in the principles of Americanism as they do in the principles of sound engineering. Write Charles Ufford.



WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY MACHINE TOOLS, TEXTILE MACHINERY, CONSTRUCTION MACHINERY

Bridging Chesapeake Bay

(*Concluded from page* 13)

dations of the bridge. A total of 600 piles were required at each anchorage.

Superstructure:

The variety of span lengths and bridge types and the total length of the bridge posed a challenging problem for the bridge erector. However, erection methods were developed, and the job was broken down into three major operations, plus the suspension structure which was to be handled last and separately. These operations were: (1) beam and shorter girder spans, (2) long girder spans and (3) truss spans.

Perhaps the most spectacular fact about the erection was the complete absence of falsework for the whole four miles of the project. The final truss span, 360 feet long and 40 feet deep, was first constructed and stationed about a mile from the western shore. It was used as falsework or a dock upon which a number of the bridge's other spans were erected and then floated on barges into place. Finally it was floated into place. The sixty-seven beam spans and the twenty-one shorter girder spans were assembled on shore, floated on barges to the site and lifted into place by a tower derrick boat. Altogether, the floating operation took about seventeen months and was the largest floatation job in the history of bridge building.

In the design of the suspension bridge, full consideration was given to the latest developments through aerodynamic studies of bridges of this type. Through-type stiffening trusses insure rigidity against movement caused by wind or traffic. Streamlining of structural members and installation of two strips of open grid-type bridge grating the full length of the span to minimize the effect of air pressures have been utilized.

The cables of the suspension span are approximately fourteen inches in diameter, one on each side of the roadway rising to a height of 350 feet above the main towers. Each cable is composed of 61 strands, most of them having a diameter of 1 21/32 inches, each strand containing 64 wires. Instead of following the usual spinning procedure, J. E. Greiner Company, Engineers, saved time by designing the suspension bridge cables of prestressed strands set to measured length. From the cables were hung completely pre-assembled roadway sections ranging from forty to eighty feet long.

Each of the two main suspension bridge towers consist of two cross-shaped cellular shafts forty-five feet, nine inches, center-to-center at the base and tapering to thirty-nine feet center-to-center at the top, and being interconnected by cross bracings. The shafts were erected in prefabricated sections and set and spliced in place by a floating derrick to the height of its maximum reach. Above that, the remainder of the shaft sections were erected by two stiff leg derrick booms, one fastened to each of the shafts. The derricks raised each other in step fashion as the shaft progressed toward the top.

The Chesapeake Bay Bridge was designed according to the standard specifications for highway bridges of the A.A.S.H.O., except as modified for long spans, for a live load of H20-S16-44.

The safety record in constructing the bridge was very good with only three deaths in underwater construction and none on the superstructure in 5,200,000 man-hours. In November 1950, two severe storms caused delays in construction by damaging equipment and destroying materials. Two other mishaps, both caused by wind or storm, caused damage to the bridge during construction. However, all damage was quickly repaired and the bridge was finished on schedule.

The bridge is owned by the State of Maryland and is operated as a toll bridge by the State Roads Commissions.

Library Notes

By Carson W. Bennett and Nina J. Mahaffey

Some books are to be tasted, others to be swallowed, and some few to be chewed and digested.

Hunter by Hunter

"Two natives were returning to their village one evening when they saw a great black mass standing motionless in the shadows of the huts. The men shouted to scare the thing away. At once the mass left the shadows and charged them at a feaful speed. Then the men saw it was a huge bull elephant.

"They ran for their lives, each going in a different direction. One man was wearing a red blanket, and that blanket was his death warrant, for the elephant followed him. The villagers cowering in their huts listened to the chase, powerless to help their friend. They heard the man's screams as the elephant caught him. The great brute put one foot on his victim and pulled him to pieces with his trunk. Then he stamped the body into the ground and went away." And the chase is on! The marauding elephant must be killed and John A. Hunter is called to do the job.

J. A., guide for big game hunters, also has done much in the field of game control. As Control Officer, his work has been largely concerned with beasts that are malicious and cunning and that have often had previous unpleasant experiences with man. The hazards encountered while hunting such beasts trifle those experienced by trophy hunters.

For a new and different slant on big game hunting, read *Hunter,* by John A. Hunter.

Soul of Amber, by Alfred Still

It was a hard human jump from superstitious awe to firm knowledge, but such a jump made possible the construction of the dynamo. It took centuries — centuries of work, centuries of inspired study —, and it took generations of men.

The "soul" of amber is, of course, the electrical property, which makes it attract certain other materials. Men knew of it in ancient times: many thought it was magical.

But other men, alchemists and physicians, politicians, revolutionaries, even religious leaders — commenced to tinker with magnetism and electric sparks. They began to speculate. Their tinkering turned into deliberate experiment; their speculations fathered the scientific method.

Here is that narrative; here are absorbing portraits of those intellectual adventurers — men whose names have become measures of electrical units — Ohm, Watt, Ampere, Farrad. Here, above all, is a fascinating account of the means by which human beings changed themselves from barbarians to men with a conscious civilization.

Soul of Amber is a fresh and different book that will reward every kind of reader by entertaining, by offering fact after fabulous fact, and by adding much to the reader's understanding of his times.

The Black Hills, ed. by Roderick Peattie.

The Hillers boast that their region is the oldest in pre-history of any area in the country; the youngest in actual history. To them, B.C. means "Before Custer."

It was in 1874 that Custer explored the Black Hills and sent out his famous dispatch which told of gold in the grass-roots. Then and there history began. The prospectors surged in, towns got on the map, and in Deadwood one Jack McCall killed Wild Bill Hickok, the "prince of pistoleers," who was so careless as to turn his back to the door. That gave the Hillers some history they could really brag about.

The Black Hills is written by a number of men who have studied the region and its history, and who write pridefully thereof. If much of the "B. C." period is legendary, "nobody worries about the factual details of a legend." There are chapters on Black Hills geology, on the Homestake Mine, on Bill Hickok and Calamity Jane, and on the Mount Rushmore memorial. Good black and white illustrations add further appeal to the book.

Calling W9NAA

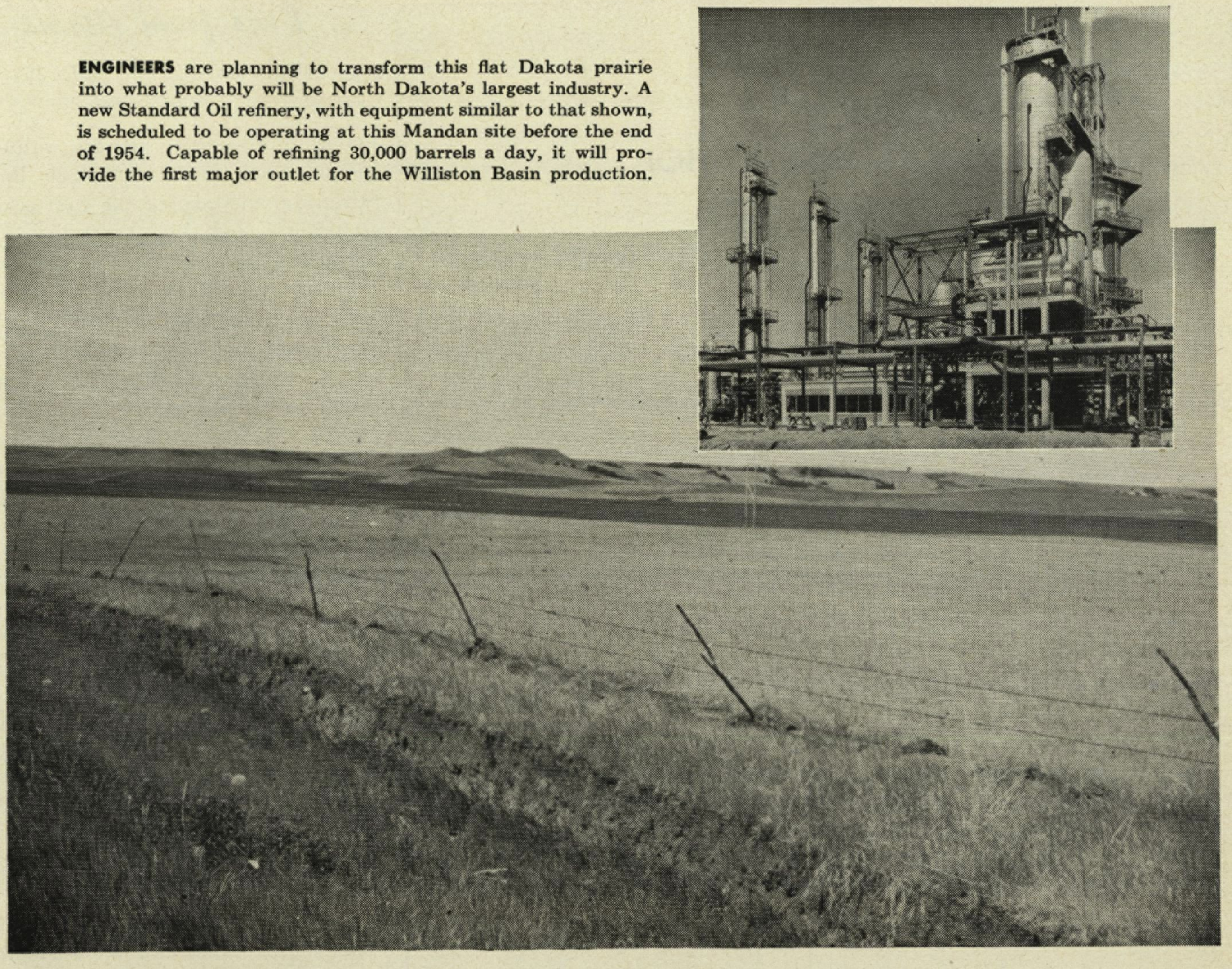
Thanks to the Radio Club, the library is now receiving *CQ*. Just in case you aren't a ham (and in the field of radio that's a compliment) we might add that *CQ* is a monthly magazine with the sub-title Radio Amateurs' Journal.

Bill Toeppe, a club member, receives the new issues and then trots them right over to the library where you can see them at any time. So, if you're interested in radio, better plan to read *CQ* regularly, and if you're not already a member of the Radio Club, why not see the head HAMoench about it?

How To Play

When you play, play hard; when you work, don't play at all; and if you have to play in the library, please play chess.

ENGINEERS are planning to transform this flat Dakota prairie into what probably will be North Dakota's largest industry. A new Standard Oil refinery, with equipment similar to that shown, is scheduled to be operating at this Mandan site before the end of 1954. Capable of refining 30,000 barrels a day, it will provide the first major outlet for the Williston Basin production.



OIL is making a prairie plant grow!

Before the close of 1954, a new Standard Oil refinery is scheduled to be operating at Mandan, North Dakota.

Behind this lies a story of Standard Oil's willingness to back its scientists' judgment with millions of dollars.

Two years ago oil was discovered in the Williston Basin. How much oil this basin eventually will produce is anybody's guess, but the current rate is only about 10,000 barrels a day. However, geologists, geophysicists and engineers, working in field and laboratory, have estimated that the basin holds a total of two and a half billion barrels.

On the basis of this estimate, Standard Oil has let a contract for the construction of a new refinery at Mandan and a 215-mile products pipeline from Mandan to Moorhead, Minnesota. A crude oil pipeline of 170 miles will be completed by the time the refinery is ready for operation and a pipeline gathering system of about 40 miles already has been built.

Construction activities such as these and the tireless search for oil are jobs that never end in the petroleum industry.

Young technical men at Standard Oil have found that there still are many exciting frontiers to explore with a company that is constantly building, constantly looking to the future.

Standard Oil Company
910 South Michigan Avenue
Chicago 80, Illinois

STANDARD

Ergs from Atoms

(Concluded from page 26)

kwh of electricity. If the value of $700 is assigned to the 20 lb. of uranium the cost of the fuel is only 0.013 per kwh.

In the breeder reactor an additional cost will be incurred because of the necessity for removing the fuel charge from time to time for chemical repurification. No estimate is available for the cost of this, but if the fuel cost is raised by a factor of 10, to $7000 for the 20 lb. charge, the fuel cost will still be only 0.13 mills per kwh.

Coolants

Several different coolants have been tried in the various experimental reactors, including water, air, and liquid metals.

Water has been used more frequently than the others but for many reasons it is undesirable. It has a tendency to slow neutron velocity considerably, which, while satisfactory for U_{235}, will retard the reaction if Pu_{239} is the fuel.

The liquid-metals provide the best chance for obtaining a satisfactory coolant. Sodium and an alloy of sodium and potassium have very desirable properties. They have high thermal conductivity and a low vapor pressure so that they can be used to transfer heat at high temperatures without excessive pressure. They become radioactive readily but, since the present heat-exchangers provide for two coolant systems, this is no problem. Also they are plentiful and relatively cheap. The major disadvantage is the fact that they react violently with air and water. This difficulty can be overcome, however, by proper design of the heat-exchange systems.

Future Prospect for Nuclear Power

At the present time it appears that power can be produced from nuclear sources at a competitive cost to conventional sources, provided a portion of the cost is borne by the sale of plutonium to the government.

Fraternity Notes

By John Gregory, George Ross, Robert Dedert, and Jack Niemi

Theta Xi

During the two weeks before Rush, the men of Theta Xi were very busy with "Operation Kemtone." The house has been brightened up and painted throughout, and all the brothers are pleased with the effect. The new game room in the basement has been christened and is proving itself a real asset. Bro. Mook was the boss for fixing up this game room.

Congratulations to Doyne Granlund, Al Merrelli, Joe Pejril, Frank Przybylski, and Sam Watts, who recently pledged themselves to Theta Xi. The pledging ceremony took place on the Tuesday after Rush. After the ceremony, an impromptu party was held, and the new pledges received their first training on their way to becoming full-fledged members of Theta Xi. All agreed that the party was a real success.

Plans for the pledge dance, "The Bowery Ball," are being drawn up by Bro. Stoker, and all the brothers are looking forward to a fine time.

Lambda Chi Alpha

Theta Kappa Zeta of Lambda Chi Alpha started the new semester off with a jam session at the house on January 30. This was the beginning of the social calendar for the semester. The featured artists were Brother Glen Rout on the piano, Don Wiel on the trumpet, Jack Cunningham on the trombone, and Bill Jaeckel on the clarinet. The rhythm section (drum player) was taken care of by Walt Anslinger. Professor Frank Guthrie acted as chaperon. All attending had a great time.

Rush Weekend was held on February 14 and 15. The parties were attended by many freshmen and upper classmen. The chapter wishes to express their appreciation to Mrs. Pinson, our House Mother, and the five girls who assisted her in the culinary department.

A successful rush season was experienced by the Lambda Chi's. Fourteen men were pledged by the Chapter. The pledges included Dick Beard, John Chinn, Jerry Fromholtz, Jim Jewell, Harvey Greene, Terry Webster, Bob Young, Jerry Coppock, R. D. Lockhart, Bill Crenshaw, Nathan Ritchie, Bud Binford, Gene Werner, and Sophomore Don "Felix" Plociennik.

Sigma Nu

Beta Upsilon, after a very successful rush program, pledged eighteen worthy men. They are Dick Allinder, Jerry Benson, Jim Burton, Bill Cade, Hugh Davis, Tom Diener, Ray Fischer, Bill Hansford, Bert Kellam, Dick Matheis, George Rezek, John Rhodehamel, Thatcher Richardson, Jack Stanley, Harry Stutts, Max Taylor, Jim Vosburgh, and Joe Williams.

The evening following the pledging ceremonies, the chapter held a buffet supper in honor of the new pledges and special guests. The supper was one of "Mom's" specials, and everyone was full-up including "dual-dish" Potter. After polishing off the desert, the troops adjourned to various parts of the house either to relax or to drum up some activity—there was plenty of action in the basement "rec" room. A mass movement to Rose's last basketball game of the season really set the evening up as one to remember.

The next week proved to be house cleaning time with the chapter preparing for open house which occurred on February 27. Open house featured a Dixieland combo, plenty of refreshments, dancing, games—just about everything. The following organizations were invited to open house along with the individual chapter member's personal friends: Alpha Tau Omega, Lambda Chi Alpha (Rose), Theta Xi, Student Nurses from St. Anthony's and Union Hospitals, Kappa Kappa, Chi Omega, Epsilon Delta, Gamma Gamma, Alpha Sigma Alpha, Sigma Kappa, Gamma Phi Beta, Lambda Chi Alpha (State), Tau Kappa Epsilon, Delta Kappa, and Theta Chi.

Beta Upsilon wishes to express their appreciation for the cordial welcome the neighbors around Center and Park have given them. Our thanks for the gifts and favors; we only hope we can return the hospitality.

Alpha Tau Omega

State Day for Province XVII's seven chapters of Alpha Tau Omega was held at Turkey Run State Park on February 21. Gamma Gamma acted as host chapter for the successful conclave which was topped off by the usual banquet and singing competition.

The same evening open house was held at 63 Gilbert following the Military Ball. Attending were alumni and visiting Taus from other chapters as well as guests and chaperons from the Ball.

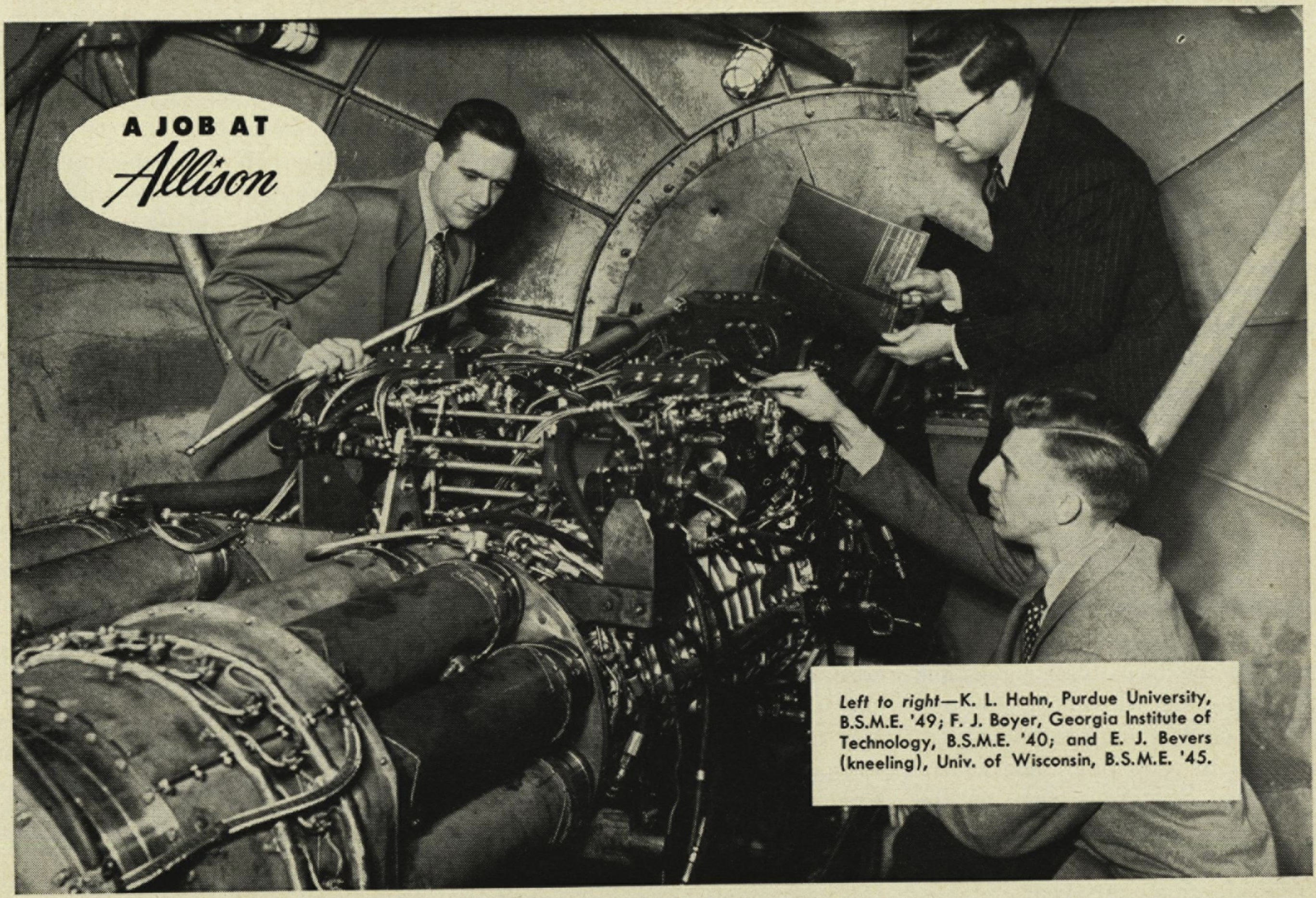
Alpha Tau Omega extends congratulations to Charles Hayward, Charles Schukai, Kenneth Hannum, Art Masters, Ronald Vahle, Jack Elder, and Frank Eppert who were pledged February 16.

During rush week-end A. T. O. disclosed its plans for building a new chapter house on campus. These plans have now been developed and a fund raising campaign begun.

February saw the loss of two more A. T. O. pins to members of the fair sex. Al Bosley pinned Miss Lucy Stovall, a Junior at St. Vincent's School of Nursing in Indianapolis, and Chris "Nick" Flesor pinned Miss Mary Chrisman who is employed at the Traveler's Insurance Co. in Terre Haute. Congratulations to two splendid couples.

* * *

Don't miss the Junior Prom, April 18, with Charlie Bay and his orchestra. It's the biggest dance of the year.



Left to right—K. L. Hahn, Purdue University, B.S.M.E. '49; F. J. Boyer, Georgia Institute of Technology, B.S.M.E. '40; and E. J. Bevers (kneeling), Univ. of Wisconsin, B.S.M.E. '45.

● Young Allison aircraft engineers, who not so long ago were in engineering schools as you are now, are playing an important part in development of controls for today's high-powered turbine engines.

Their job is to design an instrument which will relieve the pilot of much of the manual control in engine operation. Once the throttle is set, the control takes over and supplies the right amount of fuel to the engine. The control must compensate for changes in outside temperature, atmospheric pressure and other variables involved in changes in altitude.

This automatic control enables the pilot to concentrate his efforts on the fulfillment of his mission. Meanwhile, his engine is protected against overspeeding, high temperature and other critical factors affecting the life of the powerful turbine engine and the pilot's ability to perform the assigned job.

Floyd Boyer is a Montana boy who came to Allison from Georgia Tech in 1940 as a junior test engineer. By early 1944 he had been advanced to experimental engineer and in 1948 to senior project engineer. His work on engine controls began during World War II when he helped develop the automatic boost control for the two-stage supercharged V1710 reciprocating engines. In 1951 he was made group engineer in charge of turbo-prop control development and now guides the work of twelve other engineers.

E. J. "Gene" Bevers worked with us as a student engineer in the summer of 1944 before graduating in 1945. The Army called him for a two-year hitch but he was back on the job in January, 1947. One of his most interesting assignments while in our test department was as engineering representative during four months of cold weather engine tests in Alaska in the winter of 1951. Today, as Project Engineer in charge of turbo-prop fuel controls, he looks after the application and development engineering on these devices.

Kent Hahn spent his first year with Allison working in several departments and is now a project engineer in the controls development group, working on propeller coordinating controls. He also has had assignments on engine deicing controls, and on controls for the turbo-prop engines in the Allison Turbo-Liner where the commercial advantages of turbo-prop engines are now being demonstrated.

Let's check together on a job for *you* with the world's most experienced manufacturer of turbo-jet and turbo-prop engines.

Allison is looking for young men with degrees in* MECHANICAL ENGINEERING, ELECTRICAL ENGINEERING, AERONAUTICAL ENGINEERING. *A lesser number of openings exist for majors in Metallurgy, Electronics, Mathematics and Physics. Write now for further information: R. G. Greenwood, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

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Design, development and production—high power TURBINE ENGINES for modern aircraft . . . heavy duty TRANSMISSIONS for Ordnance and Commercial vehicles . . . DIESEL LOCOMOTIVE PARTS . . . PRECISION BEARINGS for aircraft, Diesel locomotives and special application.

Campus Survey

(Concluded from page 20)

men must remove a flag from a pole surrounded by mud and Sophomores, a tug-of-war across the lake, and a basketball game. In order that a maximum number of students may participate in the basketball game and tug-of-war a rotation system was inaugurated whereby each class would put an entire new team on the floor at the start of every quarter and the tug-of-war victory would be decided on a basis of the best two tugs out of three, with a new team representing each class on every tug. The point system for determining the winner of the series of games gives 20 points to the winner of the mud pole fight, 10 points to the winner of the basketball game, and 5 points to the winner of the tug-of-war. Last year the Freshmen were successful in achieving their goals.

The less boisterous side of the festivities features the annual St. Patrick's Day dance, which will be held on March 21 this year.

Engineers Day

On Saturday morning, March 28, the students of Rose will present an Engineering Program. The purpose of this program is to acquaint students and faculty members of high schools, parents, and interested friends with the subject of engineering. The visitors will tour through the school to see laboratory work and industrial equipment, combined with a few spectacular and mystifying displays. Students will bear the responsibility of setting up the program, running the devices, and displaying the equipment with the faculty acting in an advisory capacity.

After registration, a general assembly will be held in the auditorium at 9:30 before the tours of the exhibits begin. Short orientation talks will be given by Dr. Wilkinson, president of the Institution; Col. Jacobs, military director; Phil Brown, athletic director; and Glen Rout and Roy England, student representatives. The talks will include facts about the students' work load, athletic facilities, and ROTC and student deferments. Each tour will last from 10:45 to 1:00 with an hour for lunch and inspection of the dormitory. The exhibits will be run by the students during this time, and each group will have sufficient time to see all the exhibits. After 1:00 the students will remain at their exhibits should anyone wish to return for further inspection.

Typical of the exhibits in the four engineering departments will be: displays showing the strength of materials and their deformations in the Civil Department; making of plastic and the use of the centrifuge to separate materials in the Chemical Department; the use of the transistor as an amplifier, and the operation of various motors and generators in the Electrical Department; and the operation of reciprocating engines and the steam turbine in the Mechanical Department. A track meet between Rose and Franklin held in the field house will close the day's program.

Napier's Bones

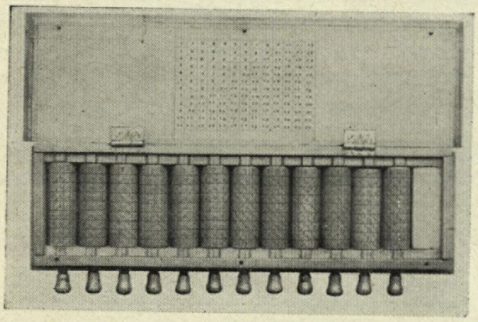
(Concluded from page 16)

as many cylinders as digits there were in multiplicant. (Figure four.)

The bones are primarily a device for multiplication, but they can be used for division, square roots, and cube roots. The process becomes more and more involved and additional paper work is necessary. The processes appear to be the same as in modern computation except that multiplication is done by the bones.

Division is executed as follows: The divisor (the number you divide by) is set up with the bones. You then run down the column adding each row as necessary to determine the multiple of the divisor which is closest to but less than the first consecutive digits of the dividend which form a number greater than the divisor. This multiple is subtracted from the dividend and the process repeated for the number of digits required in answer. For example: 5601386÷5978. (See figure two.) 5978 is set up with bones. In order to obtain a number greater than 5978 from the first consecutive digit we must take 56013. We run down the column and find that 9 x 5978 is less than 56013 and is equal to 53802. 53802 is subtracted from 5601386 with regard to correct columns, the difference being 221186. We take 22118 from dividend and find the third multiple is the largest that will be less than 22118. This multiple is subtracted from the dividend and the process repeated once more with the final quotient being 937.

Figure 4



The bones were very popular for many years, but it was not long after their invention that Pascal (in 1692) and others introduced devices which would do more of the adding mechanically thus simplifying the mental work and reducing probability of error.

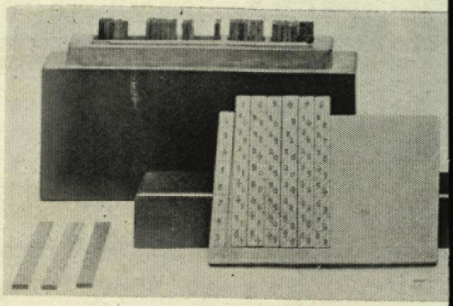
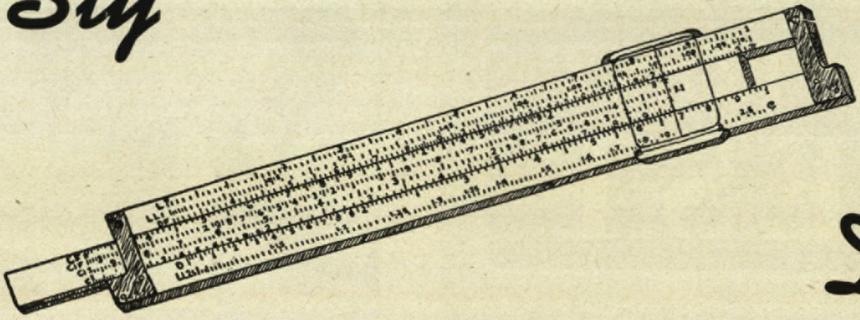


Figure 5

The following references which are part of the Rose library are included for those who might be interested in a further study of Napier and his works.

1. Bakst, Aaron, *Mathematics, Its Magic and Mystery,* New York, D. Van Nostrand Company, Inc., Second Edition 1952 pp. 117-121 (the bones).
2. *Encyclopedia Britannica* Vol. XVI *Ninth* edition, thirteenth edition, entry: Napier, John. (Napier's life work).
3. Horsburgh, E. M., editor, *Modern Instruments and Methods of Calculation* London, G. Bell and Son, Ltd., no date section A pp. 1-16 (Napier's life work.)

Sly



Droolings

Stolen by Dick Bosshardt, M.E., Soph.

Punch lines:

—there aren't enough rubber gloves!

—If she ain't good enough for her own folks she ain't good enough for us either.

—and that's not a thermometer either.

* * *

Forty Years Ago in the Technic

A bit of droll wit dug up from a moth-eaten volume of the Technic:

The Editor's Reward

A school paper is a great invention,
The staff gets all the fame
The printer gets the money
The editor the blame.

* * *

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

* * *

Nobody ever kissed a girl unexpectedly. The closest you can come to it is to kiss her sooner than she expected.

* * *

Today's greatest labor saver: Tomorrow.

* * *

Cop: "No parking. You can't loaf here."

Voice within car: "Who's loafing?"

A rude and vulgar man is one who stares at a girl's figure when she is doing her best to display it.

* * *

Freshman: Say, why'd you go out with that sad lookin' girl the other night?

Chemical: Why not, she's one in a million.

Freshman: Huh, how's that?

Chemical: She agreed to go out with me.

* * *

"Mother, are skyscrapers in heaven?"

"No, dear, engineers build skyscrapers."

* * *

Bum: "Have you a dime for a cup of coffee."

Engineer: "No, but I'll get by somehow."

* * *

Joe: "Was it crowded at the Bird Room last night?"

Nick: "Not under my table!"

* * *

No one pays any attention to apple skins, but if it's a peach peeling . . . . .

* * *

He had Tarzan's eyes — they swung from limb to limb.

* * *

"What's the difference between a little girl and a big girl?"

"A little girl wants an all-day sucker. A big girl just wants one for the evening."

The bum slept under bridges and viaducts for years — then he switched to culverts. Does this make him a Man of Distinction?

* * *

A man went to the bar and ordered a Martini, drank it, chewed up the bowl of the glass and threw the stem over his shoulder. He continued this for six Martinis and noticed that the bartender was staring at him.

"I guess you think I'm crazy, don't you?" he asked.

"I sure do," the bartender replied, "the stems are the best part."