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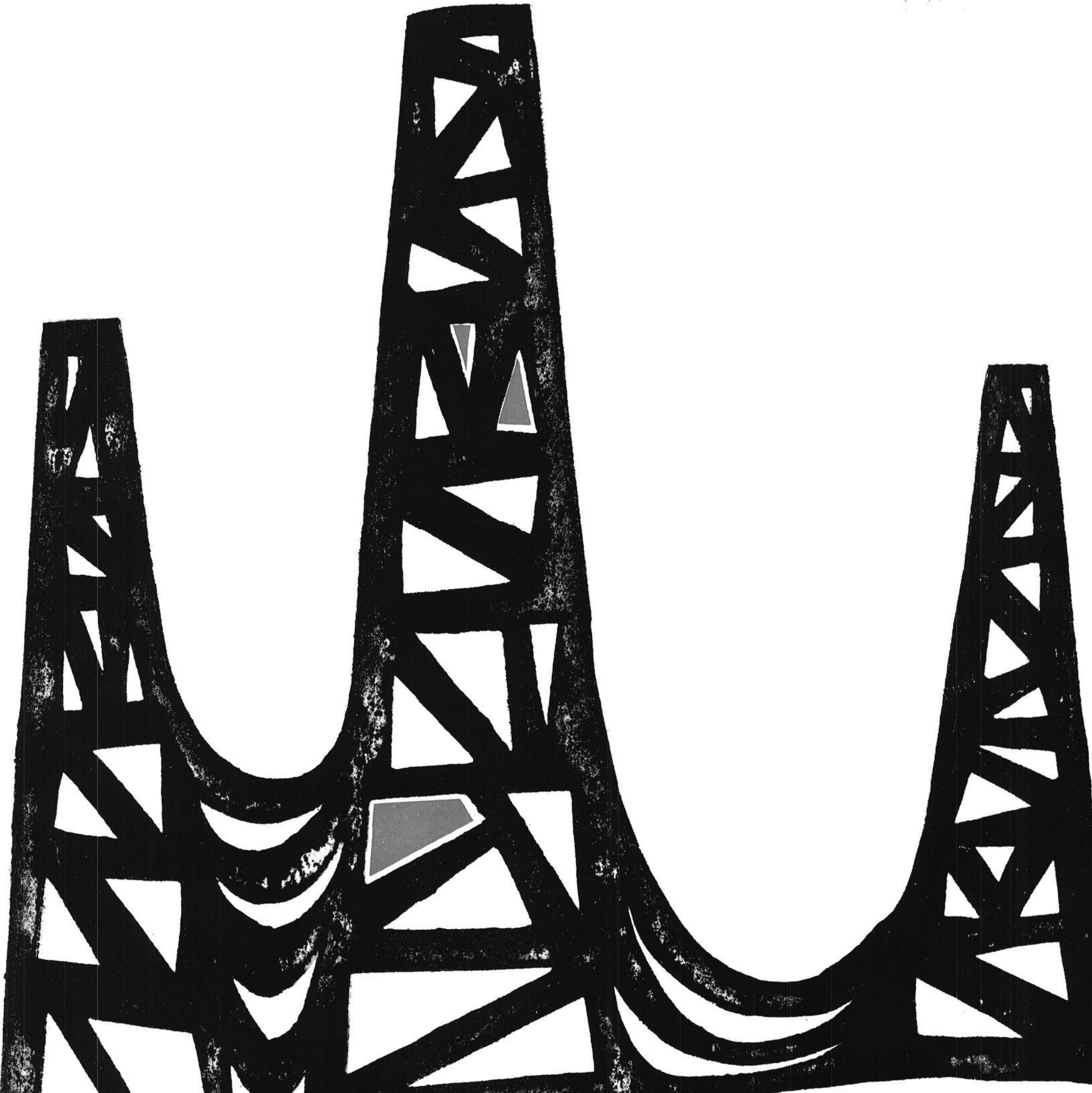
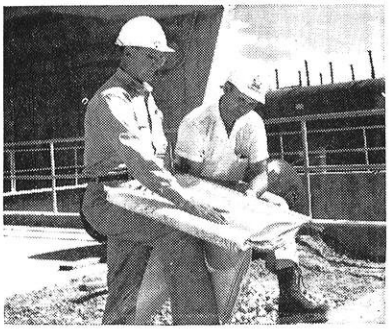
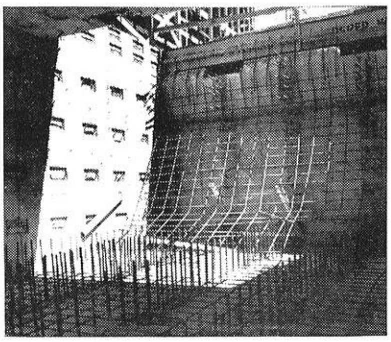


# THE WISCONSIN ENGINEER

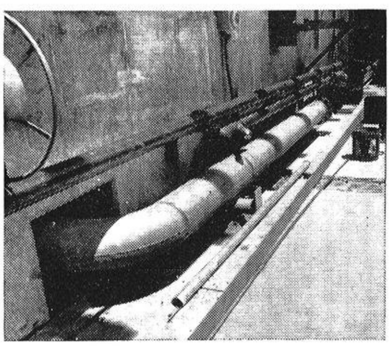
## **Somewhere east of Laramie,** on one of Wyoming's plains, you'll find the strangest government housing project ever built. Six concrete and steel buildings are being constructed to house Atlas missiles. The site is one of the operational intercontinental missile bases to be operated by the Strategic Air Command. This base is being constructed on the surface. Others will burrow deep into the earth.



The U. S. Army Corps of Engineers is constructing this operational intercontinental missile base in Wyoming. In front of the partially completed Launch and Service Buildings are Col. Sidney T. Martin, in charge of construction, and Maurice K. Graber, a construction engineer for the Corps.



This is the inside of the blast pit of one of the launcher buildings. In all six of these buildings there are 1,040 tons of structural steel, 1,950 tons of reinforcing steel, over 48,000 tons of concrete aggregate, blocks and cement, and 8,040 tons of mechanical steel items.



Fuel lines and process piping are Stainless Steel and operate at pressures up to 15,000 psi. The pipes are kept almost surgically clean to prevent contamination of fuel and subsequent malfunction. Vapor degreasing and chemical cleaning processes are used on the pipes.

Generally, the missiles are all you ever hear or read about. Actually, they're only a small part of the missile program. Most of the manpower and material go into ground support equipment. There are over 11,000 tons of steel and over 48,000 tons of concrete aggregate, blocks and cement in the six launching service buildings at this site alone.

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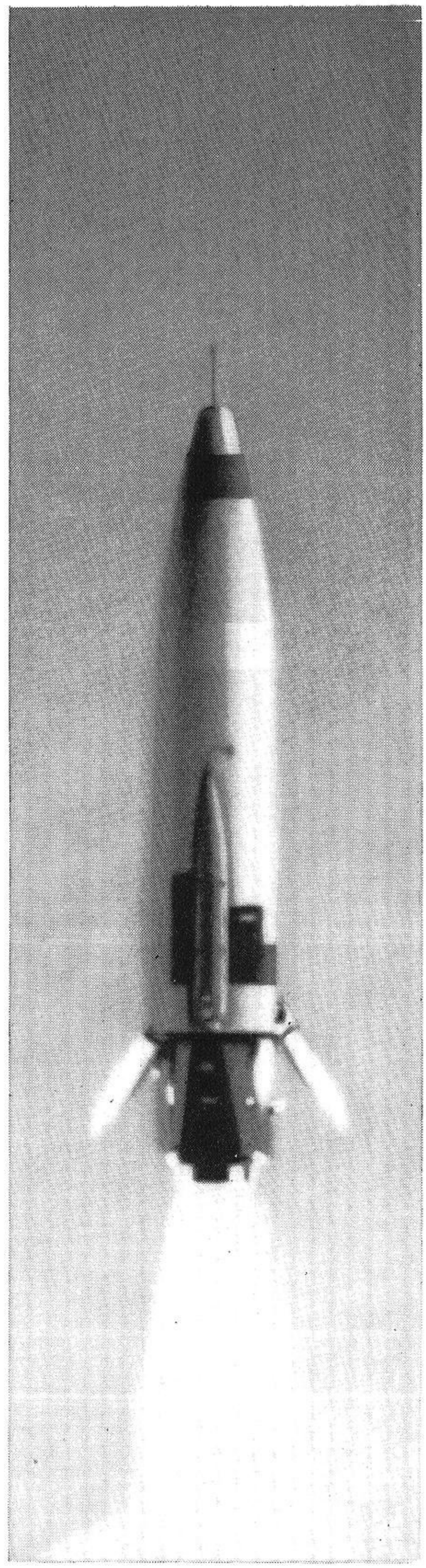

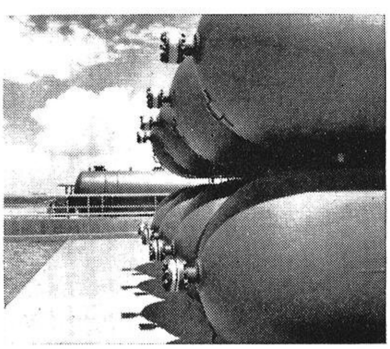

The Atlas is powered by a cluster of liquid propellant rocket engines that burn liquid oxygen and RP-1, a kerosene-like hydrocarbon fuel. 192 pressure tanks fabricated from alloy or Stainless Steel plate at this site store liquid oxygen and gases —liquid oxygen and nitrogen and helium gases which are used to inject the fuels into the missiles.

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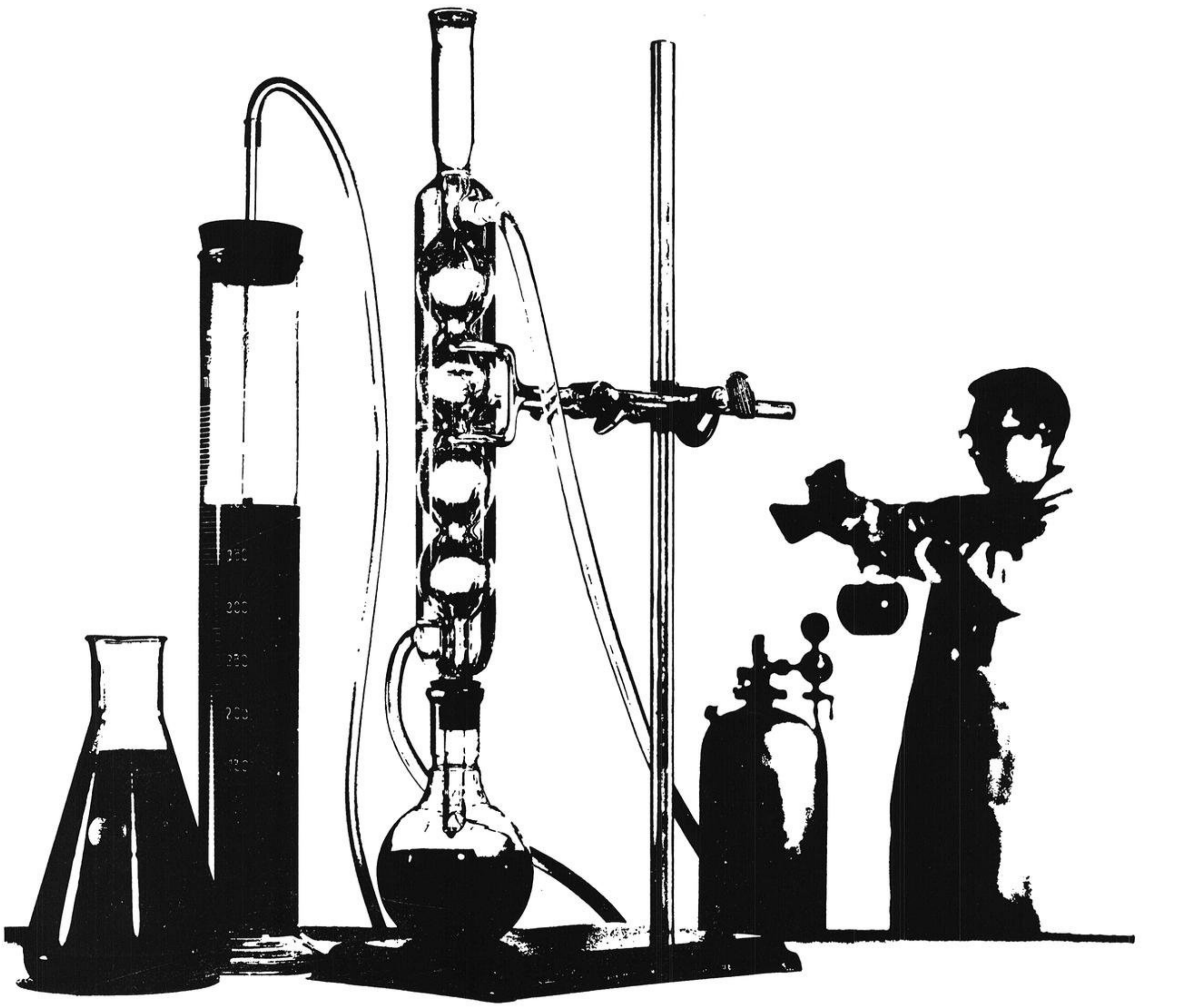

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# *Letters*

## *To The Editor*


Over the summer no one wrote to us, so there are no letters this month. We hope you will write to us this month.

**ATTENTION**

**All Engineers and General Public**

This is *your* page devoted to *your* ideas.

The subject of your letters need *not* be limited to engineering subjects or to THE WISCONSIN ENGINEER, and each letter will be personally answered.

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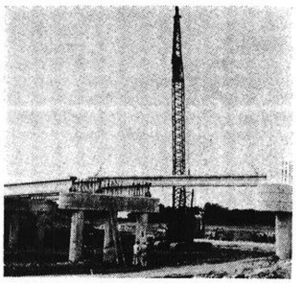
**FEATURES**





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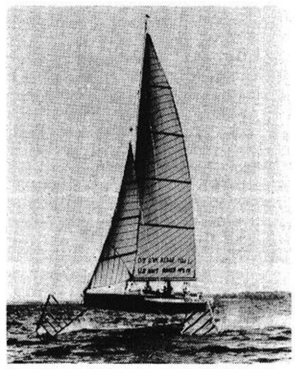

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**DEPARTMENTS**



**OCTOBER, 1960**

# THE WISCONSIN ENGINEER

*The Student Engineer's Magazine* *Founded 1896*

**VOLUME 65, NUMBER 1**

**THIS MONTH'S COVER** was drawn by Dick Nygaard, a Madison art major whose artistic interests tend toward commercial art. Dick chose oil wells since they are symbolic of an industry using the talents of all engineers. We would like to extend our thanks to Professor Donald Anderson of the art education department for recommending Dick, and to Dick for taking on this chore. We hope to see more of Dick's work on future issues.

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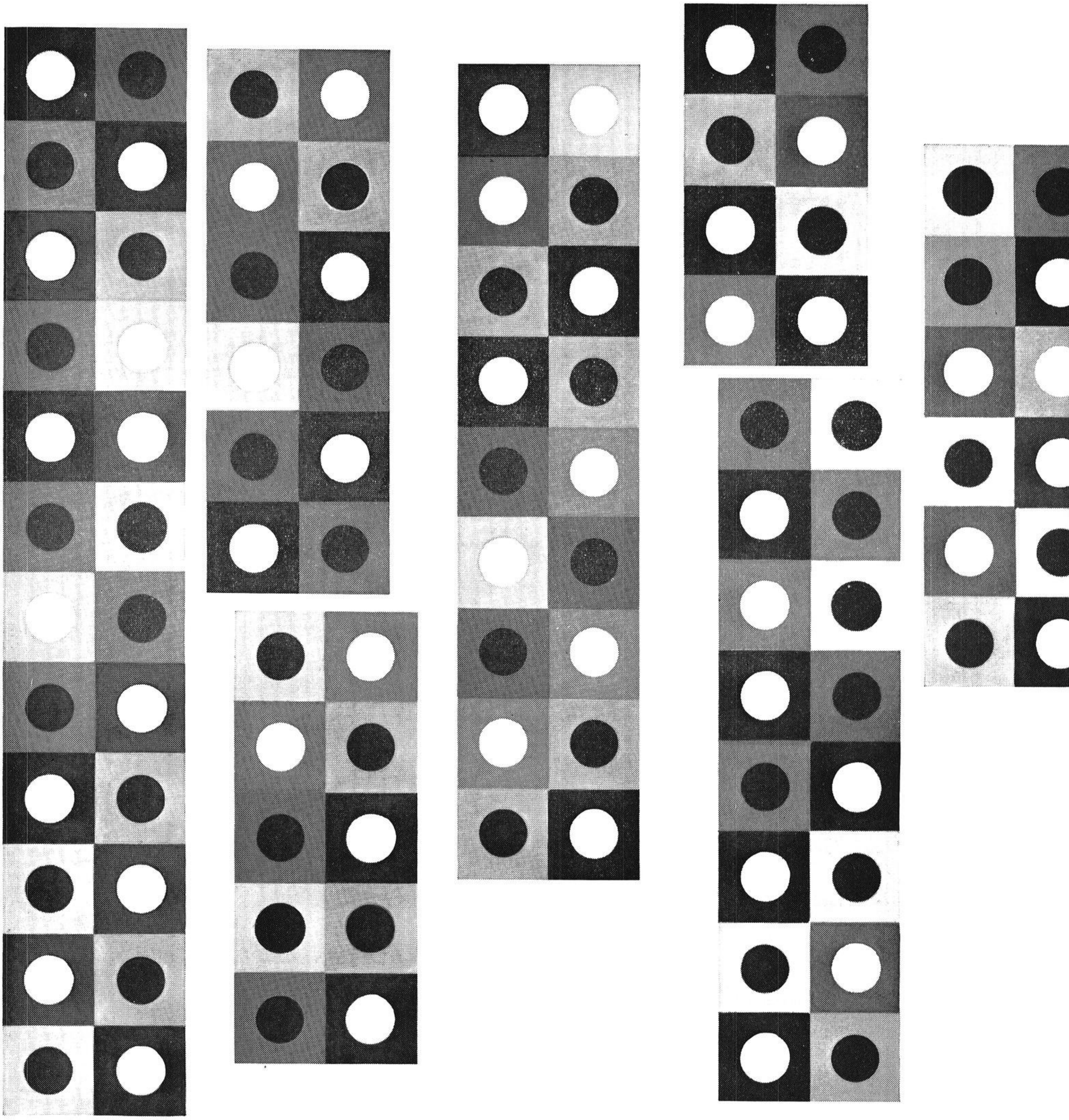
# Things we know about tomorrow:



**10,000 traffic signals controlled by a computer.**

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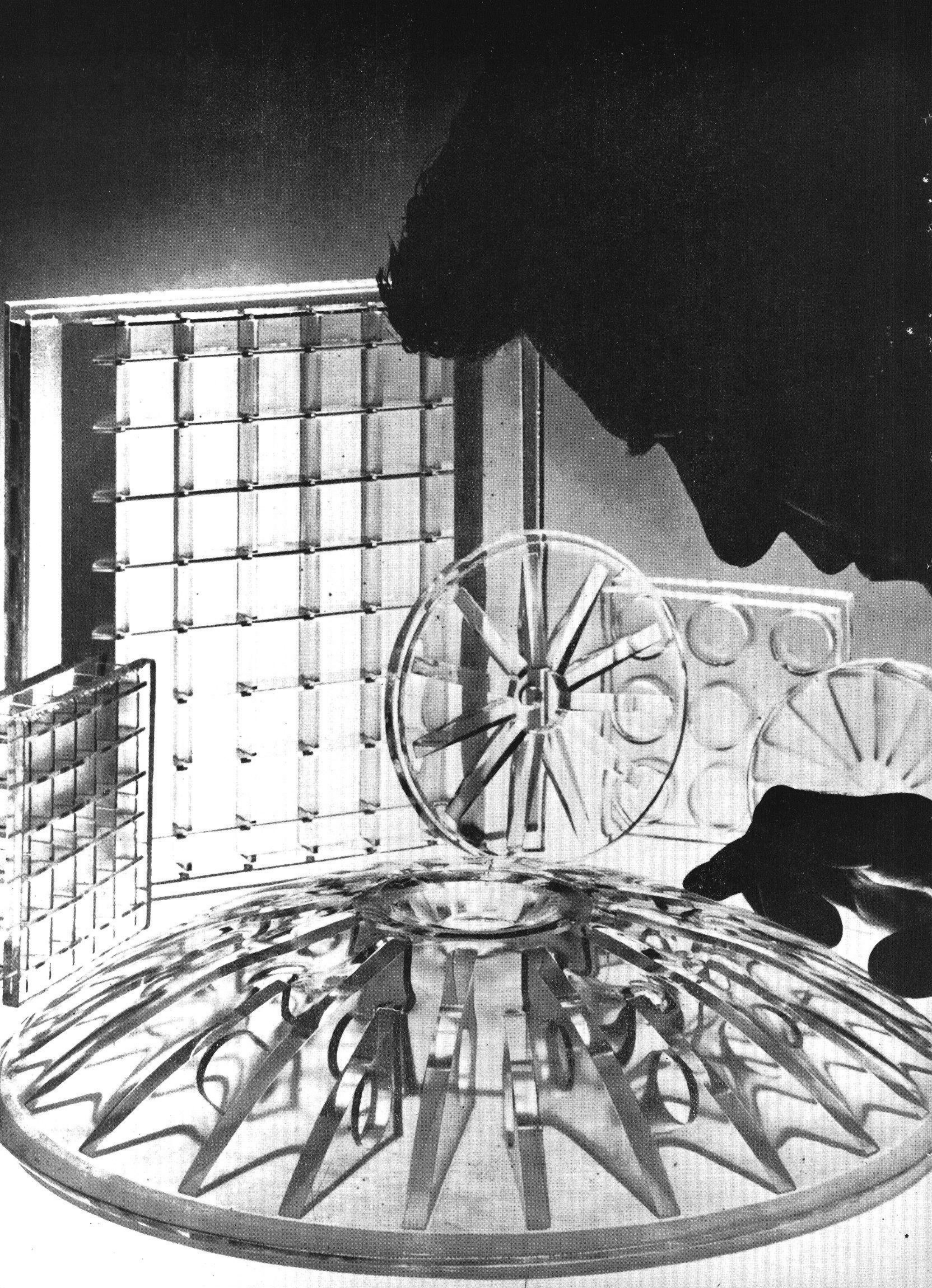


# Rambling With The Editor

You have been attending the University of Wisconsin for at least six weeks. Those of you who are veterans of the battle of the books have become re-acquainted with old friends and have finished swapping lies about summer activities. Now it is time to settle down, slide rule in hand, for another year, resolving to work harder. This resolution is made even more sobering by the conspicuous absence of some of last years classmates, a phenomenon that becomes more apparent as the semesters roll by.

Since this is the first copy of the 1960–61 *Engineer* it seems appropriate to tell you a little bit about our magazine and what we hope to accomplish this year. The *Wisconsin Engineer* has been continuously published since 1896 and is almost a tradition at Wisconsin. Many of you first became familiar with the *Engineer* in your high school libraries. Perhaps our high school edition helped you decide on the branch of engineering which you are following. This year, we will have other special issues such as the one devoted to graduate studies which will appear next month.

The magazine is almost entirely student written. The articles, which are written in technical writing classes, are chosen for publication on the basis of their interest and the skill with which they were written. Certain departments are presented every month. The Science Highlights section shows the latest developments in science and engineering while the Engineer of Yesteryear provides a look at what was considered news in the early days of the Engineer.

Engineers are noted for their appreciation of the engineering feats of nature, and for this reason we present the Girl of the Month. Other departments are Sneed's Book Review which tells of the latest developments in engineering literature and Stripped Gears which deals with the lighter side of engineering. Also there is Sneedly's puzzle page which gives someone a chance to pick up ten dollars. Sneedly, by the way is a "student" who started in engineering in 1954, but transferred to B.S. shortly thereafter. He has since had various classifications and is now Law '65, quite appropriate for an ex-engineer.

*The Wisconsin Engineer* serves the campus by providing a voice for the campus engineering organizations. This year we hope to extend this voice to everyone by providing a letters to the editor column. This is your opportunity to express yourself and to bring forward any questions, problems, ideas, or gripes that you may have. This is your column. Use it!

I and everyone on the staff hope that YOU make reading the *Wisconsin Engineer* a steady habit and that YOU do not become conspicuous through YOUR absence.—J.C.S.

**Made by an unusual sandwich-type construction, these lightweight telescope disks have been developed by Corning Glass Works for use in missiles, satellites and aircraft. The mirrors consist of two plates of fused silica, held apart by ribs or tubes of the same high purity material. This weight-saving construction makes the mirrors light enough for compact telescopes needed in outer space photography.**

Courtesy of Corning Glass Works

# Powdered Metal Products

*by Walter A. Olep, me'60*

## A Survey of the powdered metal Industry, its raw materials and manufacturing processes.

POWDERED metallurgy got its start during World War II when methods for mass production of machine parts were being investigated. Since then it has grown rapidly into one of the leading manufacturing processes today.

### PROCESS DESCRIPTION

The production of powdered metal products usually occurs in three or four steps. First, the metal powders are manufactured and blended in proper proportion to produce the desired strength and metal structure of the powdered metal part.

Next, the proper amount of the blended powder is fed into a compact die and pressed. This operation is done at room temperatures, at pressures of 40,000 to 80,000 psi, and at production rates determined by the part size, the part shape, and the composition of the blended powder.

The briquette or pressed part is then placed in a sintering furnace. In the furnace, the briquettes are heated to an elevated temperature below the melting point of the metal in a reducing atmosphere. By heating the briquette at the proper temperature for a proper period of time, interparticle adhesion occurs, thus producing a strong metal part with the desired properties.

At this point, the process could be ended. But, if other special characteristics are desired of the part, the sintering operation could be followed by sizing and coining, machining, impregnation and infiltration, plating, or heat treating.

### MANUFACTURING METAL POWDERS

The metal powders most commonly used in the manufacture of powdered metal products are copper, tin, and iron. The particle size of the powders falls into a range of 1 to 100 microns (1 micron = $10^{-6}$ meter) with the range of 10 to 20 microns being predominant. There are various methods of manufacturing powders of this size, but those most commonly used are atomization, reduction and electrolytic.

#### Atomization

In the atomization process, molten metal is forced through a nozzle into a stream of air or water. Upon contact with the stream, the molten metal is solidified into particles with sizes in a wide range. By varying the nozzle size, the metal flow rate, and the pressure and temperature of the stream, the particle size can be varied. This process is used mostly for low-melting point metals due to the corrosive action of the molten metal on the nozzle at high temperatures.

#### Reduction

In the reduction process, the oxides of the metals are used. The oxides are obtained from the ores of the metals by chemical processes. These oxides are pulverized or ground into powders. The oxide powders are placed into atmosphere controlled furnaces and reduced to the metal by the use of various reducing agents. The most widely used agents for this process are hydrogen, carbon monoxide, natural gas, and dissociated ammonia. By varying the temperature and time of the reduction period, the particle shape can be controlled for proper briquetting purposes. This process is carried out at temperatures below the melting point of the metal.

#### Electrolytic

The electrolytic process is similar to electroplating. In this process, the metal plates are placed in a tank of electrolyte. These plates act as anodes while other metal plates are placed into the electrolyte to act as cathodes. Unlike the electroplating process, high amperages are used to produce a powdery deposit on the cathode. After a period of time, the cathode plates are removed from the tank and rinsed and dried to remove the electrolyte. After this is done, the deposit is scraped from the cathode and pulverized to the particle size range. The particles are then generally annealed to eliminate the work hardening caused by the pulverization. Metal powders produced by this process are of very high purity.

### PROPERTIES OF METAL POWDERS

To determine the properties of powdered metal parts, a study of the various properties of the metal powder must be made.

#### Particle Size and Distribution

Particle size and distribution are important factors in the control of porosity, density, compressability, and shrinkage upon sintering. If all coarse or all fine metal powders were used, the overall porosity would increase due to the voids between particles. By the use of proper particle size and distribution, the space occupied by voids would be reduced. Density of a part would decrease if all coarse particles were used due to the large void space. By using all fine particles, the density of the part would increase, but the pressure required for briquetting would increase due to the larger contact area between particles and small deformation. Again, proper particle size and distribution are required to provide the proper density without increasing briquetting pressures. Particle size and distribution are determined by passing a powder sample through a standard screen set and measured by percentage of weight.

#### Apparent Density and Flow Rate

Apparent density and flow rate are important factors in determining press size and part characteristics. Flow rates determine the time required to fill the die cavity of the press. This would then set the production rate. Apparent density of the metal powder, measured in grams per cubic centimeter, is important in determining the stroke of the press. To manufacture a part of a certain density, the use of a low apparent density metal powder would increase the amount of powder required. Since the amount of powder is increased, the stroke of the press must be increased.

#### Purity

To produce powder metal products of high quality, the metal powders must be of high purity. Impurities have various effects on the briquetting and sintering operations. Foreign substances cause wear on the die parts and thus reduce the useful life of the die. Oxides and gaseous impurities can be removed from the part during the sintering operation by the use of a reducing atmosphere in the sintering furnace. The removal of these impurities increases the porosity of the part due to the decrease in the particle size after reduction.

#### Blending

Blending is an important step in the process of powder manufacture. By blending various metal powders, many different properties can be obtained in the powdered metal parts which cannot be obtained by other methods of manufacture.

Blending and mixing provides a homogeneous mixture of the desired properties. During the blending operation, lubricants are added to the powders to reduce friction during the pressing operations. This reduces die wear and lowers the pressures required for pressing.

### MANUFACTURING PROCESS

The manufacturing process consists of briquetting, pre-sintering (optional), sintering, and additional finishing operations.

#### Briquetting

In the briquetting operation, the prime objective is to obtain a uniform density throughout the entire briquette. Due to inter-particle friction, pressure applied from one direction will not be distributed uniformly through the part and, therefore, the density will vary throughout the part. To keep this density variation to a minimum, multiple action briquetting presses are employed which apply pressure from both the top and bottom of the part die.

*(Continued on page 38)*

*We are sorry, but Walter Olep graduated before we could get any information about him other than his picture and that he is from Kenosha, Wisconsin.*

# The Rotor-Piston Engine

*by James Radloff me'60*

## A new idea to improve the old gasoline engine.

### PRINCIPLE OF OPERATION

#### General Operation

THE rotor-piston engine eliminates reciprocating parts by having a triangular piston revolving eccentrically around the output shaft. The cylinder wall is shaped like an oval drawn in at the middle. This shape allows the corners of the rotating piston to be in constant contact with the cylinder wall. Note that while one side of the rotor is intaking, another side is compressing and firing, while the third side is firing and exhausting. (Refer to figure).

#### Intake

As the rotor turns clock-wise, the area between side CA and the cylinder wall gets larger, so side CA is intaking. One, two, three, and four are the intake sequence steps. The engine hasn't any intake valves. The rotating piston opens and closes the intake ports as it moves. Because there are no intake or exhaust valves, or any other projections into the intake chamber, there is no preignition due to "hot spots". Preignition is the ignition of the gases before the engine parts are in position for the power stroke.

#### Compression

After step four, the area between the side of the rotor AB and the cylinder wall begins getting smaller, and the intake port is cut off, so the gas mixture is compressed. Five, six and seven are the compression sequence steps.

The compression ratio, the ratio of the largest volume at four to the smallest volume at seven, is about eight to one. This is higher than was originally expected.

#### Power

At step seven, the spark plug fires, and the expanding gases of combustion drive the rotor thru steps eight, nine, and ten.

Since, as the name implies, the motion of the rotor is rotary, and the direction of motion is not changed as in reciprocating engines, the power is delivered smoothly, and more power is delivered to the output shaft. Power is not used to change the direction of motion. Also, for each revolution of the rotor there are three power strokes.

#### Exhaust

After step ten, when point C of the rotor uncovers the exhaust ports, the area between CB and the cylinder wall is decreasing, so the exhaust gases are forced out the exhaust port. Steps eleven, twelve, and one are the sequence steps of exhaust. As in the intake process, the rotor opens and closes the exhaust ports, so no exhaust valves are needed.

Because the rotor sweeps the whole chamber during exhaust, this design has better removal of burnt gases than the reciprocating engine. The reciprocating engine cannot remove exhaust gases completely, because the piston cannot travel to the top of the cylinder since the valves are in the way.

### ADVANTAGES

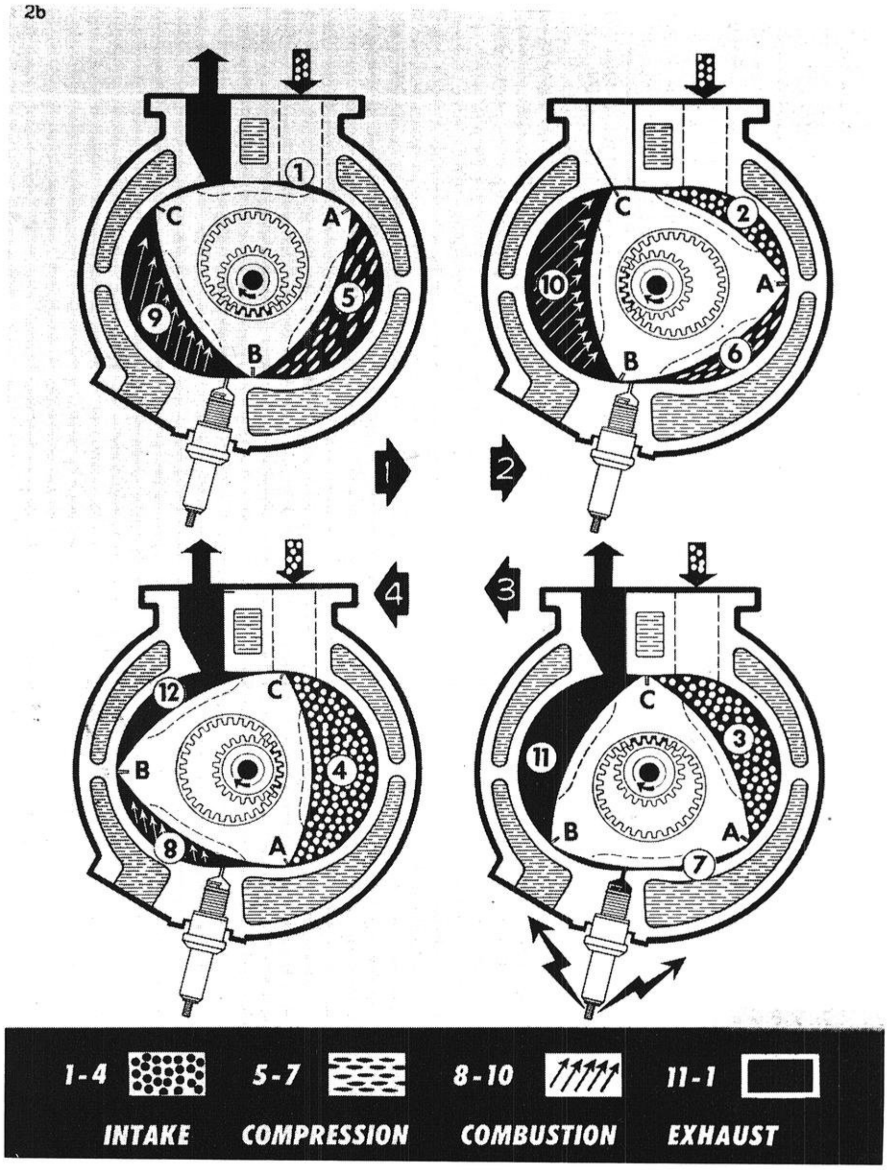
The rotor-piston engine has many advantages due both to its design and to its rotary motion. First the advantages due to rotary motion, then the advantages of economy, and finally the extra advantages are discussed.

#### Rotary Motion

The reciprocating engine has a stop-start motion. The piston must be stopped and accelerated in the other direction at the end of each stroke. Because mass times acceleration produces a force, this force must be supplied by the engine to maintain motion. The rotary engine has a constant rotary motion, so these acceleration forces are eliminated, and more power is delivered to the output shaft. Also, the parts are not loaded with the acceleration forces.

The rotor-piston engine has very little vibration because both noise and vibration are caused mainly by valves. The rotor-piston engine eliminates valves and has constant motion, so vibration is small.

The acceleration forces of the reciprocating engine increase with the square of the speed of rotation. This is why reciprocating engines are limited to low speeds. Because more power is developed at high speeds, the rotor-piston engine has a large advantage. It can run at speeds of 17,000 rpm, compared to about 5000 rpm for most reciprocating engines. More power is developed because of higher speed. Power does not have to be used to change direction of motion, and no power is used to operate valves. Therefore, far more power is available to the output shaft in the rotor-piston engine than in the reciprocating engine.



The strokes of a Rotor-Piston Engine.

Courtesy of Motor Trend

### Economy

The initial cost of the rotor-piston engine will be less than a comparable reciprocating engine, because the rotor-piston engine is cheaper to manufacture. Many parts are eliminated in the rotor-piston engine. There are no camshafts, valve lifters, valves, or timing gears, because the rotor itself acts as a valve and timing device. Other parts are very simple. The output shaft is straight as compared to the crooked crankshaft of the reciprocating engine. Also a gear replaces the connecting rod and wrist pin.

The rotor-piston engine is economical to run, too. It will burn cheaper fuels than the reciprocating engine, and it burns less fuel. The rotor-piston engine will burn fuels with a 43 octane rating compared to fuel of 100 octane for todays auto engines.

### Other Advantages

The rotor-piston engine develops one horsepower per pound of weight because it will run at high speed and because less power is stolen by many moving parts. This means that the payload of the motor is greater. Also, the torque curve of the rotor-piston engine is very flat. That is, the torque changes very little with a change in engine speed. So the rotor-piston engine will require a less complicated transmission.

Since the rotor-piston engine is lighter in weight and has less vibration, the engine is much easier to mount.

## DISADVANTAGES

Along with advantages, this new design has some disadvantages. Properly speaking, they are design problems rather than disadvantages. These problems must be solved before the rotor-piston engine can be put into general use.

The stress on the gear teeth on both the rotor and the output shaft are subject to direct power impulses. There is no shaft to cushion the impulses so the gears must be very strong.

Although the engine has been run successfully with water cooling, it is very hard to cool with air. Air is not as good a heat transfer agent as water.

Another problem is the sealing between the rotor and the cylinder walls. The seals must stand 17,000

(Continued on page 57)

*We are sorry but the author graduated before we could get his picture and information about him.*

# The History and Development of Portland Cement

*by John DeHorn, ce'61*

***Portland cement has developed through the years into one of the most widely used and dependable construction materials.***

EVER since man first started to build, he has sought a material that would bind stones into a solid, formed mass. The Assyrians and Babylonians used clay for this purpose, and the Egyptians advanced to the discovery of lime and gypsum mortar as a binding agent for building such structures as the Pyramids. The Greeks made further improvements, and finally the Romans developed a cement that produced structures of remarkable durability.

The Romans understood calcareous cements quite well. Their structures are proof of this. They were probably the first people to deliberately make hydraulic cement. Ordinary lime mortar was probably used, but a true hydraulic cement was prepared by adding puzzolanic material, a substance containing siliceous matter which was active enough to combine with lime to form calcium silicates resistant to the action of water.

As the Roman Empire decayed the secret of hydraulic cement was lost with it. During the Middle Ages the failure of structures intended to resist the action of water must have been many. It is difficult to say just what proportion of failures there were because their destruction has removed any proof that they ever existed. This situation remained until the eighteenth century.

Repeated structural failure of the Eddystone lighthouse off the coast of Cornwall, England, led a British engineer named John Smeaton to conduct experiments with mortars in both fresh and salt water. These tests led to his discovery in 1756 that lime made from limestone containing a considerable proportion of clay would harden under water. With this discovery, he rebuilt the Eddystone lighthouse in 1759. His structure stood for 126 years before replacement was necessary.

Other men experimenting in the field of cement during the period from 1756 to 1830 were L. J. Vicat and Lesage in France and Joseph Parker and James Frost in England.

In 1824 a bricklayer and mason in Leids, England, named Joseph Aspidin took out a patent on hydraulic cement. He called it "portland" cement because it resembled in color the stone quarried on the Isle of Portland off the British coast. Aspdin's greatest contribution was his method of carefully proportioning limestone and clay, pulverizing them and burning the mixture into a clinker, which was then ground into finished cement. Portland cement, which was patented by Aspdin, was a predetermined and carefully proportioned chemical combination of lime, silica, iron oxide and alumina. Before portland cement was discovered and for some years after its discovery, large quantities of natural cement were used. Natural cement was produced by burning a naturally occuring mixture of lime and clay. Because the ingredients of natural cement were mixed by nature, its properties varied widely. This is the reason that natural cement has given way to portland cement, which is a predictable, known product of consistently high quality. Today about 98 per cent of the cement produced in the United States is portland cement.

In Aspdin's day the new product caught on slowly. Aspdin established a plant in Wakefield to manufacture portland cement, some of which was used in 1828 in the construction of the Thames River Tunnel. But it was almost 20 years later, when J. D. White and Sons set up a factory in Kent, that the portland cement industry saw its greatest period of early expansion. This was not only in England, but also in Belgium and Germany. Portland cement was used in the construction of the London sewer system built in 1859–1867.

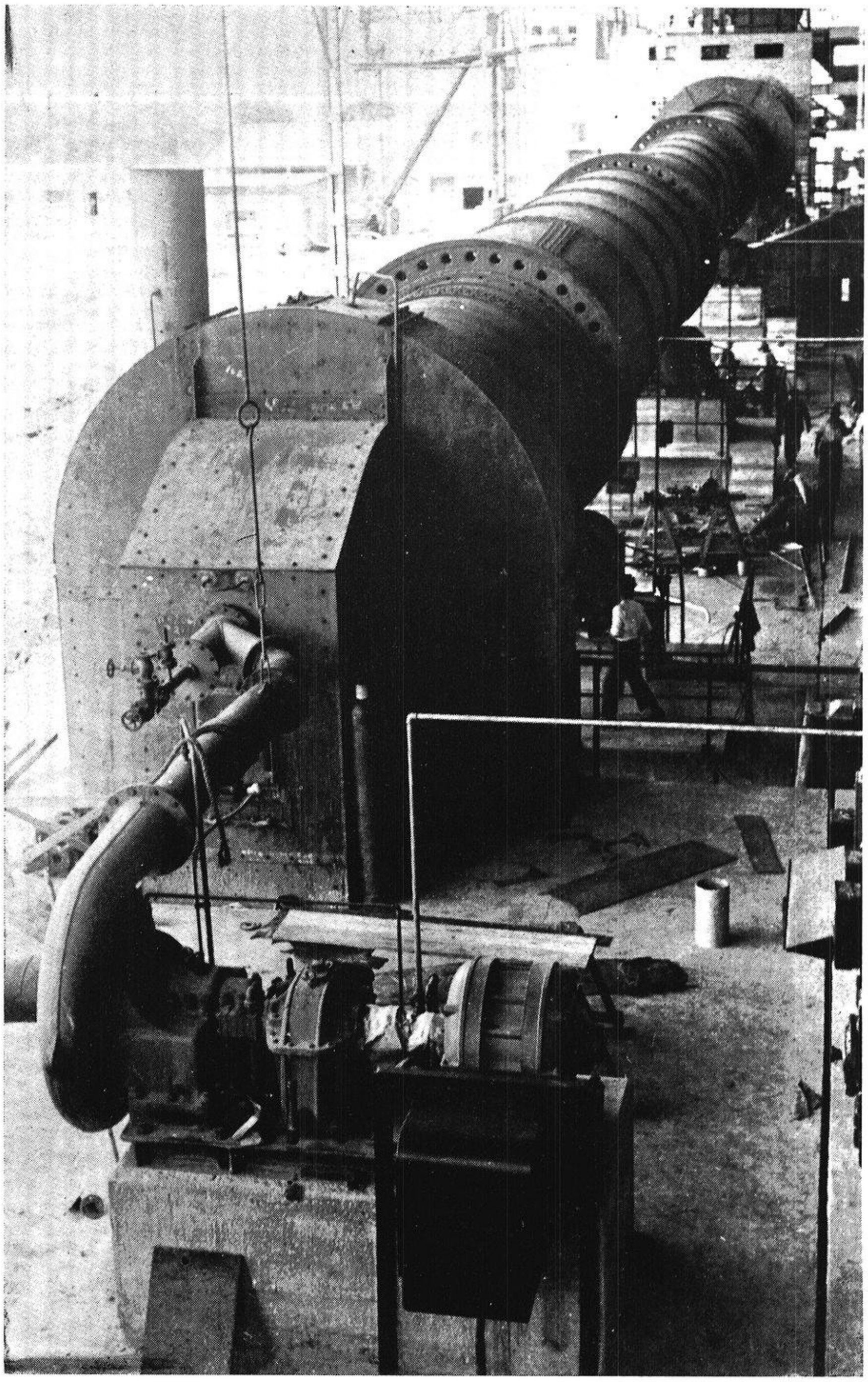
The first record of portland cement's being shipped to the United States was in 1868, when European manufacturers began using cement as ballast in tramp steamers, which enabled them to ship at very low freight rates. The volume increased to a peak of nearly 3 million bbl. in 1895. After that date Americans began producing increasing amounts of portland cement for themselves.

In 1880 about 42,000 bbl. of portland cement was produced in the United States; a decade later the amount had increased to 335,500 bbl.; and since that time production has increased steadily, until today the United States manufactures and uses more than two and one-half times as much portland cement as any other country in the world.

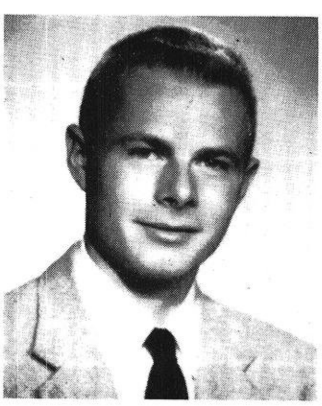
One factor in this great increase was the development of the rotary kiln. In the early days, vertical kilns were used and allowed to cool after each burning. This resulted in a waste of fuel and time. In 1885 an English engineer, F. Ransome, patented a horizontal kiln, slightly tilted, which could be rotated so that the material moved gradually from one end to the other. Because this new type of kiln had much greater capacity and burned more thoroughly and uniformly, it rapidly replaced the older type. Thomas Edison was a pioneer in the further development of the rotary kiln.

### The Composition and Chemistry of Portland Cement

Portland cement is a closely controlled chemical combination of lime, silica, alumina, iron oxide and small amounts of other ingredients —to which gypsum is added in the final grinding process to regulate the setting time of concrete. Lime and silica make up approximately 85 per cent of the mass. Among the materials used in its manufacture are limestone, shells and chalk or marl, combined with shale, clay,



**A rotary kiln showing blower and burner extending into kiln firing hood.**



*John DeHorn is a junior in Civil Engineering from Thiensville, Wisconsin. Mr. De Horn attended Michigan Tech as a freshman before transferring here. John had no special reason to write on Portland cement although he is interested in structures. He is a member of Chi Phi fraternity, Scabbard and Blade, and the Society of American Military Engineers.*

slate or blast-furnace slag, silica sand and iron ore.

Portland cement is made by combining $SiO_2$ and CaO by the aid of some flux which may vary from $Al_2O_3$ to $CaCl_2$. The product of chief importance is $3CaO \cdot SiO_2$. This calcium silicate is what causes the setting of concrete.

A large amount of very valuable work has been done by many investigators on the chemistry of cement. While Henry Le Chalelier was doing research on cement he wrote *The Constitution of Hydraulic Mortars* (translated by Joseph Lathrop March) which remains a classic. Although the original work was done in 1887, it has been repeatedly criticised and revised so that it may be taken as the basis of our modern knowledge of cements. The fundamental idea concerning the setting of cement is best expressed in Le Chalelier's work on plaster of paris. The same chemical reaction takes place in cement as in plaster of paris. The following paragraph is a direct quote from his original book.

"The physical phenomenon of the crystallization of plaster of paris during its setting would then be as follows: calcined plaster is hydrated in contact with the water, which has been used to temper it, and gives a solution which soon allows the hydrated sulphate to crystalize, and then becomes able to dissolve new quantities of dehydrated sulphate. The phenomenon continues in this manner until the complete hydration and crystallization of the plaster. Indeed, these two contrary actions occur simultaneously at adjacent points. A continuous solution of new quantities of plaster compensates for the impoverishment of the liquor resulting from the equally continuous deposition of the hydrated crystals. The degree of concentration at which the solution is maintained depends upon the relative speed of these two contrary phenomena. When it is rapid, on the contrary, the supersaturation is considerable."

This is the crystalline theory. There are others, but this one seems to be the most logical. This part of the chemistry of cement is still questionable and will remain so until more thorough and difficult research is made.

**Manufacture of Portland Cement**

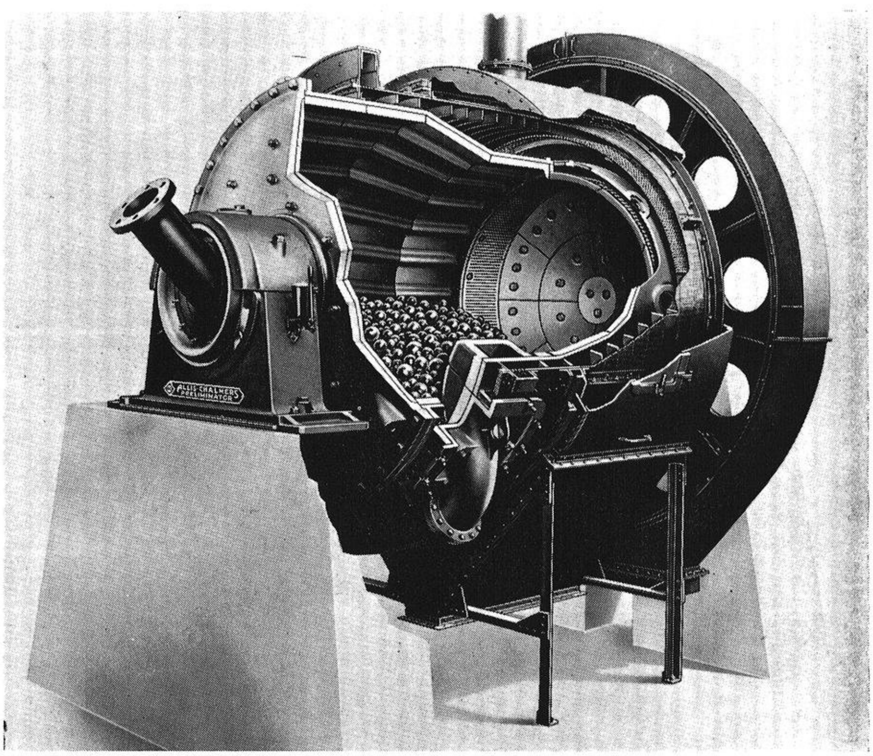
Most people have the impression that portland cement is mined from the ground and needs only crushing to be ready for use. Actually portland cement is produced from mountains of rock, clay and shale, all of which must go through some 80 different and carefully controlled operations. These include crushing, burning at a temperature that would melt steel, and grinding extremely fine. More than 600 pounds of raw materials, in addition to fuel, are required to make one barrel of cement weighing 376 pounds.

Two different processes are used in the manufacture of portland cement. One is the dry process; the other, the wet. In the wet process, the raw materials, properly proportioned, are ground with water, intimately mixed and fed into the kiln in the form of a "slurry". In the dry process, raw materials are ground, mixed and fed into the kiln in a dry state. Otherwise the two processes are essentially alike.

When rock is used as the principal raw material, the first step in both processes after quarrying is the primary crushing. Large amounts of rock are fed through crushers which can handle pieces as large as oil drums. The first crushing reduces the rock to a top size of about six inches. The rock then goes to secondary crushers or hammer mills for reduction to approximately two inch size or smaller.

The rock and other raw materials are then raised to a temperature of around 2,700 degrees F. in huge cylindrical steel rotary kilns lined with special firebrick. Kilns are sometimes as much as 12 ft. in diameter and longer than the height of a 40-story building. Kilns are mounted with the axis inclined slightly from the horizontal. The finely ground material is fed into the higher end. At the lower end is a blast of flame, produced by burning of powdered coal, oil or gas under forced draft.

As the material moves through the kiln, certain combinations of elements are driven off in the form of gases. The remaining elements unite to form a new substance with its own physical and chemical characteristics. This new substance,




**Dry grinding preliminator equipped with peripheral screen.**

called a "clinker", is formed in pieces about the size of marbles and is harder than the rock from which it came.

The clinker comes out of the lower end of the kiln and is generally brought down to handling temperature in various types of coolers. The heated air from the coolers is returned to the kilns; this saves fuel and increases efficiency.

The clinker may be stockpiled for future use, or it may be taken at once to a series of grinding machines. Here gypsum is added. The final grinding operation reduces the clinker to a powder called portland cement. It is so finely ground that more than 90 per cent of it will pass through a screen containing 40,000 holes to the square inch; and more than 80 per cent will pass through a screen that has 100,000 holes to the square inch.

Strong paper sacks, which are sealed before receiving the cement, are then filled through a valve from a packing machine that automatically cuts off the flow of cement when 94 lbs. has entered the sack. When cement is shipped in bulk, it is pumped into hopper-bottom railroad cars, trucks, barges or ships and is accurately weighed.

### Uses of Portland Cement

Portland cement occupies a dominant position in modern civilization. It is now regarded as indispensable in highways, sidewalks, bridges and dams; in the construction of virtually all large buildings; and in airport runways, drydocks, harbors, and a multiple of other major and minor projects. Both farmers and city dwellers use it in innumerable ways.

By far the greatest use for portland cement is in making concrete. Concrete is a mixture in which a paste of portland cement and water binds aggregates into a rocklike mass as the paste hardens through the chemical reaction of the cement and water. Concrete in itself is more than sufficient for many uses. It is durable, sanitary and fire resistant. The upkeep cost of concrete is low, and it can easily be made attractive in appearance. Because it is plastic when first mixed, concrete lends itself well to the construction of many objects.

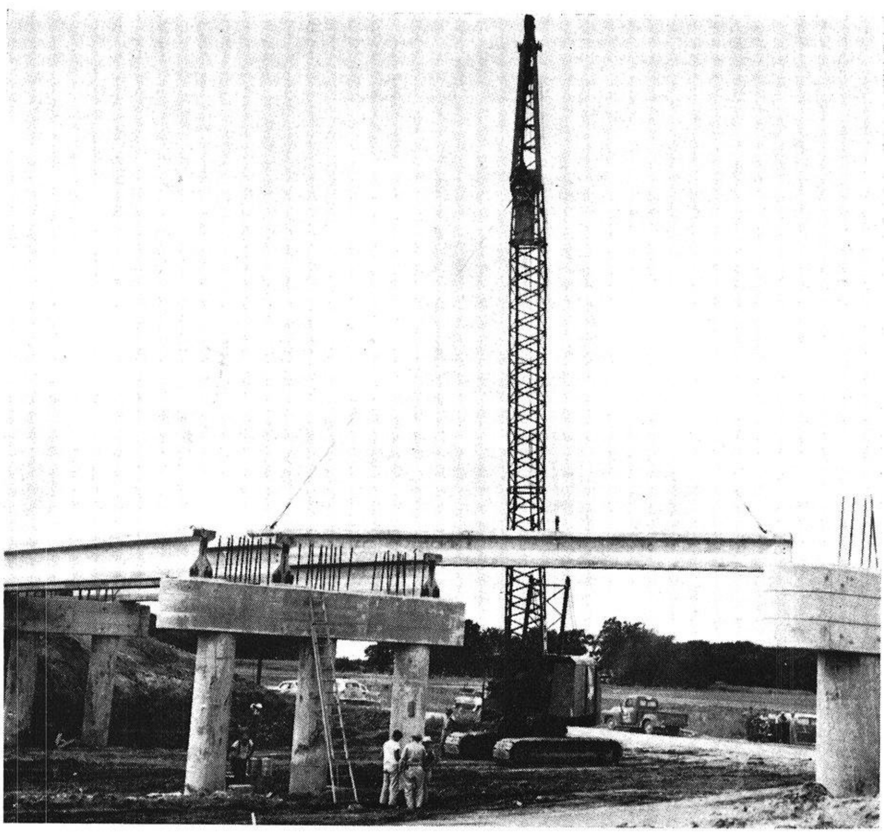
Portland cement is also used in grouting. Portland cement grout is a fluid mixture of portland cement and water, to which fine sand is sometimes added. It has a variety of purposes and is applied by air or hydraulic pressure, and by gravity.

In pressure-grouting, the grout is forced under pressure into oil-well casings, into subgrade under track or foundations, and into open joints of old masonry.

Track maintenance has always been one of the largest items of expense for the railroads. The grout is forced into the track subgrade, displacing air, water or water-saturated material. When the grout hardens, the subgrade is stabilized.

Still another use for cement was discovered by Ludwig Hatschek, an Austrian, when he developed a process for combining asbestos fibers with portland cement to produce a construction material of great strength and durability. This led to the manufacture of the first asbestos-cement product, roofing shingles, in 1905 at Ambler, Pa. Asbestos-cement products are now made by more than a dozen companies with plants in various sections of the country.

One can be assured that Portland cement will continue to be used in an increasing amount and in an increasing number of ways in the future.



**Portland Cement is used in most highway work including many highway structures.**

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**THE END**

# The Hydrofoil

## Its principles and applications

*by Reidar O. Nilsen, C.E.'61*

BOATS have been used by men for thousands of years, but few significant changes have been made with respect to shape and speed.

Most ships are of the displacement type, which means that their uplift equals the weight of the water displaced. Ocean vessels, barges, tugboats and ferries fall into this category.

Planing boats constitute a second category, a typical example being the high speed motorboat. Their uplift is caused by the pressure of water against the bottom surface of the hull. At high velocities planing boats actually skip along the surface; however, substantial energy is still required to overcome the hull friction. In hydrofoil boats this hull friction is avoided by lifting the hull entirely out of the water. The lift is obtained from narrow "wings" or foils running submerged under the boat.

*Progress.* In Europe, where the hydrofoil idea originated, Enrico Forlanini was one of the pioneers. In 1905 he built a ship weighing 1.6 tons and claimed to have reached a speed of 38 knots on Lake Maggiore in Switzerland. A year later, the Italians Crocco and Ricaldoni tried out a different type of hydrofoil on Lake Braccino in Italy and reached a speed of 37 knots, using two 40-hp aircraft engines on 1½-ton craft.

In Canada, shortly after World War I, the well known telephone pioneer, Alexander Graham Bell, together with Casey Baldwin, developed a 5-ton ship, the HD-4. The HD-4 had two 350-hp aircraft engines and reached a speed of approximately 65 knots.

In 1938 a patent was taken out by W. Grunberg in Paris on the principle that a rigid, fully submerged main foil could be activated to increase or decrease lift by some kind of sensing device, such as a fixed, forward projecting float which would anticipate disturbances or changes in height. In contrast to this fully submerged system, we find the partially submerged, self-stabilizing, v-shaped foils, used by Crocco. The more the v-foil is submerged, the more uplift is created by the additional active foil area. This will fluctuate a little until uplift ultimately equals the weight of the craft. A variation of this is the ladder type foil, where active foil area depends on the number of "ladder steps" submerged.

The largest hydrofoil boat ever built was the VS-8, launched in Germany in 1942 by Schertel-Sachsenberg. It weighed eighty tons, was almost one hundred feet long and reached a top speed of more than forty knots. This boat performed satisfactorily in waves six feet high and 150 feet long. Unforunately, it was run aground and damaged in 1944 before more performance data could be obtained.

During and after the Second World War several companies in the United States became interested in the hydrofoil. Many of them concentrated on the Grunberg principle and tried to modify the sensing mechanism which controls the main foil. Gibbs & Cox, New York, used an electrical sensing device instead of using a float. The Hydrofoil Corporation of Annapolis used a fully submerged hydrostatic diaphragm, and Baker Manufacturing Company, Evansville, Wisconsin, used a projecting ski which activated the main foil hydraulically. These sensing mechanisms will be explained more in detail later under the heading "Theory". Baker Manufacturing Company also developed a partially submerged foil system with a high angle of dihedral.

*Classification of Systems.* Of the many methods of constructing the hydrofoil boat, two main systems became prevalent:

1. Hydrofoils, partially submerged, with self-stabilizing height control
   a. Ladder type (Forlanini, Bell)
   b. V-shaped (Crocco, Baker, Tietjens, Schertel-Sachsenberg)
2. Hydrofoils, fully submerged, with variable angle of attack to control height
   a. Linkage type sensor (Hook & Baker)
   b. Electric type sensor (Gibbs & Cox)
   c. Hydrostatic diaphragm (Hydrofoil Corp. of Annapolis)

### Theory

*Drag-Thrust Relationship.* The frictional resistance or drag against a conventional displacement hull increases rapidly with each little increment in speed. To illustrate the advantages of the hydrofoil

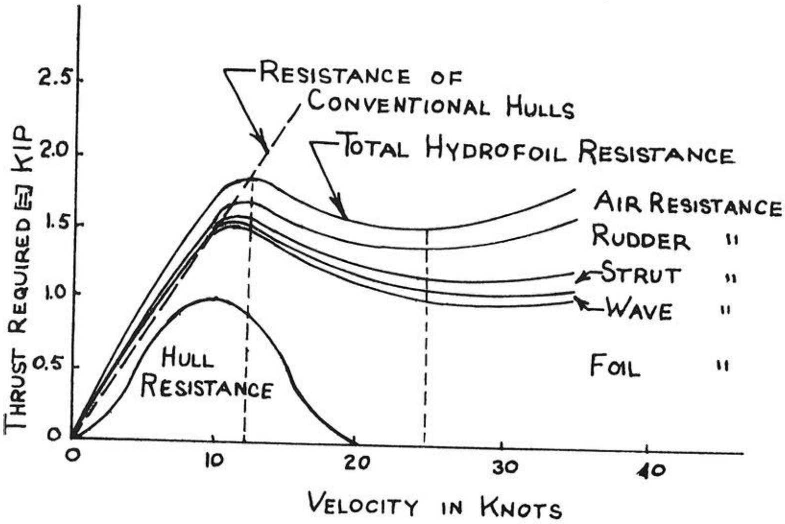

Fig. 1. Typical Resistance velocity diagram for a Hydrofoil boat.

boat, a typical resistance-velocity diagram is shown in Figure 1. The green, broken line represents the resistance against a conventional hull as the velocity increases. The blue, solid line illustrates the total resistance encountered by the hydrofoil boat. This overall resistance may be attributed to the many component resistance factors as indicated by the colored sections in the diagram. The critical point (Vc), insofar as the application of thrust power is concerned, is reached when the hull is still partially submerged, but at the point of breaking out of the water. The same critical point can be observed in water skiing when the start is made in deep water and the skier is half way out of the water. Once past this critical stage, the hull climbs out of the water, and the hull resistance ultimately becomes zero. Immediately after this, the most economical velocity (Ve) is reached where minimum thrust is required. The total resistance curve from this point climbs gently, and higher velocities can therefore be obtained without too much increase in power output.

*Foil Consideration.* Looking at the diagram in Figure 1 one can easily see that the hydrofoil itself (red area) is the factor causing the greatest resistance, but it is also here that the work is done to keep the boat aloft. The lift is achieved on the same principle as that applying to an airplane wing. A typical cross-sectional profile of a foil is illustrated in Figure 2. The line A-B is given an angle of two to five degrees from the direction of travel. This is called the angle of attack or angle of incidence. In the case of an airplane wing, the air is split by the air foil at A, and part of it goes above, part below. The airstream below hits the under-surface, called the pressure side, and forces the foil upwards to cause part of the lift. The larger share of the lift, however, is caused by the air which has to travel the long way around. Since it has the longer way to go, it increases speed. From the laws of dynamics we know that as speed increases, pressure drops. This results in a suction which pulls the wing upwards. The top surface is termed the low pressure side. Since water has a density of approximately 800 times that of air, the "wings"

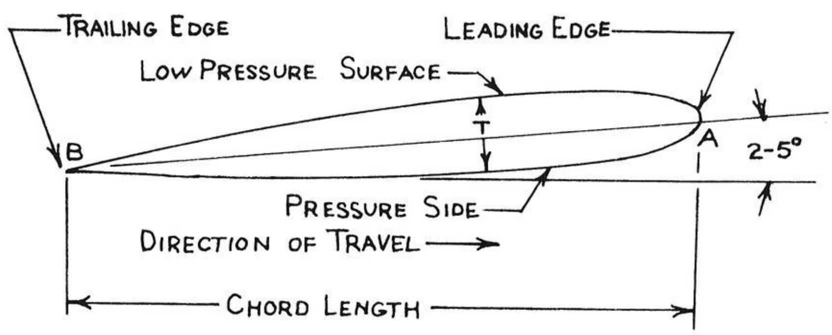

Fig. 2. Cross-section of a typical foil.

*Reidar O. Nilsen came to the United States from Norway in 1956. He worked as a layout draftsman for "Allstate Design and Development Company" in Milwaukee and saved enough money to start school the next year. He is married and now lives in Madison. Mr. Nilsen is a member of the A.S.C.E. and the U. W. Sailing Club. Upon graduation he plans to go into consulting engineering, preferably in the field of hydraulics.*


Courtesy of Baker Mfg.

**The Hydrofoil sailboat "Monitor" being tested on Lake Mendota.**

or foils under water receive tremendous lift and can, consequently, be built smaller than an airplane wing. On a 24-foot boat the chord length of the foil would be only four to five inches and the maximum thickness of the chord would be approximately one-half inch.

*Transverse Stability.* The rolling or heeling can be as much as ± 18 degrees from the horizontal plane on conventional hulls when the waves come in from the side. On trans-oceanic liners this rolling has been somewhat reduced by the use of stabilizing fins controlled by a gyro. On a hydrofoil boat the heel angle is reduced to approximately ± 3 degrees. Such transverse stability can be obtained by using two dihedral (v-shaped) foils with fixed angle of attack, one on each side of the boat. Another method used is to vary the angle of attack of the left and right fully submerged foils to regain equilibrium.

*Longitudinal Stability.* The pitch angle (angle between longitudinal and horizontal axis) of a hydrofoil boat in head sea is also less than on conventional boats. The longitudinal stability is achieved, for example, by using one fixed foil aft and then changing the angle of attack on the forward foil. The impulse for changing this angle can be given in several ways. In the Gibbs system, an electric sensor pole or strut projects vertically into the water. The higher the water stands on this strut, as, for example, when it meets a high wave, the more resistance (R) is shorted out. The consequent increase in electric current (I), $I = \frac{U}{R}$, signals an electrical servo-mechanism to increase the angle of attack and give the boat more lift. On the Annapolis hydrofoils, the signal is given by a depth diaphragm. This is a sensitive pressure gage at a certain distance below the hull, and, as the distance between the gage and the water surface increases, a signal is given to the foil to increase the lift. Baker Manufacturing Company has improved the Grunberg system by using a forward projecting sensing ski, instead of float, which gives an impulse to a hydraulic servo-mechanism, which in turn activates the foils.

A simpler way to accomplish longitudinal stability is to have two sets of v-shaped foils. Longitudinal stability is complicated in following sea inasmuch as the orbital velocities of the waves decrease the relative speed of the hydrofoil with a consequent loss of lift. On the other hand, in head sea the relative speed of the hydrofoil increases and gives better lift.

### Special Problems

*Ventilation.* Ventilation is a problem encountered when undesired air is drawn down along the upper low pressure, surface of a partially submerged, v-shaped foil. One method used in Europe to solve this was to place thin strips of metal chordwise along the foil. This ventilation problem is avoided in the United States by using high angle of dihedral (more than 30 degrees).

*High Speed Cavitation.* High speed cavitation is caused by the formation of small air turbulence bubbles along the leading edge and upper trailing edge of the foil. This destroys lift and is an obstacle for reaching the high speeds of 100 knots and more. Besides, these bubbles also cause corrosion and pitting on the smooth surfaces of the foils. At such high speeds one experiences difficulty in making the water follow any curved surface without having it burst into harmful bubbles.

*Foil Materials.* The materials used in hydrofoils are mainly stainless steel and aluminum. Experiments are now going on to find more corrosive resistant metals with good weight to strength ratios

*(Continued on page 52)*

# SCIENCE HIGHLIGHTS

*by Dave Cress '63*

## SILICONE WATER REPELLENT

One of the largest known applications for a silcone masonry water repellent is the treatment of Indiana University's new football stadium at Bloomington, Indiana. Scheduled for completion early this fall, all seats and walkways of the curved stadium are being made from pre-cast concrete sections treated with a silicone water repellent for maximum masonry protection.

"Thoroclear", a masonry water repellent containing G-E silicones which is produced by Standard Dry Wall Products, Inc., was selected for this particular application. This firm, in turn, supplied the repellent to Shute Concrete Products Co., Inc., of Richmond, Indiana, where the concrete beams were cast and received a water repellent treatment prior to shipment. As an indication of the size of this project, over 15 miles of pre-cast concrete sections, using some 6500 gallons of "Thoroclear" were required for the stadium.

While silicone masonry water repellents have been used successfully on private homes and commercial and industrial establishments, this represents the first time they have been used on a masonry structure of this type and size.

For some time, silicone-based water repellents have been recognized for their effectiveness in masonry protection. Silicones provide an invisible protective coating which minimizes water penetration without altering the original appearance of the masonry. One of the major advantages that silicones offer is the ability to repel water without sealing the masonry pores. Any trapped moisture can escape through the exterior surface at the same time that water from the outside is being repelled. As a result, this type of treatment offers masonry structures longer life, improved appearance and lower maintenance. In the construction of Indiana University's stadium, a silicone treatment was selected to prevent discoloration of the masonry and to provide long-term protection against the effects of weathering.

## ELECTRONIC ANALOG HELPS SOLVE PLANT PROBLEMS

A unique electronic machine that greatly reduces costly piping alterations at compressor stations along new natural gas pipe lines is being used at Worthington Corporation's new research laboratories at the firm's compressor and engine plant in Buffalo, New York.

Called an electrical analog, the Worthington machine is the newest and most advanced of three analogs for this purpose in existence. This machine allows Worthington engineers to create electrical circuit analogies which accurately predict machine and system performance, before design and construction are finalized. Its use is a special service that benefits Worthington compressor customers.

The analog enables engineers to spot in advance vibration patterns that cut efficiency and cause maintenance problems. At the compressor stations, multiple compressors repressurize natural gas being piped to market areas and discharge it back into the main line pipe. Pulsations cause the vibration and wear. To prevent harmful vibrations and pulsations, each stroke of the compressor and the length of each piece of pipe must be carefully coordinated.

Coordination is the job of the analog. Electrical resistors and capacitators take the place of each piece of pipe in the blueprints. Engine speed and the exact relationship of each component from one moment to the next must also be electrically accounted for in the analog.

Once the machine is set and turned on, vibration patterns in the proposed piping produce a wave shape on a panoramic analyzer. Problems can be seen in advance and changes in the plans can be made before costly construction work begins. In the past it was necessary to weld the entire installation together before it was possible to test efficiency.

The Worthington labs study each component of the engines and compressors as well as their overall performance in the field. The new labs, built utilizing existing plant space, contain each major type of industrial engine built by Worthington. Special equipment stands are set up for testing components and results are then applied to the full-scale machines.

Southwest Research of San Antonio, Texas built the first analog in 1955 for the Southern Gas Association. The natural gas industry and heavy equipment manufacturers such as Worthington, which supply machinery to the natural gas industry, contributed to the development. The analog was then made available for use by the participating firms.

However, there is usually a big backlog of projects awaiting the Southwest Research analog. Plans for the analog were also available to member firms and Worthington decided to build its own improved analog. The Worthington machine went into operation last summer before the new laboratories were completed.

### NEAR-PERFECT LIGHT AMPLIFIER

A small electronic tube, developed by scientists at the Westinghouse research laboratories, reaches the near ultimate in the ability to amplify ordinary light. The tube, known as the Astracon, is so sensitive that it makes visible a single electron, released at the tube's input by an individual photon—the smallest unit of quantity of light that exists.

The electronic development was described by Dr. J. W. Coltman, manager of the electronics and nuclear physics department of the Westinghouse research laboratories in Pittsburgh, Pa.

The Astracon tube operates upon a unique amplifying principle discovered at the Westinghouse research laboratories five years ago. The image of an object, so dim that it is invisible to the naked eye, is focused by lenses onto a light-sensitive screen, called a photosurface, at the input end of the tube. The individual particles of light, or photons, arriving from the scene strike the surface and eject electrons from it.

Each ejected electron is then accelerated forward by 2000 volts and strikes head-on into a thin two-layer film, only a few millionths of an inch thick. The front surface of the film is aluminum; on its back surface is deposited a slightly thicker layer of an insulating material. When a high-speed electron crashes into the film, it penetrates into the insulator and releases four or five additional electrons. These are accelerated into a second film, or dynode, where the electron multiplication is repeated.

By using five such steps, a single electron is multiplied into about 3000. These are given a final 20,000-volt boost and are aimed into a thin layer of fluorescent material at the output end of the tube. Here they release 20,000 or more photons of visible light. Thus, if the light striking the input photosurface is in the form of a dim, invisible image, the Astracon exactly reproduces that image on its output, only thousands of times brighter.

The Astracon achieves the ultimate in amplification for now it is possible to see individual electrons, released at the tubes input. Each electron shows up as a separate flash of light. The only way to increase the Astracon's remarkable sensitivity is to increase the probability that an incident photon will release an electron from the input photosurface.

This remarkable ability to record photons makes the Astracon useful in many fields of research. In astronomy it will increase the effective size, or light gathering ability, of the largest telescopes. In nuclear physics it will, for the first time, permit the viewing of the tracks of high-energy cosmic rays and other particles. Until now there has been no practical method for observing these particles as they flash through solid crystals with a feeble glow.

### STAINLESS STEEL IN HEAT EXCHANGERS

More than 19 miles of stainless steel tubing will snake through three intermediate sodium heat exchangers being built for the Enrico Fermi Atomic Power Plant near Detroit to provide electricity to the Southeastern Michigan area.

These units are the largest sodium heat exchangers to be built to date. The shells are 88 inches in diameter of which 16 inches is shielding and nearly 31 feet long; one completely-assembled heat exchanger weighs 130,000 pounds. Cost of the three exchangers has been estimated at about $1,750,000.

Heat is removed from the Fermi nuclear reactor by liquid sodium which circulates through the reactor core and blanket to the heat exchanger. A second sodium system transfers the heat from the exchanger to a steam generator, producing steam which turns a turbine directly connected to an electric generator.

Liquid sodium is a desirable heat transfer medium because it can maintain higher temperatures at lower pressures than water.

One of the unique features of the heat exchangers is a special sine curve put into the Type 304 stainless steel tubes. Each tube—approximately 18 feet long, with an outside diameter of 7/8 inch and an 18 gauge minimum wall thickness—is bent cold on a specially designed machine.

The sine curve, a compound curve required of space limitations and flow direction in the exchanger, accommodates differences in thermal expansion in the tubing. U-shaped curves are common in heat exchangers utilizing ordinary fluids.

The other unique aspect of these units is that the tube bundle can be easily removed from its shell, thus facilitating maintenance work. Most exchanger units in nuclear application are of all-welded, integral construction. Therefore they must be cut apart for repair. In addition to being removable, the bundles have a gasketed joint which separates the primary from secondary sodium fluids. Ten-inch long springs act as load members for setting and sealing this joint.

High standards of cleanliness and non-contamination dictate the use of stainless steel in nuclear equipment. Its high strength-to-weight ratio also permits use of thinner walls, resulting in lower fabrication costs.

Each of the three heat exchangers is designed to transfer 489 million British thermal units per hour at flow rates of 12,500 gallons per minute. In an exchanger, primary sodium coolant flows by gravity from the reactor at a temperature of 900 degrees F through the shell side of the unit to the pump from which it is returned to the reactor at 600 degrees F. Secondary sodium from the steam generator is pumped at a temperature of 520 degrees F through the downcomer in the exchanger, and through the 1860 bowed tubes where it is heated to 820 degrees by the primary sodium. It then returns to the steam generator.

Three primary coolant loops and three secondary coolant loops will be connected to one reactor in the Fermi plant. It is scheduled for startup late in 1960.

*(Continued on page 57)*

ELDOR, SOMETIMES I GET THE IDEA THAT COMPANY RECRUITING REPS ARE EXAGGERATING TO US. DON'T YOU FIND IT THUS?

AS YOU KNOW, ALBRECHT, I HAVE ACCEPTED AN ENGINEERING POSITION PRIMARILY ON THE BASIS OF AN HONEST, FORTHRIGHT PRESENTATION.


THEY SAID THAT I WOULD BE WORKING ON NEW UNCHARTED TRAILS THROUGH THE UNIVERSE... WITH THE ONLY LIMITS THOSE IMPOSED BY MY IMAGINATION.


I WILL LIVE IN AN ULTRA-MODERN ALL ELECTRONIC HOME SNUGGLED AMONG THE PINES AT THE EDGE OF A CRYSTAL BLUE LAKE.


WITH MERELY A DOUBLE GARAGE, ONE OF MY SPORTS JOBS WILL HAVE TO SIT OUT IN THE YEAR-ROUND PLEASANT WEATHER.


THEY TOLD ME EXACTLY WHAT MY SALARY WOULD BE, AND I'LL HAVE TO SET ASIDE (TEMPORARILY) MY PLANS FOR AN OCEAN-GOING YACHT.

AND SO YOU'RE JOINING COLLINS?
YES, ALBRECHT, SUCH HONESTY AS THEIRS SHOULD NOT GO UNREWARDED.

Furthermore, Collins is one of the nation's leading growth companies, producing for both government and business. Commercial fields include airline and business aircraft communication and navigation equipment, data transmission, microwave, amateur radio, broadcast and ground communication equipment. Research, development and manufacturing facilities are located in Cedar Rapids, Dallas and Burbank.

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# ENGINE EARS

*by Larry Hyde ce'62*

### KAPPA ETA KAPPA, YOUR PROFESSIONAL ELECTRICAL ENGINEERING FRATERNITY

Kappa Eta Kappa is a national Electrical Engineering fraternity composed of active chapters at various colleges and universities, alumni associations, and a National Executive Council. It is a service organization, serving the student, the school, and the Electrical Engineering profession.

Kappa Eta Kappa is governed locally for the most part, as each chapter's governing body administers its affairs in accordance with its own and the national Constitution and By-laws. The National Executive Council, which is elected each year at the annual convention of the fraternity, administers the national affairs of the organization and supervises the local chapters.

Membership in Kappa Eta Kappa, since it is a professional fraternity, is limited primarily to electrical engineering students. This is further outlined in excerpts from the National Constitution. Membership in Kappa Eta Kappa is not in any way affected by association with any other fraternity, social or honorary; in fact, we, of Kappa Eta Kappa, are proud of our members who are also members of honorary organizations and the part they have played in making these organizations what they are.

Delta chapter's fraternity house is located at 204 N. Murray Street here at the University of Wisconsin, conveniently near the Wisconsin Union, library, lower campus, and the engineering buildings. The members have a variety of social functions including banquets, picnics, and house parties. As an aid to obtaining a well integrated education, KHK has a regular speakers program with authorities in such fields as law, medicine, religion, economics, and engineering. KHK is one of the most active fraternities in the engineering school and each semester places men in positions of importance to the entire engineering school. Its men are prominent participants in St. Pat's campaigns, AIEE and IRE, Polygon Board, EE building tours, and the Engineering Exposition. Also, KHK's pledge training program is held to a sane and educational level befiting any professional fraternity.

Membership in Kappa Eta Kappa offers several advantages. The first is the opportunty to develop the ability to meet new people with ease and the second is the opportunity to make new friends. Both of these are offered in any organization but in Kappa Eta Kappa they have more meaning, for these friends are men of your profession with whom you have common interests and with whom you will be in contact the rest of your life, professionally and socially.

This relationship of men with common interests also has another advantage. You have the opportunity to discuss any problems you might have with men who have had similar problems. Whether you are in school and the problem is academic or whether you are in the professional world and the problem concerns a decision about a new piece of equipment, knowing people who have faced the same or similar problems and who are happy to make your problem theirs, is a great asset.

In the field of leadership development, Kappa Eta Kappa offers other advantages. Men with natural leadership traits are encouraged to develop and use these abilities, and men whose qualities for leadership have not been tested are given more opportunities to develop them. Nearly every fraternity offers the above advantages but in KHK, leadership is directed toward professionalism, service, and integrity.

In summary, Kappa Eta Kappa has a plan for every man who becomes a member, a plan of living together that helps men learn how to get along with other people, to assume leadership naturally, and to accept the social obligations that every educated person has for the preservation, welfare, and growth of our nation.

Men who live and study within the walls of a Kappa Eta Kappa house leave upon graduation with qualifications they never could have had without their opportunity of membership in our fraternity.

### A. F. S.

The American Foundrymen's Society is an organization composed of students interested in the foundry industry. The meetings are generally held on the first or second Tuesday of the month at 7:30 P.M. in the Mining and Metallurgy building.

Mr. Joseph Vinette of Evinrude Motors was the speaker at the last meeting. He gave a very interesting talk on "Troubleshooting in the Outboard Industry" and illustrated his point by showing some crankshafts cast at Evinrude. After the talk Professor R. W. Heine invited any interested members to go along on a field trip to Grede Foundries in Reedsburg. About fifteen members subsequently made the trip.

Following the meeting refreshments were served.

### A.I. CH. E.

The A.I.Ch. E. welcomes back the 'old timers' and extends a special welcome to those new on the U. W. scene. The American Institute of Chemical Engineers is a student branch which eventually leads to the professional organization. The chemical engineer who joins as a student can defray some of the costs of joining the professional society after graduation.

The program for the year has not been completely formulated. However, it will include the following. Meetings will be held once a month with a program which will include either a speaker or a movie, followed by beer and chips. The speakers are representative of the various jobs to which a chemical engineer may be assigned. Any person who is indefinite about a career in chemical engineering may find the kind of opportunities which he is looking for and thus set his goals as a chemical engineer.

A picnic is also planned for the spring. Something new which is pending this year is a banquet in connection with the St. Pat's Dance. It will depend upon the participation in the society.

The dues are $2.00 for the year and one can join at any time. The society provides an opportunity for the freshmen to meet upper classmen and gain hints about instructors and classes, and to meet professors and representatives of industry.

### U.W. FLYING CLUB

The University of Wisconsin Flying Club is looking forward to another busy year. Members now have two fine aircraft to use when they want to get away from classes for a while. Last May the club purchased their second Cessna 120, a two-place, side-by-side, 85 horsepower aircraft.

Club members can now use two different types of radio navigation systems on cross-country trips. One plane is equipped with a VHF omni-range radio for navigation. The other has a LF (low frequency) radio for navigation either by following government-operated radio beams or by using a loop antenna to establish fixes on broadcast stations. Both planes have VHF transmitters for communication with airport control towers and airways control centers. Clyd Beasley, a physics instructor, flew one of the Cessna 120s to New Orleans last May on a five-day trip and reported excellent reception by the LF receiver.

Since last May the club's planes have been based at Truax Field. Since two-way radio is required at Truax Field, members have become thoroughly familiar with air traffic control procedures. Our present locations also means that operations will not be restricted during winter and spring months because of poor runway conditions.

Currently the club has forty active members, including five faculty members. Most are student pilots, with about ten members holding either commercial or private pilot ratings. Meetings are held usually the second Tuesday of every month in the Union. Interested students, faculty members, or University personnel are invited to attend. If you have questions call Dave Hotchkiss at Al 5–6438.

### SOCIETY OF AUTOMOTIVE ENGINEERS

The student section of the Society of Automotive Engineers at Wisconsin is open to students from any branch of engineering, mechanical, electrical, etc. Membership dues are $4.00 for the entire school year. The cost includes monthly issues of the SAE Journal mailed direct. Attractive gold and green lapel pins are available for 50¢.

The activities of the senior branch are not exclusively devoted to automobiles as the name Society of Automotive Engineers might imply. The entire field of transportation by land, sea, and air is covered as well as the field of lubrication.

New last year is a job placement service run free of charge by the senior branch enabling student section members to find summer engineering jobs as well as permanent positions.

Some highlights of last year were the two compact car lectures on the Falcon and Corvair, the field trip to the American Motor's proving ground at Burlington, Wis., and the annual picnic where four compact cars were borrowed from local dealers for members to drive. Free beer and chips were served at all the meetings of course. At some of the meetings a supply of SAE technical papers was passed out free to members with no limit to the number an individual could have.

Among the things in the works for this year is an overnight trip to the General Motors Proving Grounds at Milford, Michigan. It is still not definite, pending the approval of G. M. officials and the faculty. The compact car lobby displays last semester were an activity of the SAE and more are planned for this year.

Further information on the SAE can be obtained by contacting any of the officers, a list of whom is on the SAE bulletin board in the ME building lobby.

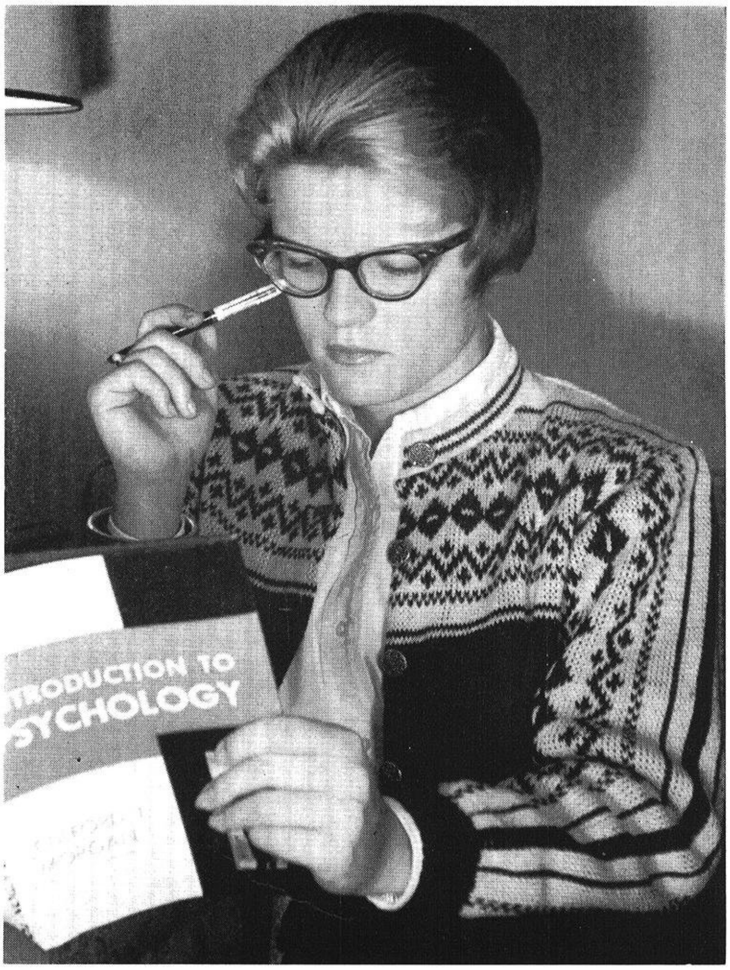
### TRIANGLE FRATERNITY

Triangle, carries on a social program which is adjusted to the spare time of its engineering members. Parties are held after football games and approximately every two weeks thereafter. Extracurricular activities include participation in volleyball, football, softball, basketball, and bowling, membership

*(Continued on page 50)*

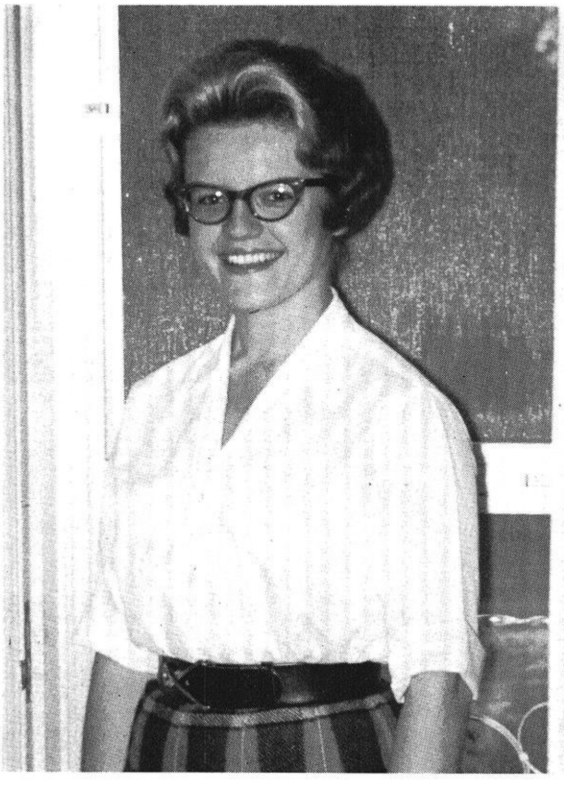
# GIRL OF THE MONTH

## Nancy Johnson




Don't let the book on psychology scare you for Nancy may be studying the psychology of getting herself a man, an engineer.

**Photos by Walter Ronn**



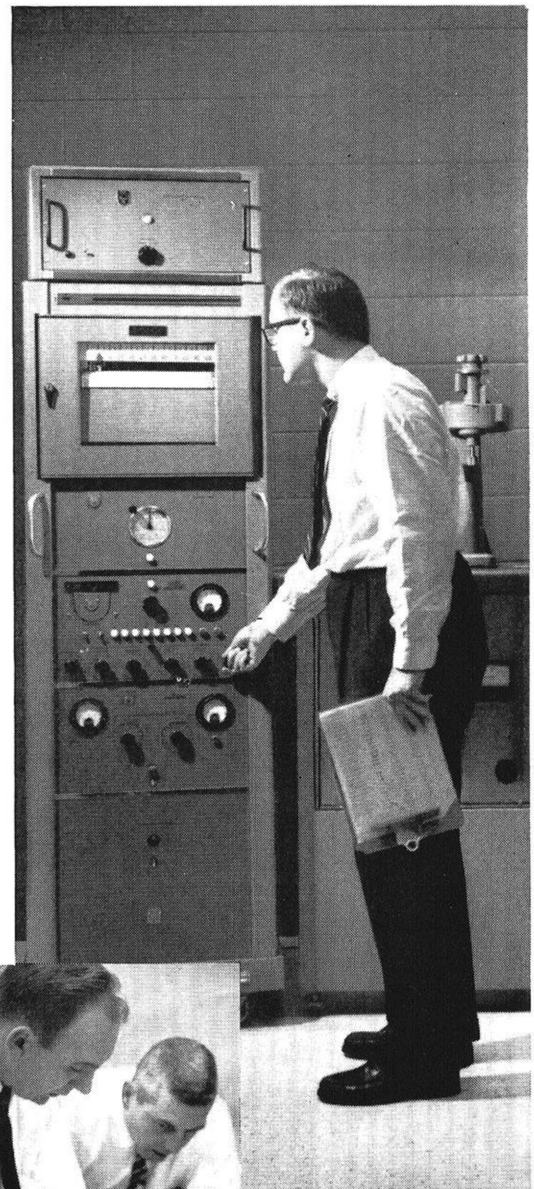
# Facts about chemical industry growth that can be important to your future career

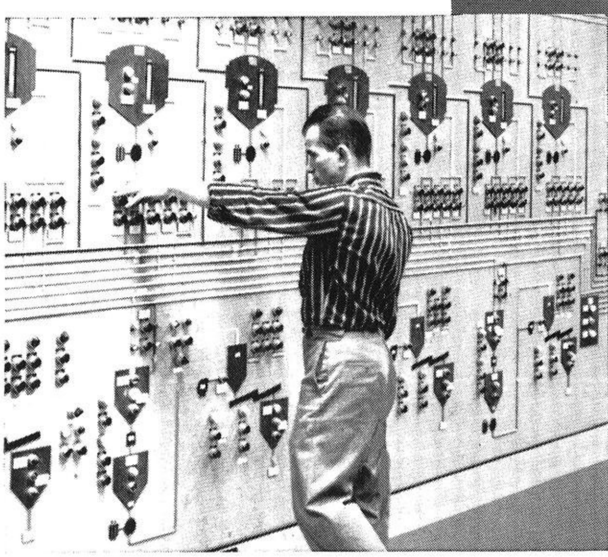
Did you know that the chemical industry has grown at a rate of about 10% per year since 1929, as compared with only 3% for the economy as a whole? It's a fact! And there's every reason to believe that this favorable growth rate will continue.

For the graduating chemist or chemical engineer, this spells opportunity. Opportunity to grow with a growing industry.

Allied Chemical, for example, now produces more than 3,000 diversified chemicals at over 100 plants throughout the country. Many of these products are basic—used in volume by almost every industry. Allied is at the heart of the nation's economy and looks forward to continued growth and stability.

Ask our interviewer about career opportunities at Allied when he next visits your campus. Your placement office can give you the date and supply you with a copy of "Your Future in Allied Chemical." Allied Chemical Corporation, Department 106-R1, 61 Broadway, New York 6, New York.





**DIVISIONS:**

BARRETT • GENERAL CHEMICAL
INTERNATIONAL • NATIONAL ANILINE
NITROGEN • PLASTICS AND
COAL CHEMICALS • SEMET-SOLVAY
SOLVAY PROCESS

Allied Chemical

**BASIC TO AMERICA'S PROGRESS**

## Powder Metals

*(Continued from page 15)*

Modern briquetting techniques require briquetting pressures in the range of 40,000 to 80,000 psi with 20,000 psi being the lowest limit for briquetting and 200,000 psi being the upper limit. To obtain the briquetting pressures, three types of presses are used: (1) mechanical, (2) hydraulic, and (3) mechanical-hydraulic.

Mechanical presses usually operate in the lower pressure ranges and utilize their fast action for high production rates in the range of 40 parts per minute. The mechanical press operates to a certain stroke length and thus produces a part of uniform volume. Capacity ratings for these presses are in the range of 150 tons.

Hydraulic presses are not noted for their speed, but for the high pressures they can develop. Unlike mechanical presses, the hydraulic press operates to a set pressure and, therefore, the hydraulic press produces a part of uniform density. The capacity of these presses range from 150 to 5,000 tons while producing only 10 parts per minute.

Mechanical-hydraulic presses combine the features of both mechanical and hydraulic equipment. Production rates are around 20 parts per minute.

### Pre-Sintering

Pre-sintering is done before the final sintering for many parts. This is done in the sintering furnaces at temperatures below the final sintering temperature in order to increase the strength of the briquette for handling or to remove lubricants or binders added to the powders during the blending operation.

### Sintering

Sintering is the operation where the powdered metal part gains its strength and properties. To accomplish this, the briquettes are heated to a temperature below the melting point for a pure powder or to a temperature below the melting point of the major part of a mixture. By keeping the part at the right temperature for a proper period of time, bonding of the particles is accomplished by atomic diffusion between particles. Sintering times are determined by the composition of the powder and the properties desired.

Sintering produces a metal structure that is similar to a sponge. This type of structure contains approximately 20 per cent void space, and it imparts the chief characteristics of powdered metal parts—self-lubrication, low coefficient of friction, and minimum wear.

Sintering is accomplished in high volume, continuous furnaces. Because of the large exposed areas of the briquettes, the sintering furnaces contain controlled atmospheres for protection against oxidation and other chemical reactions.

### Additional Finishing Operations

Many parts may be used directly after the sintering operation, but if surfaces or metal structures are desired which could not be obtained by briquetting additional finishing operations must follow. These operations include coining and sizing, machining, impregnation and infiltration, plating, or heat treatment.

When a part is required to be dimensionally correct, the sintering operation is followed by a sizing operation. In this operation, the part is placed in a die which is designed to meet the required tolerances, and it is repressed.

When a density increase is desired to improve the strength characteristics of the part, a coining operation is used. In this operation, the part is repressed in a die to reduce the void space of the part to the proper proportions. After the pressing, the part is usually resintered for stress relieving.

In many cases, the sizing and coining operations are combined in the same die.

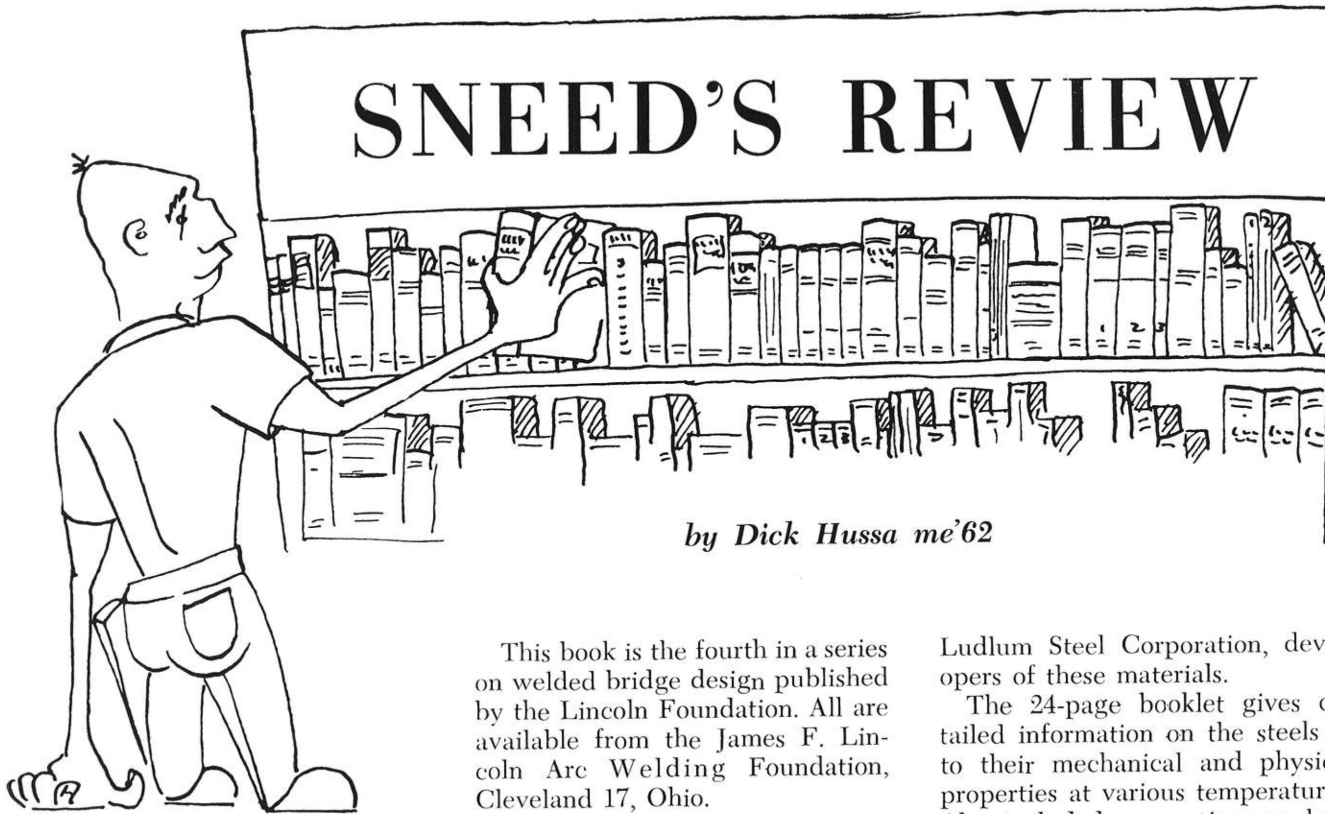
A machining operation must follow sintering for parts that require surfaces or shapes which cannot be pressed. Such surfaces are grooves, threads, undercuts, and tapped holes. Because of the porosity of powdered metal parts, the machinability is generally considered poor, but if dead-sharp tungstun carbide tools are used along with high speeds and fine feeds, the machining of powdered metal parts is no problem. The dead-sharp tools prevent the closing of the metal pores which would reduce the self-lubricating property of the part. Coolants are very important in the machining operation. Water or cutting oils are not recommended since they cannot be removed easily from the porous structure and cause internal corrosion to the part. Volatile coolants like carbon tetrachloride are used during machining since they can be removed by heating the part after the machining operation.

Where self-lubricating properties are desired, the parts are impregnated with oil, grease, wax, or other lubricating materials. In the process, the parts are placed in tanks of lubricants heated approximately to 200°F. The porous structure is completely impregnated after a period of 10 to 20 minutes. The lubricant is retained in the part by the capillary action of the pores until external pressure or heat of friction draws it to the surface.

Infiltration of sintered parts by a lower-melting-point metal increases the weight of the part, improves the machinability of the part, improves the anti-friction properties of the part, or increases the strength and ductility of the part. The infiltration process may either come after the pre-sintering operation or after the full sintering of the part. For this process, the infiltrant metal is pressed into the form of rings or slugs which are placed on the briquettes. The size of these forms is calculated to provide the proper amount of infiltrant to fill the voids in the part. With the infiltrant form in place, the briquettes are placed in the sintering furnaces and heated to a temperature slightly above the melting point of the infiltrant. By using the proper temperature and time, the infiltrant will diffuse throughout the porous structure of the part.

Plating of powdered metal parts is done to provide a pleasing appearance or provide corrosion resistance. Procedures for plating powdered metal parts are quite different than those used for wrought metals due to the porosity of the metal structure. Any electrolyte which is entrapped in the porous structure will cause internal corrosion which will lead to failure

*(Continued on page 42)*




# SNEED'S REVIEW

*by Dick Hussa me'62*

### WELDED INTERSTATE HIGHWAY BRIDGES

**The James F. Lincoln Arc Welding Foundation**
**Cleveland 17, Ohio**

**269 pages. $2.00**

The James F. Lincoln Arc Welding Foundation has published a new book of welded bridge designs which comprise a review of current practice on the Defense and Interstate Highway System. The designs, recipients of awards in the Lincoln Foundation's recent design competition, are reviewed with written discussions and drawings abstracted by the editor, James Clark, from the author's original comments and drawings. Fourteen designs are presented in sufficient detail to cover all of the significant aspects of each. The types of designs reviewed include examples of continuous, simple and cantilever plate girders; two-hinge and three-hinge arches; conventional and orthotropic plate box girders; and double leaves bascule. 200 of the 269 pages are drawings and photographs, bound with a hard, board, gold stamped cover.

The book will be helpful to designers planning highway structures and will be a considerable aid in reducing costs.

This book is the fourth in a series on welded bridge design published by the Lincoln Foundation. All are available from the James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

### MOTOR SELECTION AND APPLICATION

**By Charles C. Libby**
**Published by McGraw-Hill**

Charles C. Libby, Electrical division, Fairbanks, Morse & Co., located at Freeport, Illinois, is the author of a new book entitled "Motor Selection and Application," which deals with motor selection for specific industrial services in terms of load characteristics, service requirements, space limitations, duty cycle requirements, and safety.

Mr. Libby has organized and condensed a wealth of information without involving the reader in advanced mathematics or electrical theory. This book was commissioned in 1957 to fill the need for an electrical engineering text for mechanical, civil, industrial, and chemical engineers. It is also expected to provide reference material for plant managers, mechanical designers, or students to whom motor selection rather than design is of prime importance.

### BOOKLET ON AIRCRAFT STEELS

**By Allegheny Ludlum Steel Corporation**
**Oliver Building**
**Pittsburgh 22, Pa.**

A new booklet on the aircraft steels AM-350 and AM-355 is now being distributed by Allegheny Ludlum Steel Corporation, developers of these materials.

The 24-page booklet gives detailed information on the steels as to their mechanical and physical properties at various temperatures. Also included are sections on heat treating, fabrication, including forming, forging, welding, brazing, and machining. Numerous tables giving detailed data are included.

While most of the current production of these two steels goes into the aircraft and missile fields, both AM-350 and AM-355 can be used for other applications, including flat and coiled springs, corrosion resistant fasteners, dental and surgical equipment, saws and saw blades, piston rings, glass molds, and pump and camera parts.

A copy of the booklet can be obtained by writing to the Advertising department, Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania.

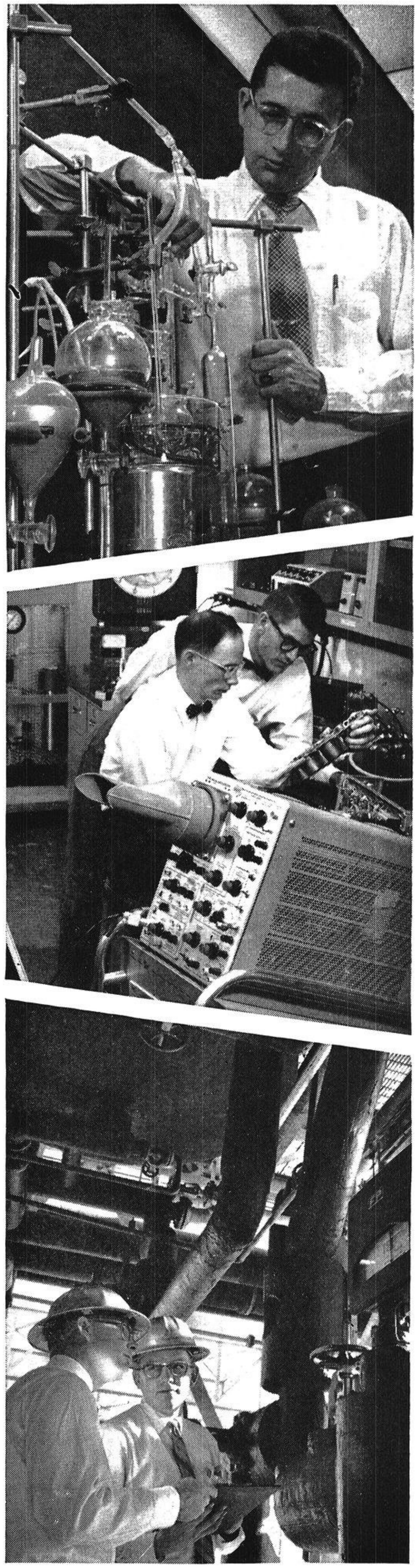
### HANDBOOK OF FILTRATION

**The Eaton-Dikeman Company**
**Mount Holly Springs, Pa.**
**124 pages. $2.50**

This handbook is the first known text devoted exclusively to the subject of paper filtration. It is designed for use as a college reference book and for use by laboratory technicians and process engineers. A non-commercial manual, it summarizes data acquired over many years by the technical staff of its publisher. In several chapters, notably those on retention and per-

*(Continued on page 55)*

# Why college men choose careers with Du Pont



Every year, several hundred new college graduates choose Du Pont. Many Masters and Ph.D.'s do, too.

From time to time we learn from recent graduates the factors which led to their decision to join this company. They cite more than half a dozen reasons. Here are four of the most important:

## OPPORTUNITY AND RECOGNITION

**They were aware that college-trained beginners go right to work with men who have achieved.**

For example, research chemists work with individuals who've done successful research. New engineers work with pros, some of whom have designed new plants, or devised new manufacturing methods, or distinguished themselves in some other way. And other graduates, with B.A. or M.B.A. degrees, go to work with leaders who've been successful in Sales or Advertising or Treasurer's, or another of Du Pont's many departments.

They had been told—and rightly—that Du Pont rewards individual achievement. And they were eager to start achieving.

## RESEARCH CREATES NEW PRODUCTS; NEW PRODUCTS CREATE NEW JOBS

**Men like working for a company that believes in research, enough to invest in it... $90 million a year!**

The fact is that important new products come from Du Pont laboratories and go to Du Pont manufacturing plants with frequency.

Here are but a few since World War II: "Orlon"* acrylic fiber followed nylon (soon after the war). Then came "Dacron"* polyester fiber, "Mylar"* polyester film, "Lucite"* acrylic lacquer and "Delrin"* acetal resin.

These, and many others, have created thousands of new jobs... in research, manufacturing, sales ... in fact, in *all* Du Pont departments.

## DU PONT BACKS EMPLOYEES WITH HUGE INVESTMENT

**New graduates feel that every facility is provided for doing the job well.**

Last year, Du Pont's operating investment per employee was $32,500. Since much of this was expended to provide the most modern and best of equipment to work with, it further increases the chance for individual achievement.

This applies to men in lab, plant and office.

## DU PONT PROVIDES STEADY EMPLOYMENT

**Career seekers appreciate the importance of security.**

Today, the average annual turnover rate at Du Pont is less than one-third that of industry nationally.

• • •

These, and many other reasons, draw new talent to Du Pont each year.

Prospective graduates, M.S.'s and Ph.D.'s interested in learning more about job opportunities at Du Pont are urged to see their Placement Counselor, or to write direct to E. I. du Pont de Nemours & Co. (Inc.). They should tell us the course they are majoring in so we can send literature that is most appropriate.

DU PONT
REG. U. S. PAT. OFF.

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

* REGISTERED DU PONT TRADEMARK

## Powder Metals

*(Continued from page 38)*

of the part. Porosity must be eliminated. Prior to plating, the part may be infiltrated with another metal or impregnated with a suitable plastic resin. After the porosity is eliminated, the usual plating procedures for wrought metals may be followed.

Powdered metal parts are heat treated to improve grain structure and improve strength and hardness. All conventional methods of heat treatment that can be used for wrought metals may be also used for powdered metal parts. Care must be given to several steps of this process. Since porosity decreases the heat conductivity of the part, longer heating periods are required while shorter periods for quenching are required to produce good results. Heat treatment must be carried out in controlled atmospheres to prevent oxidation due to the large areas of the parts open to the furnace atmosphere. Heat treatment is carried out in the same furnaces used for the sintering operation.

### ADVANTAGES AND DISADVANTAGES OF THE POWDERED METALS PROCESS

A comparison between the powdered metals process and other manufacturing processes is difficult to make without a comparison of the type of parts to be made. However, several general advantages and disadvantages may be stated.

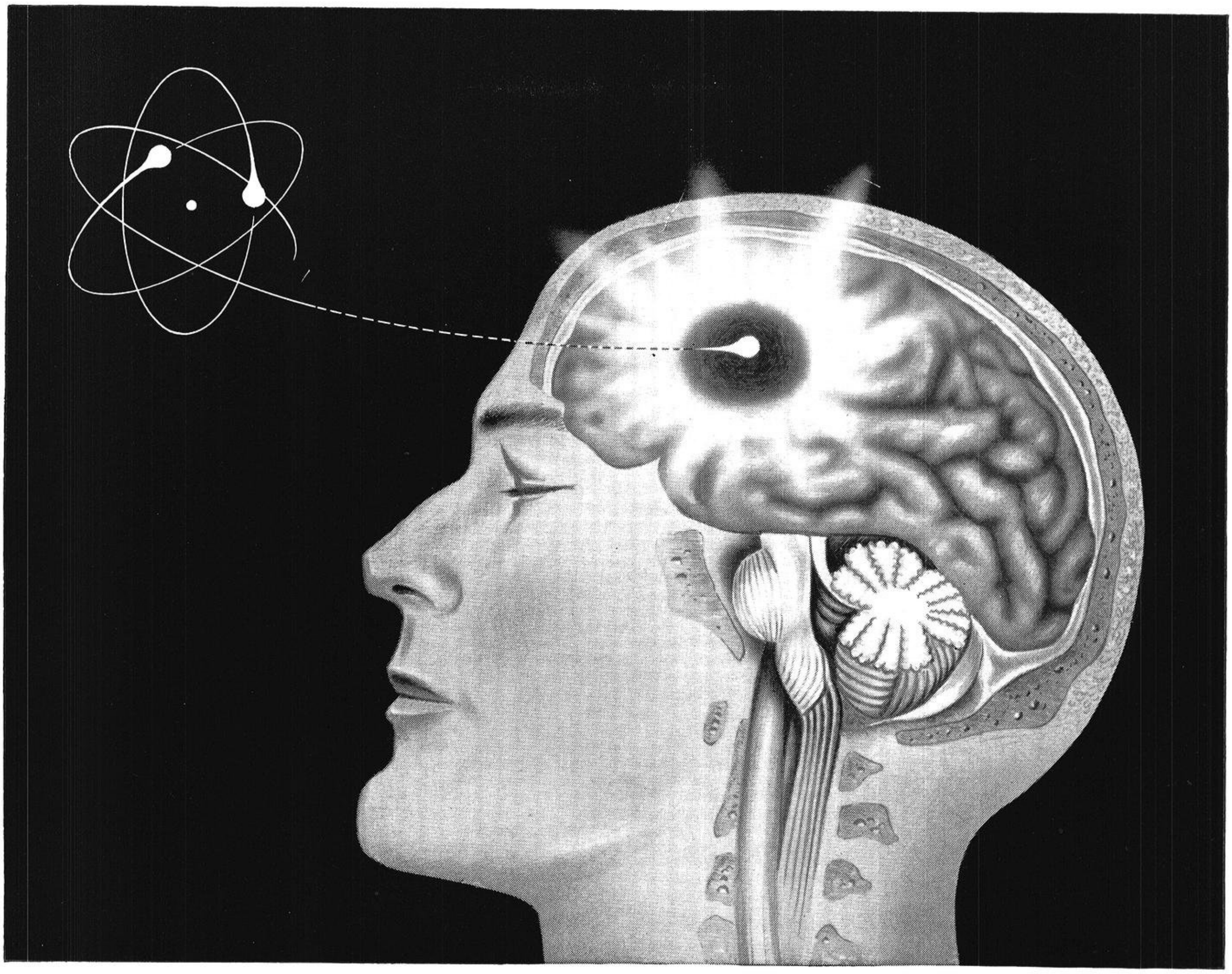
The advantages of the powdered metals process may be listed as follows:

1. High production rates with low scrap loss can be obtained due to the elimination of machining operations and by the use of only the proper amount of metal powder for the part.
2. Close tolerances can be obtained by sizing and coining operations.
3. Parts can be produced with properties that cannot be obtained by any other process by blending various metal powders and non-metal powders.
4. Good control of purity and porosity in the parts can be obtained by the powdered metals process.

The disadvantages of the powdered metals process may be listed as follows:

1. Parts with very complex designs cannot be made without difficulty.
2. Since the initial cost of process equipment is high, only high volume production is financially practical.
3. The physical properties of powdered metal parts are lower than wrought parts due to the porosity in the parts.
4. Material costs are higher than wrought metals because of the costly methods of powder manufacture.

**THE END**



# Boron-10 vs. brain tumors

**Physicians and scientists** working in cancer research at Brookhaven National Laboratory, Upton, N. Y., are probing the use of Boron-10 isotope in treating a common type of brain tumor (glioblastoma multiforme).

Results of this therapy are so encouraging that Brookhaven and at least two other institutions are constructing additional nuclear reactors used in this therapeutic venture.

**The method.** In a technique known as Neutron Capture Therapy, the patient receives an injection of a Boron-10 compound. Cancerous tissue absorbs most of the neutrons.

In the split second that the Boron-10 becomes radioactive, it produces short-ranged alpha particles which destroy cancerous tissue with a minimum of damage to healthy tissue.

**Producing the isotope.** The plant furnishing Boron-10 to Brookhaven ordinarily turns out about three pounds during a 24-hour work day. Separation of the isotope takes place in what is described as "the world's most efficient fractionating system." In 350 feet of total height, six series-connected Monel* nickel-copper alloy columns enrich a complex containing 18.8% Boron-10 isotope to one containing 92% Boron-10.

**Purification.** To purify the 92% concentrate, a whole series of complicated processing steps are needed . . . including deep freeze. Columns, reboilers, condensers, vessels, pumps, and piping abound—each a constant challenge . . . both to the metal and to those concerned with equipment design and operation.

**How would you meet such challenges?** Some problems, of course, were unique and demanded ingenuity of a high order. But answers to most, 90% or more, could be found in the vast "experience bank" maintained by Inco . . . some 300,000 indexed and cross-referenced reports of metal performance under all manner of conditions.

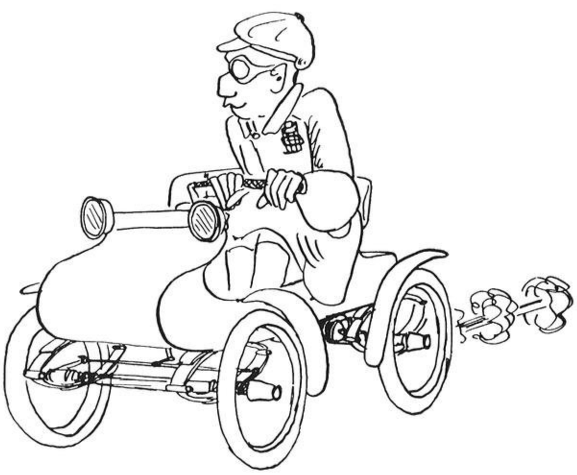
**Make a mental note:** (1) that The International Nickel Company is a rich source of information on high-temperature and corrosion-resisting alloys; (2) that Inco makes this experience available to you.



The International Nickel Company, Inc.
New York 5, N. Y.

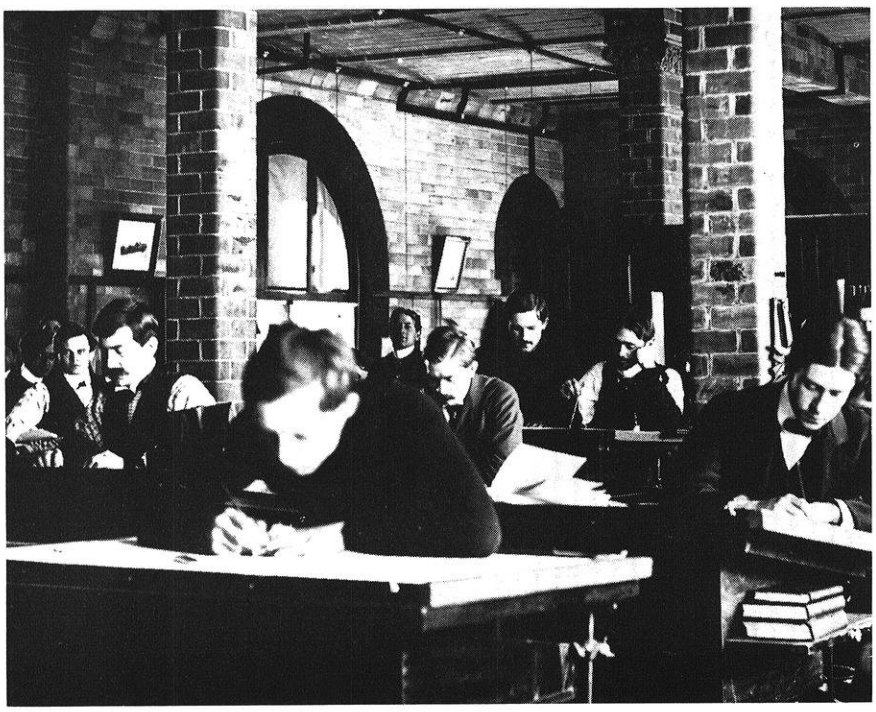
## International Nickel

The International Nickel Company, Inc., is the U. S. Affiliate of the International Nickel Company of Canada, Limited—producer of Inco Nickel, Copper, Cobalt, Iron Ore, Tellurium, Selenium, Sulfur, and Platinum, Palladium and Other Precious Metals.



# THE ENGINEER OF YESTERYEAR

*by Joellen Fisher ce'62*



Mechanical Drawing Class 1896.

**June, 1896**

PROFESSORS Snow and Austin of the Physics Department have been doing much successful work with the "X" rays. Since the early experiments in the general line now so familiar to all, in which many fine negatives of special value were obtained, they have been investigating along the line of the rays. Besides the reflection through tubes and from pieces of metal placed behind photographic plates, experiments have been tried with the Crookes' tube placed in the focus of a parabolic reflector from a locomotive headlight. The fluorescent screen glowed faintly but certainly, when placed in front of the reflector when the direct radiation of the tube was entirely cut off. With a plain metal mirror behind the tube instead of the parabolic, no evidence of reflection great enough to excite the screen was found. This may perhaps be taken as an indication that the reflection is at least in part regular. Unsuccessful attempts have been made to repeat the experiments described by Becquerel (Comptes rendus, March 2, 1896) on some invisible radiation given out by fluorescent substances, which are capable of traversing bodies opaque to ordinary light. Though these experiments have been amply verified elsewhere, the results here have been negative. The salt used was uranium nitrate. A photographic plate was exposed to its influence for twelve hours, the salt being a part of the time in direct sun light. A new Edison screen of calcium-tungstate has been obtained with which better results in reflection are expected. They are now engaged on the diffraction of the rays.

## A COURSE IN ARCHITECTURE

**July, 1897**

Should the university have a course in architecture? After talking with several architects and with some of the university professors, we have decided that the university should have a school of architecture but not for several years to come. There are good schools at Cornell, Columbia, Boston Tech., and Illinois, also at several other institutions of learning. The large number of poor, unschooled architects practicing the profession is a good indication that there is room for a still larger number of educated men. The College of Engineering offers a splendid opportunity for the architectural student to study engineering principles. The architect of today is becoming more and more an engineer, as is shown by the work on modern business blocks and other large buildings, where it is often the case that nearly the entire structure is planned by the engineer who turns his work over to the artist to make it pleasing to the eye.

In residence work, however, it is more a question of art than of engineering, and the student of architecture should be educated in an atmosphere of art to be successful from a decorative standpoint. Madison is lacking here and this is a great drawback to the student of architecture. While it is possible to make inspection trips to art centers as do the engineers to engineering centers, still the inspection trip is of more importance to the architect and should be almost continuous if he intends to specialize in the more artistic line of work.

Considering the question from the financial standpoint we are not yet ready to establish such a course. We must first have an engineering building and let it be made large enough to accommodate a school of architecture when the time for its establishment arrives.

(Editor's note—63 years have gone by, 4 engineering buildings have been built, and we're *still* waiting. Are we going to have to wait another 63?)

### COAL DUST ENGINES

### 1929

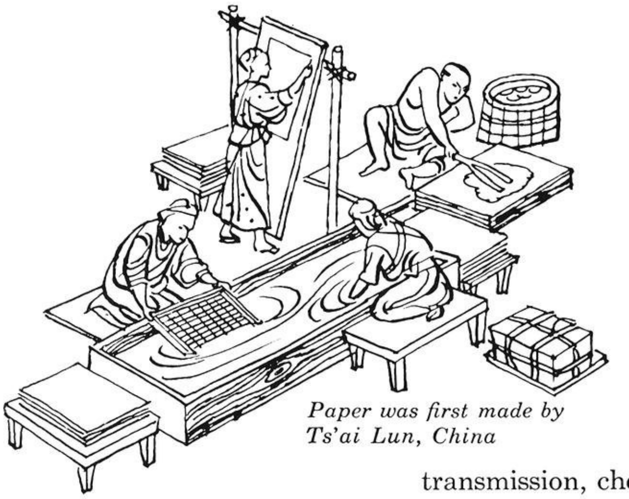
The successful operation of the Pawlifowski powdered coal engine proves that Doctor Diesel's original patent on the internal combustion engine was sound, even though he was forced to turn to oil for satisfactory operation. That the two engines now using coal dust at Gorlitz, Germany, are beyond the experimental stage is attested by impartial American engineers who have seen the machines in action. The original unit was a single cylinder machine, 16.5 inches by 25 inches and rated at 80 horsepower. To this has been added a three cylinder unit of 180 horsepower capacity. In operation of the engine, coal is fed into a hopper which is heated by the exhaust gases to dry the coal. From the hopper this coal is fed to a grinder, where it is pulverized until 80 per cent of it will pass a 100 mesh screen. A blower then conveys the crushed coal to a separator above the cylinder head, where the coarser particles are returned to the grinder. The finer particles are kept in suspension by the air currents until they are deposited in the feed hopper immediately above the cylinder head. From the hopper outlet the coal dust is conveyed to the fuel valve by a screw conveyor. The engine is provided with a second conveyor to carry the excess fuel back to the hopper outlet, thus providing a constant stream of fuel over the inlet valve. The speed of the conveyors is such that the fuel is kept well mixed with air. The fuel valve is the most ingenious part of the whole layout. It consists of a double valve, with an outlet to the air provided for insuring no more than atmospheric pressure in the combustion chamber when the fuel is to be injected into an auxiliary chamber connecting with the clearance space of the engine. The action described, and the closing of the relief port to the atmosphere, followed by the injection of fuel to the auxiliary chamber, takes place during the suction stroke of the engine, and the entire fuel valve is closed when compression begins. Just before head end dead-center on the compression stroke, a fuel valve injects a minute quantity of fuel oil into the auxiliary chamber, and at the same time an air valve is opened and the mixture of coal and oil is injected into the cylinder proper by the air blast. The ignition of the oil insures the ignition of the coal charge. The combustion proceeds as in the oil Diesel, and the piston moves on the power stroke. At approximately bottom dead-center, the hot gas ports to the coal drier are opened, and air from a scavenging pump is directed across the piston to clear it of ash. It has been found that this scouring is not needed, and that ash is kept off the piston through the use of more lubricating oil which is later reclaimed. On the exhaust stroke air is blown through a port higher in the cylinder to scour the ash off the piston and force it through the exhaust ports. The success of this engine is due chiefly to the design of the fuel inlet valve and the use of a small charge of oil to insure ignition. In former designs, the fuel caked about the inlet valve and refused to enter the cylinder, but this is eliminated by the constant flow of coal dust and air mixture.

### ELECTROPLATING ON ALUMINUM

### 1912

The wide-spread use of aluminum in the mechanic arts in recent years has given rise to a problem which is still unsolved, that is, a reliable method of electroplating on aluminum. There are various reasons that make the solution of the problem of general commercial interest. It is often desirable to protect aluminum from mechanical wear by a coating of some harder metal, sometimes the corrosion which occurs under certain conditions must be prevented, and occasionally a plating of some more beautiful metal would add materially to the saleable quality of the manufactured articles. Then, too, the process known as spot welding cannot be used on aluminum, but could an adherent plating of some other metal be given to aluminum, this method of welding could be readily employed.

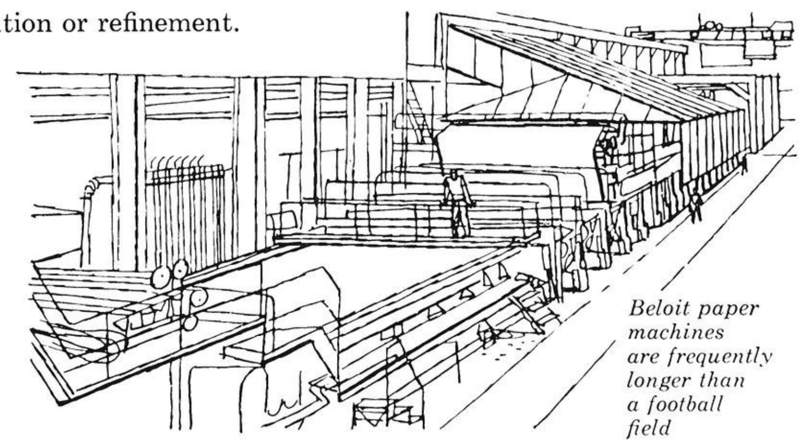
While it is easy to deposit coherent films of various metals on aluminum by the electric current, these deposits do not adhere well to the underlying metal, but blister or strip off, either in the process of polishing or in subsequent use. This action is so characteristic of all electro-deposition on aluminum that one method of preparing thin sheets of various metals is to electro-plate the metal on an aluminum cathode, and strip off the sheet when it has attained the desired thickness. The cause of this poor adhesion is a film, generally considered to be the oxide, on the surface of the metal, and in the preparation of the aluminum for receiving the deposit especial attention is usually given to securing the removal of the film. Another factor, not generally mentioned, but which the writer believes contributes to poor adhesion on aluminum is its high potential in comparison with that of the metals which are deposited on it. In many cases this results in the deposition of metal by mere immersion of the aluminum in the plating bath, without the application of any external electromotive force. Since such deposits are caused by the dissolving of a quantity of the metals receiving the deposit equivalent chemically to that deposited, it is to be expected that such deposits will be less adherent than upon metals which do not receive a deposit by immersion.



*Paper was first made by Ts'ai Lun, China*

What's going on here? Papermaking!—but you needn't know a single *thing* about the process—that is, to *start* with. What *we* want to know is, can you demonstrate engineering proficiency in any of these fields: mechanical engineering, electrical engineering (with mechanical interests), vibration, fluids, balance, noise control in sound levels, power transmission, chemistry of papermaking, machine design, controls, structures, thermodynamics, lubrication, stress, and instrumentation?

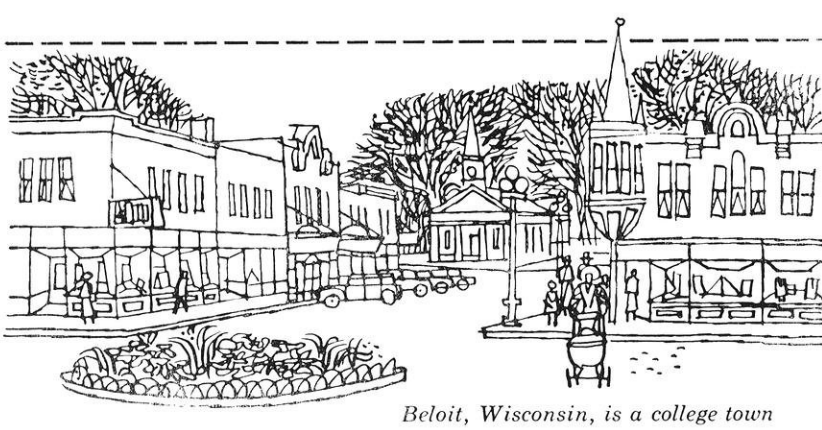
If engineering is your field, you may find a real challenge at Beloit Iron Works—where the *world's largest papermaking machines* are designed and built. In the papermaking field, there is scarcely a branch in which Beloit hasn't broken a record or introduced an engineering innovation or refinement.



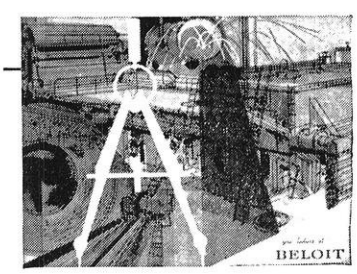
*Beloit paper machines are frequently longer than a football field*

Beloit engineering—since 1858—has set standards for papermaking around the world. Beloit also manufactures machines and equipment in Pennsylvania, Massachusetts, England, Japan, Italy. As for the community, Beloit, Wisconsin, is a place of pleasant dwellings and modern shopping facilities. It's also the home of Beloit College. It's located in the heart of the Midwest's lake and recreational region. Let us tell you more.

## send for brochure: "Your Future at Beloit."



*Beloit, Wisconsin, is a college town*




For interview appointment date consult your **College** Placement Director—or send for brochure:

Beloit Iron Works, Personnel Division,
Beloit, Wisconsin

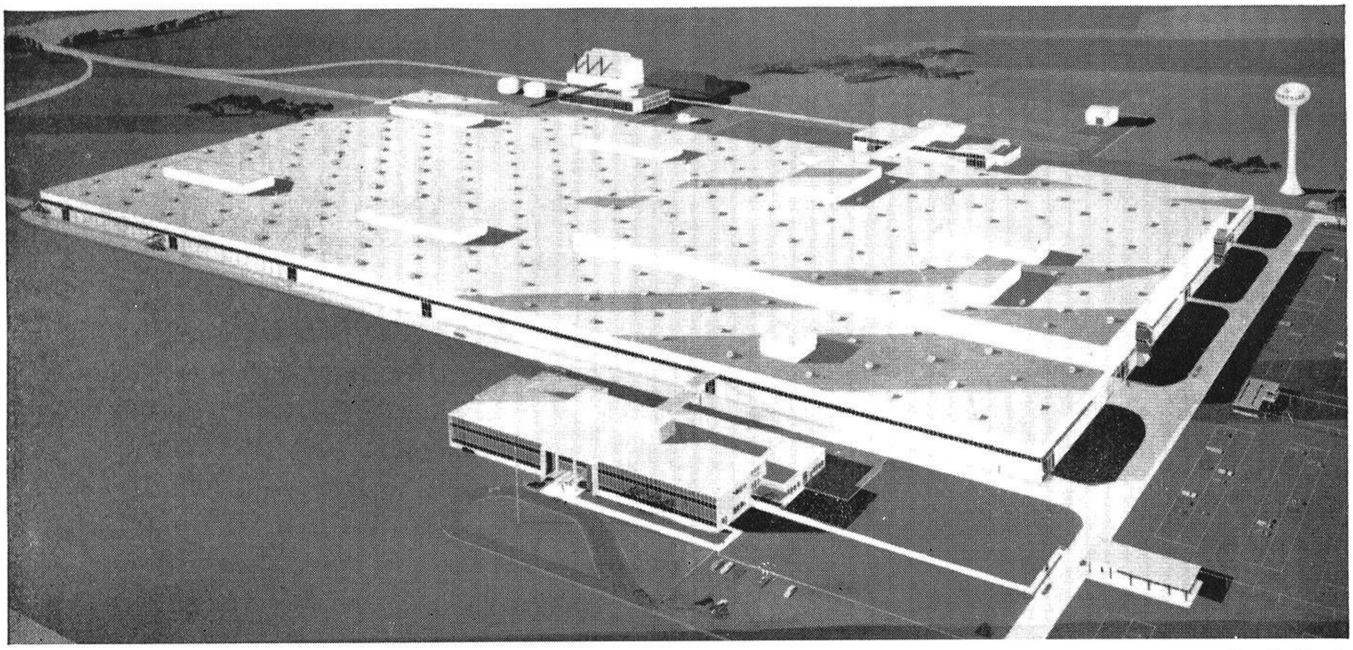
Please send me illustrated "Beloit" brochure

Name____________________

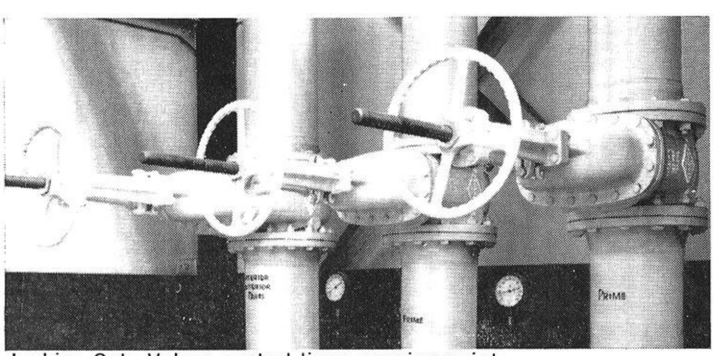
School____________________ Date of graduation

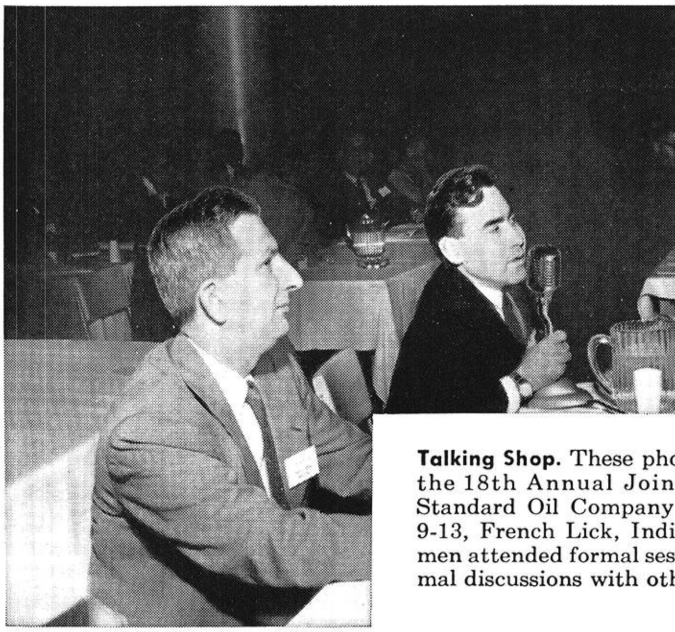
Address____________________

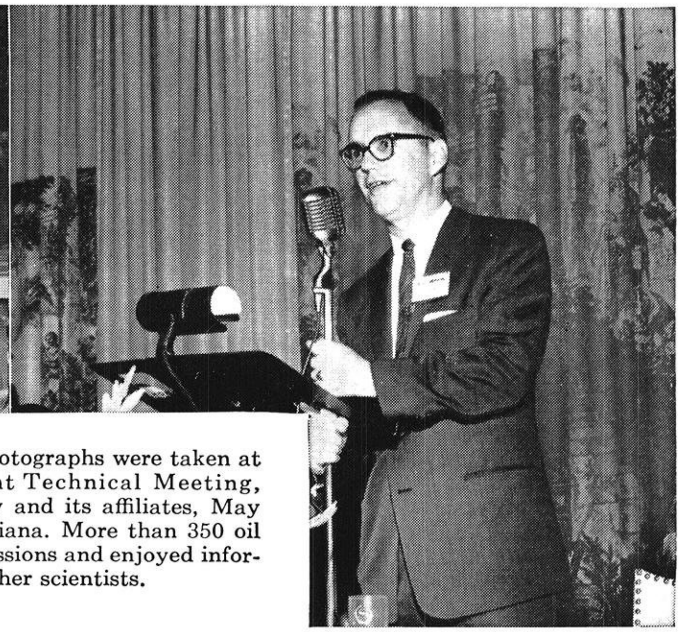
City________ Zone____ State________





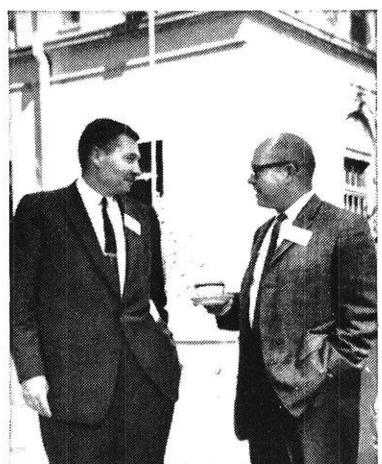






**Talking Shop.** These photographs were taken at the 18th Annual Joint Technical Meeting, Standard Oil Company and its affiliates, May 9-13, French Lick, Indiana. More than 350 oil men attended formal sessions and enjoyed informal discussions with other scientists.

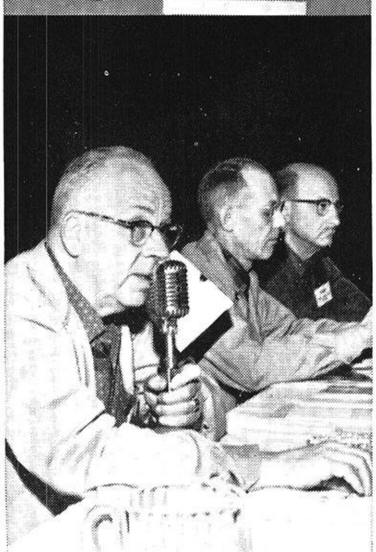
# "SHOP-TALK" SESSION FOR SCIENTISTS



In a company where scientific research ranges all the way from palynology to metal stress, the need for an exchange of information is imperative. Much of this can be accomplished with written reports. However, Standard Oil has found that a "Shop-Talk" conference once each year accomplishes a meeting of scientific minds that is even more satisfactory.

This year, at Standard's 18th Annual Joint Technical Meeting more than 80 technical papers were presented to 350 technical experts and representatives of other departments. Discussed were such subjects as the potential use of atomic energy as a commercial fuel source, electronic computer controls, and the use of $80-an-ounce platinum in making higher octane gasolines. In addition to these formal meetings, small discussion groups and conversations between individuals contributed to the exchange of ideas. The result was a stimulating five-day period that saw new ideas take shape. The meeting benefited everyone—scientists, the company, and consumers.

This type of meeting, which Standard pioneered, is another example of scientific leadership by Standard, and another reason why men with technical training find a Standard Oil career offers unusual creative encouragements.



## STANDARD OIL COMPANY

910 SOUTH MICHIGAN AVENUE, CHICAGO 80, ILLINOIS

STANDARD

THE SIGN OF PROGRESS...
THROUGH RESEARCH

## Engine Ears

*(Continued from page 33)*

in the engineering societies, positions on the Wisconsin Engineer, and Parent's Weekend tours.

Why be a fraternity man? Or more specifically what has membership in Triangle Fraternity to offer to an engineering student? This is a question that many students have asked themselves. The answer to this query can be gleaned from what the fraternity strives to attain and from what the fraternity offers to its members.

Triangle, as a fraternity, has always sought to mold its members into individuals who will be true assets to society. Towards this end, it strives to inculcate in the member a sense of real brotherhood through mutual social and extra-curricular activities, while at the same time to impress upon the student the genuine value of scholastic achievement.

Scholastic achievement is realized through time spent in studying together or with help from upperclassmen in addition to the individual effort which is so necessary to an engineering education.

Triangle has much to offer its members. First of all, there are the opportunities of personal improvement which are had by living in brotherhood with fellow students all seeking to attain the aims of the fraternity. Secondly, there is the asset offered by all fraternities, the cultivation of close and lasting friendship, which is, in the case of Triangle, magnified by reason of Triangle being a professional fraternity, one in which the membership is drawn from a specific field of achievement. By this selectivity a member is kept in a close relationship with men in his chosen field of endeavor. This is of incalculable professional value to the member since it is certain that one will find at least one brother, often in key positions, in practically all technical or scientific organizations and firms.

Thirdly, Triangle offers its members the comforts and pleasures of living at the chapter house together with their friends and brothers.

The chapter house is located at 438 North Frances in the heart of the campus community. Extensive remodeling during summer months has readied the house for another school year.

Each year Triangle welcomes into its ranks many new members. The procedure to be followed in the acquisition of new members is specified in the National Constitution. Students interested in Triangle are encouraged to attend all rushing smokers and after the prospective member signifies by his actions a sincere interest in Triangle, the fraternity strives to help in every way possible to aid the student to get to know the fraternity better. It can justifiably be said that if you are interested in Triangle, Triangle is interested in you.

Once the desire of the student has been recognized and he has been found to measure up to the standards demanded by Triangle, he is pledged. His pledgeship is "a period of testing, some reworking, and considerable tempering." If during his period of pledgeship, the student exhibits that he is truly acceptable and desires to become a member, he is initiated into the fraternity as an active.

Triangle as a fraternity is a living organization and as such can be counted as worth no more than what its members are. The worth of Triangle has been, is and will continue to be of the highest because it demands much of its members and aids greatly in the realization by its members of its chosen ideals.

### A.S.C.E.

The American Society of Civil Engineers has scheduled the following meetings for this semester:

Sept. 21
Oct 12 and 26
Nov. 9 and 30
Dec. 14
Jan. 4

Some very interesting speakers have been scheduled for these meetings which we feel will be both informative and interesting.

All students enrolled in civil engineering are eligible and encouraged to join the organization.

### ASME

The student branch of the American Society of Mechanical Engineers was organized by the National Society to give to student engineers opportunities to become acquainted with the practical side of engineering work and as means of contact between the students and practicing engineers. While the courses that the student engineer takes in college provide a good technical background for his chosen profession, they can not give him an accurate picture of himself as he will be after graduation. The next best thing to a magic mirror, then, is contact with engineers and with industrial concerns, and so, the main purpose of the A. S. M. E. is to help out by providing part of this contact.

Contact is accomplished in a number of ways, among which is the magazine "Mechanical Engineering," published by the Society, and with which the student may keep up on late developments in all fields of mechanical engineering. Also, during the meetings, discussions of engineering subjects, job opportunities, or problems of young engineers starting in industry are held between members and often with the aid of guest authorities. Here, excellent experience in public speaking and handling meetings may be obtained. One of the major activities of the Society is the sponsoring of field trips to nearby plants and other places of interest so that the student can see for himself the way things are done in industry and how the theoretical problems of his courses apply to actual situations.

The student branch is also designed to benefit industry in that it gives to the student engineer a little bit of "know-how" about his field and help him to better understand the role he is to play in his profession.

In these ways, the Student Branch of the A. S. M. E. at Wisconsin stands ready to help students whose interests seek out the many fields of mechanical engineering.

The Student Branch at the University of Wisconsin has an active year planned, including meetings, a picnic, a faculty night, a dinner meeting, lectures, movies, a speech

*(Continued on page 55)*

East wall of Alcoa's home office, Pittsburgh

# AT ALCOA, ALUMINUM IS PEOPLE

People of imagination. People perfecting new alloys, developing new processes, finding new applications. Men caught up in the vision of a wonderful world of aluminum. Men excited by their share in the amazing success of the metal.

Each has found an environment where personal ambition can be realized. Income, opportunity, challenge, security, authority—it varies with the individual.

People—*your* kind of people. Like to join them? Ask your placement officer to arrange an Alcoa interview.

*Openings in Engineering, Production, Accounting, Industrial Sales, Sales Administration, Sales Development and Research* for men with all types of college degrees.

ASK FOR BOOKLET

Alcoa's booklet, *A Career For You With Alcoa*, describes career opportunities at Alcoa more fully. Get a copy from your placement officer—or write to Manager of College Recruitment, Aluminum Company of America, 810 Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

## Hydrofoil

(Continued from page 24)

which are easy to shape and weld. The light vibrations produced in a hydrofoil boat by the propeller increase the possibilities of fatigue failure in the structure, a fact which also makes it necessary to consider the flexibility of the materials used.

*Power Plant.* The power plant of a hydrofoil boat should be an engine with high horsepower to weight ratio, therefore internal combustion engines are widely used. The light outboard motors are ideal for small hydrofoil crafts. The power required to propel a hydrofoil boat is only about half that required for an ordinary boat to obtain the same speed. For example: A 60-ton planing hull requires 6000 hp to achieve 45 knots. The same 60-ton hull on hydrofoils requires only 2700 hp to achieve this speed. This power economy is also proven by the performance of a hydrofoil sailboat discussed later.

*Power Transmission.* With the new designs in marine propellers, the most practical way of propelling the boat seems to be choosing a submerged propeller rather than an aircraft type propeller, such as the one used by Crocco and Bell. The disadvantage of using an aircraft type propeller is that the thrust line is located far away from the drag forces on the foil. Consequently, the craft will have a tendency to change height. Beside the disadvantage of a high thrust center, the efficiency is not good at low speeds, and the propellers are hazardous to the crew.

*Payload.* Limitation of the weight that can be carried constitutes one of the drawbacks of the hydrofoil. The payload, including fuel, is presently limited to about 25 per cent of the total weight. Also, the distribution of weight is critical. The weight must be balanced fore and aft just as on an aircraft.

*Wave Size.* Uncertainty still exists as to the maximum size of waves in which a hydrofoil boat can operate safely; however, if the weather becomes unmanageable, the hydrofoil boat can decrease speed, rest on the surface and weather the storm like an ordinary craft. The hydrofoils also serve as dampers when weathering a storm, giving added lateral stability. Also, the center of gravity is lowered, giving greater metacentric height.

*Hazards.* Another problem is that of hitting floating obstacles. This is not as serious as it may seem. In one case, an experimental Navy boat on hydrofoils accidentally ran into a 1-inch thick icefield at 35 knots, but was able to cut through and turn back without mishap. On one of the commercial kits, the foils are held by friction clamps which are designed to slip if the foil should hit flotsam in the water preventing damage or capsizing.

### Hydrofoil Sailboat

The hydrofoil principle, its advantages and problems, have been discussed in general. To illustrate a specific application of the hydrofoil, a discussion of a sailboat will follow.

Sailboats have always been relatively slow crafts. The fastest racing yachts, such as the American Cup boat, "Yankee", only reached a speed of 13.5 knots. A big 19th Century four-mast sailship with several thousand square feet of sail area, such as the tea clipper "Sovereign of the Seas", reached speeds of around 18 knots.

*Development.* Baker Manufacturing Company built two hydrofoil-equipped sailboats in the summer of 1950, which were tested in a 15 mph wind on Lake Mendota near the University of Wisconsin campus in Madison. The larger of the two boats, the 26-foot "Monitor", reached a speed of 30.4 knots on a beam reach, that is, with the wind almost at right angle to direction of travel. This velocity is apparently the highest reached by any sailboat to date.

*Construction.* The "Monitor", has a sail area of 230 square feet. It has a parabolic, cigar-shaped hull with room for two people. The mast is made of aluminum and rests in a knuckle joint on deck, which permits it to move in a forward direction against a spring restraint. The boat has an automatic trim control, which consists of a linkage system with a built-in mechanical computer. The computer automatically determines the pitching moment of the sail on the hull and controls the pitch of the main foil without using any other power than pressure from the sails. For example, with the boat running diagonally downwind and a wind gust hitting the sail, the bow will be pressed down, and the mast will pivot forward shortening the forestay. This forestay is connected with pulleys under the deck to the upper arm of the pantograph-shaped mechanism, which in turn increases the pitch of the main foil and returns the boat to level position.

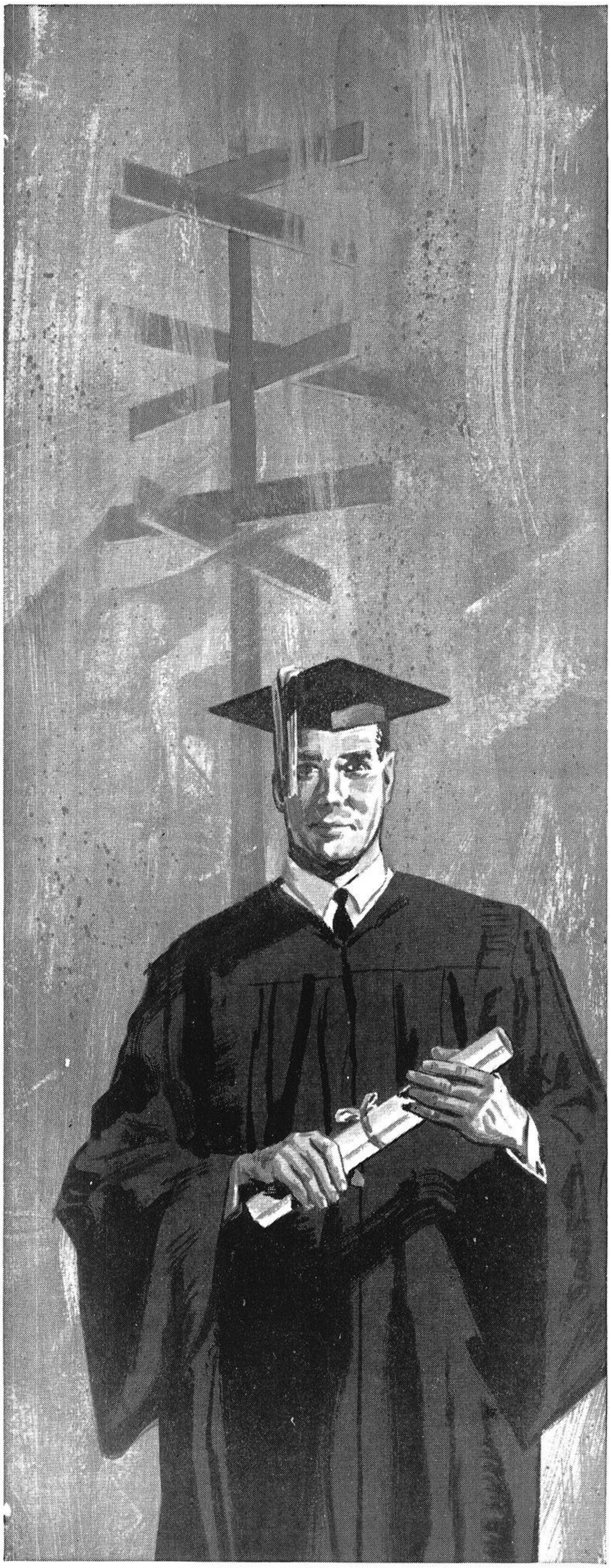
*Stability.* Transverse stability is obtained by designing the lift forces so that there will be no rolling moment. The foils are placed about 10 feet out from the center line of the boat. The resultant forces of each set of foils intersect at a certain distance up on the mast. The center of pressure, resulant of the wind forces on the sail, is also located at the same height, thus eliminating any moment forces which would upset the equilibrium and cause the boat to heel excessively. When sailing with the wind from the side, the angle of incidence of the leeward foil can be increased by a crank to give more lift. The steering is done by turning an automobile type wheel, which, through a system of pulleys and cables, rotates the rear foil about a vertical axis.

The earlier prototype sailboat equipped with hydrofoils was a smaller, 16-foot craft with three v-shaped foils which did not give the same dynamic stability as the ladder type foils on the "Monitor". With sudden gusts of wind, this boat had a tendency to overcompensate by climbing or diving sharply, with the consequence that ventilation destroyed the lift and the boat dropped down to the surface. These difficulties were largely overcome on the newer boat "Monitor".

### Potential Usage

The hydrofoil is a reality today. Large hydrofoil-equipped passenger ferries trafficated the strait of Messina between Italy and Sicily; hydrofoil police boats are used in Europe, and Baker Manufacturing Company, Grumman Aircraft Company, along with half a dozen other

(Continued on page 57)



*(Continued from page 50)*

contest, and many activities still in planning. This year's officers are:

Charles Doyle, President
Art Hoefner, Vice President
John Eberhardt, Treasurer and Recording Secretary
Wayne Thomas, Corresponding Secretary
Don Roeber and Don Paisley, Polygon Representatives

Any M.E. interested in membership may contact any of the officers or inquire at the *Wisconsin Engineer* office, 333 Mechanical Engineering Bldg.

### AIEE-IRE

Electrical engineering as a life work is broad, expanding, challenging!

Electrical engineering needs the desire to create something new, the ability to change course and to adapt the learning of one field to the requirements of another and newer field. Coupled with that is need for knowledge of the fundamental laws of electricity, circuits, mathematics, field theory, and electronic circuits. Get all that in your chosen college or university while you can.

There is an additional ingredient needed in the field of engineering —that is association with a professional organization. The American Institute of Electrical Engineers and the Institute of Radio Engineers are the kind of organizations suited to a moving field; anxious to work for the technical advancement of its members, keeping abreast of changes and new knowledge, providing the professional contacts so necessary to scientific progress.

The AIEE-IRE provides a framework of Student Branches, one of which is located here, at the University of Wisconsin, through which you can receive information and professional contacts before and after graduation. Should you decide to join the IRE or AIEE,

1) You become a Student Member of the AIEE or IRE, world-wide organizations interested and working in the fields of electrical engineering and electronics.

2) You will receive the "Electrical Engineer" as a member of the AIEE, or the "Proceedings of the IRE" and the "IRE Student Quarterly" as an IRE member as long as you remain a Student Member.

3) You become eligible to join one or more of the 23 IRE Professional Groups of your choice for a nominal fee and receive their publication after membership in the IRE. AIEE Members may subscribe to any of the three bi-monthly transactions at a student rate.

4) After graduation, you will automatically be transferred to the grade of Member in the IRE, or Associate Member in the AIEE without payment of a transfer fee.

In addition, you will have the opportunity to broaden your acquaintance with the engineering world outside the classroom as a member of the Student Branch. Most important, however, is that you associate yourself with a dynamic professional organization, an important forward step in becoming a full-fledged member of the engineering profession.

## Sneed's Review

*(Continued from page 40)*

meability, the findings are based on original research.

The handbook adequately develops the basic theory of fluid flow through porous media and describes the paper permeability tests based on this theory. The process engineer should find the permeability data based on results obtained with a high-pressure tester quite valuable in analyzing his particular filtration problems. Included is a five-colorchart that unfolds to 11 by 18 inches to give at a glance the permeability characteristics of 75 grades of filter papers.

Retention is treated both qualitatively and quantitatively. The concepts developed help explain some of the little-known mechanisms of retenion occurring during filtration. They also present a convincing argument for the use of paper in many filtration operations where other media have commonly been used. Both process engineers and laboratory scientists should find these particular chapters of benefit.

The layman is treated to a general review of the art and growth of filtration and an illustrated treatise on filtration equipment currently employing paper media. Such equipment ranges from the well known plate-and-frame filter press to modern coffeemakers.

A six-page glossary of technical terms and a four-page index help to make the *Handbook of Filtration* a valuable reference work upon a subject that has by no means been exhaustively treated in technical literature.

### BOATING HANDBOOK

**ARCO Publishing Company**
**New York, 17, N.Y.**

**144 pages. $2.50**

The new *Boating Handbook* offers boat owners and vacationers hundreds of tips for the successful use and maintenance of outboard motors and sailboats.

Collected from outstanding boating features in a leading magazine, these 42 articles were chosen for their usefulness and clear instructions. 336 photographs and 25 drawings have been added to illustrate the various principles of good boating.

The book contains sections on outboarding, sailing, novelty craft, docks and moorings, kits, boating safety, and building and upkeep, in that order. Many unusual articles come under these headings; one of them shows the reader how to plan and prepare for an outboard cruising journey with full camping equipment. *Boating Handbook* also aims to prevent the nuisances of motor failure and needless accidents which have spoiled many an outing.

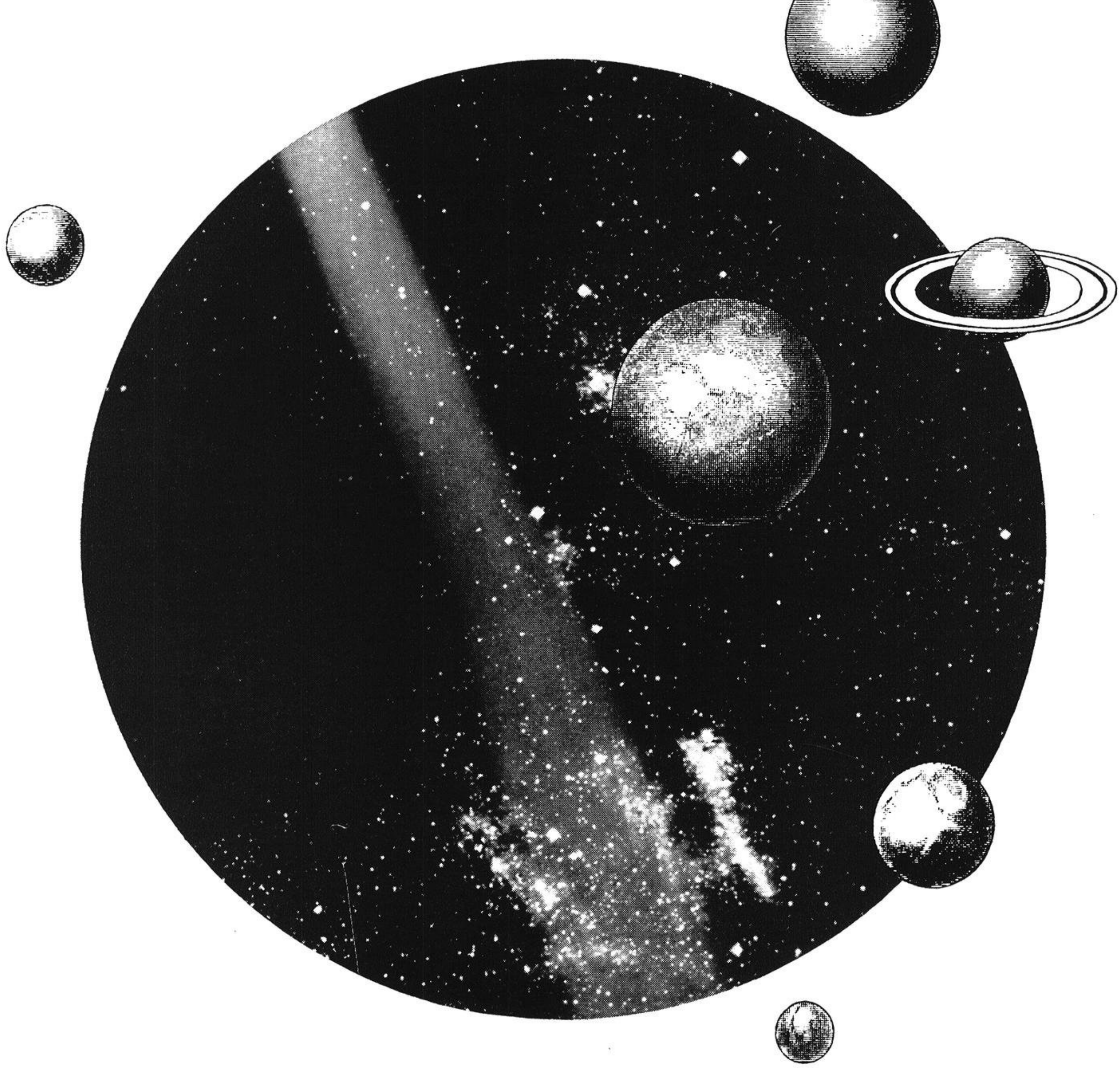
Anyone who enjoys the pleasures of motor and sail boating will want this book—it is an indispensible item in his boating equipment.

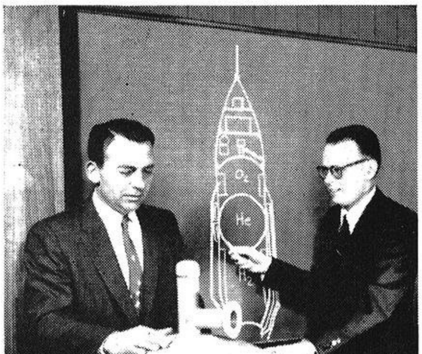
*— IN TRIBUTE —*

*If its funny enough to tell, its been told; if it hasn't been told it's too clean; and if it's dirty enough to interest an engineer, the editor gets kicked out of school.*

**"Do you know how to drive a baby buggy?"**
**"No."**
**"Tickle his feet."**

# *Biggest thirst in the universe*





Each 6,000,000 pound thrust rocket ship now being planned for manned interplanetary exploration will gulp as much propellant as the entire capacity of a 170 passenger DC-8 Jetliner in less than 4 seconds! It will consume 1,140 tons in the rocket's approximately 2 minutes of burning time. Required to carry this vast quantity of propellant will be tanks tall as 8 story buildings, strong enough to withstand tremendous G forces, yet of minimum weight. Douglas is especially qualified to build giant-sized space ships of this type because of familiarity with every structural and environmental problem involved. This has been gained through 18 years of experience in producing missile and space systems. We are seeking qualified engineers and scientists to aid us in these and other projects. Write to C. C. LaVene, Box P-600, Douglas Aircraft Company, Santa Monica, California.

Dr. Henry Ponsford, Chief, Structures Section, discusses valve and fuel flow requirements for space vehicles with Donald W. Douglas, Jr., President of **DOUGLAS**

MISSILE AND SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ DC-8 JETLINERS ■ CARGO TRANSPORTS ■ AIRCOMB® ■ GROUND SUPPORT EQUIPMENT

## Hydrofoil

(*Continued from page 52*)

manufacturers, sell custom built boats and conversion kits.

One of these commercial kits, The Baker Hydrofoils, can be attached to a 20-foot plywood hull, requires only a few screws for fastening and is a safe and simple device. It enables a boat to be lifted out of the water and travel over 30 mph (26 knots) powered by a 10-hp outboard motor.

Beside the uses already mentioned, the hydrofoil boat could be, and is, applied to military advantage on landing crafts, minesweepers, coastal patrol boats and anti-submarine vessels because there would be no hull below the water line for torpedoes to hit. The hydrofoil can also be used to good advantage to help the big flying boats break free of the water during take-off.

Further, it could be of use on public fire and rescue boats where speed is essential, and, commercially, the hydrofoil boat can be used in the fishing industry, and in the oil industry for transportation to and from off-shore projects. Water travel is one of the least expensive means of transportation today. It is used by millions all over the world, and, therefore, it is only reasonable to assume that these radically new improvements, such as low fuel cost and more comfortable travel, will be recognized and utilized to the fullest advantage.

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THE END

## Rotor Engine

(*Continued from page 17*)

rpm and pressure over 125 pounds per square inch. This problem seems to be solved, although the inventor will not say whether it is or not.

### USES

There are some NSU Prinz cars running now on rotor-piston engines. In addition, Curtiss-Wright is working on some large models (over 100 hp) for aircraft. The present rotor-piston engine is ideal for automobiles, because they are small, light, and quiet. They have good performance characteristics and run economically. The rotor-piston engine will also be fine for aircraft because it runs at high speed and has low weight and little vibration. If the problem of air cooling is worked out, the rotor-piston engine will be good for motor bike and stationary motor needs also.

It seems as though this new engine will work anywhere a present engine will, and the rotor-piston engine will open some new fields of use for internal combustion engines.

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THE END

## Science Highlights

(*Continued from page 27*)

### PRECISION THERMOMETRY FOR LOW TEMPERATURES MAINTENANCE

The National Bureau of Standards is expanding its low-temperature research program in an attempt to provide higher-precision thermometry in the range from 90 down to 20°K (−183 to 253°C), and to provide a calibration service for secondary thermometers from 20 down to 2°K. The measurement of low temperatures is growing in importance because of recent advances in cryogenic techniques, and because physicists and chemists need a practical and reliable working scale when they determine specific heats, thermal conductivities, and other fundamental properties of materials at these temperatures.

Although there is no international agreement on a practical temperature scale below 90°K, a gas thermometer may be used to make measurements on the thermodynamic temperature scale in this region. The inherent difficulties of this thermometer, however, make it impractical for use in a regular calibration service. When stable platinum resistance thermometers were developed to operate in this range some years ago, the Bureau was able to establish a provisional scale from 90 down to 11°K. These thermometers are so stable that after 15 years of use, they have been found unchanged within the accuracy of their original calibrations. The provisional scale is based on a group of six of these thermometers, each of which was calibrated with reference to a helium gas thermometer. The use of several thermometers to maintain the scale serves to show whether one of the standards has deteriorated. In the present calibration service from 11 to 90°K, resistance thermometers are compared (at 16 or more temperatures) with two of the Bureau's standards. This makes available a temperature scale which is believed to agree with the Thermodynamic Scale to an accuracy of 0.02°K.

In preliminary research toward making absolute temperature determinations from 20 down to 2°K, the Bureau studied changes in the velocity of sound in helium gas as a function of temperature in the region of 4.2°K. An acoustical interferometer was used for the first velocity measurements, and temperatures derived from the velocity of sound were compared with the temperatures associated with the vapor pressure of the liquid helium bath surrounding the instrument. Although the results were encouraging, there was a need to know more about measuring helium vapor pressure and its association with liquid helium bath temperatures.

Recent Bureau investigations show that a nearly constant-temperature liquid helium bath can be achieved and associated with an extremely reproducible vapor pressure. The bath consists of a few liters of liquid helium in an ordinary metallic liquid-helium storage Dewar of 15 or 20 liters capacity. The vapor pressure of the liquid is controlled very accurately and liquid helium evaporates at a rate of approximately 300 cc per day. This technique will be of considerable help in determining the accuracy of temperatures derived from sound velocity measurements, because a better comparison will be possible between temperatures derived from vapor pressure and those derived from sound velocity.

When used in the constant-temperature liquid helium bath, carbon resistors displayed remarkable reproducibility of electrical resistance (resistances equivalent to temperatures ranging from a millidegree to a few tenths of a millidegree) versus helium vapor pressure in the range of from 2 to 4°K, even when the resistors had been cycled between 300 and 4°K. Several sources indicate that germanium resistors also exhibit excellent reproducibilities. Thus, both carbon and germanium resistors appear to be promising sources of secondary thermometers for use at low temperatures. THE END

**"I've heard you've had a terrible time with your jalopy."**

**"Yeah."**

**"What happened?"**

**"Well, I bought a carburetor that saved 30 per cent on gas, a timer that saved 50 per cent on gas, and spark plugs that saved 20 per cent on gas, and after I drove 10 miles the darn gas tank overflowed."**

**Rules for handling women electrically:**
**If she talks too long—Interrupter.**
**If she wants to be an angel—Transformer.**
**If she meets you half way—Receiver.**
**If she gets too excited—Controller.**
**If she gets up in the air—Condenser.**
**If she is hungry—Feeder.**
**If she is wrong—Rectifier.**
**If she is too fat—Reducer.**
**If she gossips too much—Regulator.**
**If she wants to get married—Resister.**

*A modern mechanical genius is the fellow who can shift gears in a Volkswagen without getting his face slapped.*

# STRIPPED GEARS

*by William S. Huebner*

**The best way to get ahead is to be like a swimming duck. Keep calm and cool on top but paddle like hell underneath.**

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

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

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

**"Madam, may I see your daughter?"**

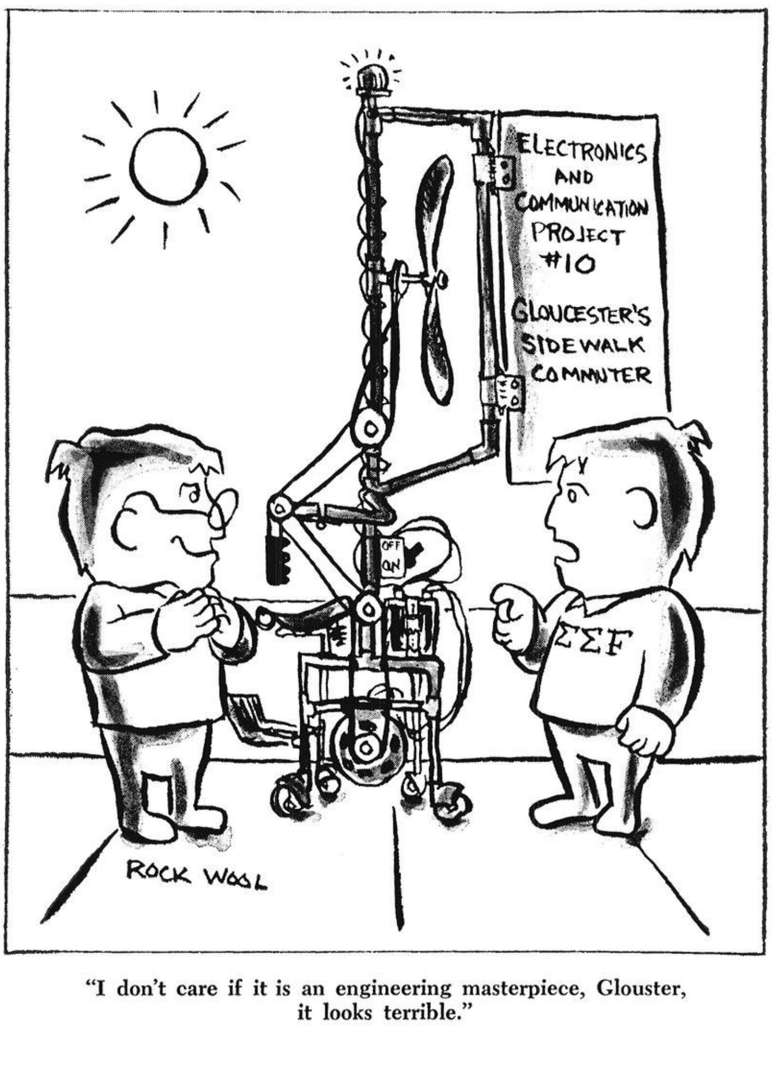
**"No. Get out and stay out."**

**"But, Madam, see this badge? I'm a detective."**

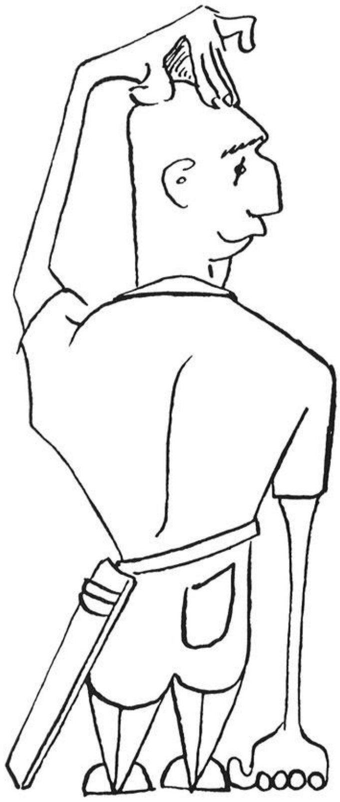
**"Oh, I'm sorry; come in. I thought it was a fraternity pin."**

*Professor (rapping on desk during class) "Order."*

*Student: "Bourbon and Soda."*




**"I don't care if it is an engineering masterpiece, Glouster, it looks terrible."**



# So You Think You're SMART!

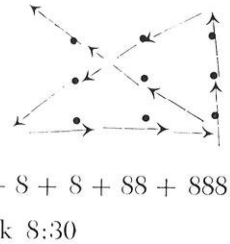
*by Sneedly, Law'66*

WELCOME back to Sneedly's Hideway. For the benefit of the freshmen and other uninformed engineers, I will present for you super intellects three juicy problems each month. To the sender of the complete set of correct answers with the earliest postmark I will give ten sweet dollar bills. So, sit up and take notice!

I, Sneedly, hope that you will respond so I will rid myself of this rejected feeling that I now possess. I know there are no gouges on these problems, but we have to get your super brain working somehow. So, jump onthe wagon and get your answers in, and I, with joy in my heart will quickly send you the ten dollars.

The answers to May's problems are:

1.



2. 8 + 8 + 8 + 88 + 888 = 1000

3. Jack 8:30
   Ed 7:40

The May winner was: Paul J. Shaver, 1001 University Ave., Madison 5, Wisconsin.

Get your solutions in fast. The ten dollars won't last long. Send your answers and fan mail to:

SNEEDLY
% The Wisconsin Engineer
Mechanical Engineering Building.
Madison, Wisconsin

**Problem #1**

```
          XXX
XX3 √ XXXXX
      3XX
       XXX
       X3X
        X3X
        XX3
```

There is at least one "5" in the calculation. Find the five figure number.

**Problem #2**

Two snails were on a cylindrical column of 6 feet in circumference. The first snail was two feet up from the base when the second snail was six feet up on the exactly opposite side.

If the second snail traveled to the first snail's present position, what would be his shortest path?

**Problem #3**

Say, my digits are three,
But just what can they be?
Take a third of my first
From a half of my third:
And a minus right here,
Would, of course, be absurd.

Now add twice my middle
To continue the riddle.
If you figured it right,
Then you couldn't have got seven;
For, believe me, I know
That you must have eleven.

There's no catch in this,
But don't take it amiss
When I add one thing more,
Just to make it quite clear:
You should know that a five
Is no part of me here.

Send your answers with your own name and address to:

SNEEDLY
c/o The Wisconsin Engineer
333 Mechanical Engineering Building
Madison 6, Wisconsin

All answers *must* be sent in the mail and only letters with the correct answers having the *earliest postmark* will be considered the winner(s).